WWF for a living planet®

WWF-Canada Tel: 604-678-5152
World Wildlife Fund Canada Fax: 604-678-5155

1588 – 409 Granville Street pacificregion@wwfcanada.org
Vancouver, British Columbia wwf.ca
Canada V6C 1T2

WWF-CANADA SUBMISSION TO ENBRIDGE NORTHERN GATEWAY JOINT REVIEW PANEL

Mr. Kenneth M. Bateman
Ms. Sheila A. Leggett
Mr. Hans Matthews

Dear Panelists:

On behalf of WWF-Canada, I am pleased to submit the attached submission regarding the proposed Northern Gateway project.

WWF is firmly opposed to this project, which we contend is not in the public interest. The risks to the environment, to the economy of British Columbia, and to Canadian society and our natural heritage far outweigh any potential benefits. Our statement discusses the following topics:

1. **WWF's interest in the project, and reason for making this statement to the JRP**

   Five years ago, WWF awarded its highest international accolade – the Gift to the Earth award – to the architects of the Great Bear Rainforest Agreement. That Agreement established a world-leading model of sustainability that meshes ecological integrity and human well-being. WWF remains committed to working with all interests to advance conservation and prosperity together, in this unique and globally significant ecoregion. The proposed project directly threatens both the foundations and the future of this vision.

2. **Benefits of Connected Land, Rivers, Sea – A Valuable Ecosystem that Supports a Healthy Economy**

   The Great Bear region of north coastal BC comprises some of the richest and most productive ecosystems on Earth. Currently, oceans, rivers, and coastal rainforest exist as an interconnected living system that sustains many thousands of jobs, with the prospect of lasting prosperity and economic diversity through continued investment in the region's natural capital. The proposed project puts at risk marine habitats, marine species, a globally unique concentration of free-flowing rivers, and freshwater fish habitat. All of these are essential to sustain the existing – and nationally significant – BC coastal economy.

3. **Risks to the Environment Are Too Great**

   Suggestions that the project is in the national interest have relied on assumptions that the risks of the project can be managed or mitigated. However, evidence shows that the risk assessment approach advanced by the proponent is inadequate, that the potential impacts are significantly higher than the proponent suggests, and that the prospects of either preventing or mitigating environmental and economic damage are very low. Furthermore, regulations that were in place at the outset of the project

review process, and which formed part of the case advanced by the proponent, have since been weakened through changes in federal law.

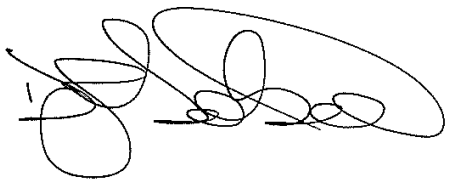
A comprehensive approach by Canada to oil spill risk management should begin by identifying those places where oil spills will never be allowed to happen: that is, where oil pipelines and oil tankers will simply not be permitted. Given its acknowledged global significance, the Great Bear region is one such place.

4. Guidance from the Great Bear Rainforest Agreement

The world-leading sustainability model that exists in the Great Bear region has been established through a combination of political accords, legislative and regulatory processes, institutional arrangements, and financial commitments involving federal, provincial, and First Nations governments as well as a broad range of stakeholders. Together, these offer policy guidance for governments and industry alike with respect to resource management and development decisions in the region. The proposed project is clearly inconsistent with the vision and policy direction established for the Great Bear.

The environmental, economic, and social risks associated with the proposed Northern Gateway pipeline project outweigh any potential benefits. The Great Bear is a global ecological treasure, and its future is in Canada's hands. This is one place where the promise of sustainability – healthy ecosystems sustaining a prosperous economy and healthy communities – is already being realized. Our public interest lies in demonstrating that Canada is ready to live up to its role as a steward of this extraordinary place.

For a living planet,



Darcy Dobell

VP, Pacific Region, WWF-Canada

WWF-CANADA SUBMISSION TO ENBRIDGE NORTHERN GATEWAY JOINT REVIEW PANEL

Linda Nowlan
JD, MA
Director of Conservation, Pacific Program

Hussein Alidina
B.Sc., Masters of Marine Management
Senior Officer, Marine Science and Planning

Mike Ambach
MA Educational Studies, Masters of Environmental Studies
Manager, North Coast Program

Louise Blight
Post-doctoral researcher, MSc, PhD candidate

James Casey
BA PoliSci, MA candidate, International Studies
Freshwater Conservation Analyst

Rob Powell
PhD
Senior Officer, Priority Conservation Programs

INTRODUCTION

WWF is one of the world's largest and most experienced science-based conservation organizations with over 5 million supporters worldwide and a global network active in more than 100 countries. Our mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

In Canada we have over 100 staff in 8 offices across the country, 150,000 supporters, and distribute our newsletter to about 250,000 people. Our priority programs are the health of our oceans and fresh water, climate change, and the future of the Arctic amidst its current ecological transformation.

WWF works with many of the world's leading companies with the goal of achieving transformational conservation results on our key priorities: ocean conservation, freshwater health, Arctic stewardship, climate change mitigation and renewable energy solutions. For example, at the global level, over thirty major corporate members of WWF's Climate Savers Programme succeeded in preventing the release of over 100 million tonnes of carbon dioxide between 1999 and 2011.

WWF-CANADA'S WORK IN THE GREAT BEAR

A major focus of WWF's work in the Pacific region is on the responsible management of the unique ocean and coastal area known as the Great Bear Sea (1).

We work to identify and secure marine protected areas, and to support the wise management of those already in place. We also recognize that protecting the environment means more than establishing protected areas: it requires the sound management of working landscapes. Accordingly, we are active participants in marine spatial planning initiatives through the Pacific North Coast Integrated Management Area (PNCIMA) process and the provincial/First Nations led Marine Planning Partnership (MaPP).

We have produced scientific reports on climate change and the Pacific Ocean (2); cumulative impacts (3); and the impact of anthropogenic ocean noise on marine species (4). We work collaboratively for improved national and international regulations to protect BC's ocean species, such as sharks, whales, salmon and eulachon. We work with communities, governments, and industry to improve freshwater management in the region, including adaptation to climate change impacts.

At a local scale, for 11 years we have worked on BC's North Coast through our office in Prince Rupert and are proud of our wide range of outreach, education and capacity building initiatives to engage people in stewarding and managing their coast. Partners in this work have included First Nations, Federal and Provincial Government agencies, community groups, and local volunteers.

Advancing science and community engagement work are further complemented by our policy work on Oceans Health at the national level, where we have played an integral role in convening policy makers, ocean industries, scientists, and conservation perspectives through workshops and other events to advance meaningful and pragmatic solutions to the challenges facing Canada's oceans.

WWF-Canada also promotes sustainably sourced seafood with consumers and retailers, primarily through a partnership with Loblaw, Canada's largest grocer, to help reach their goal of carrying 100 per cent sustainably sourced seafood products by the end of 2013.

WWF'S INTEREST IN THE PROJECT, AND REASON FOR MAKING THIS STATEMENT TO THE JRP

Our focus on collaborative solution-building to advance our mission is best achieved by interest based negotiation rather than one that is position based. WWF does not normally engage in the review of specific individual projects unless they are of critical national and international importance. It is rare for us to take a public position on specific developments. Nonetheless, the proposed Northern Gateway oil pipeline and oil tanker project is an exception with significant implications, as it threatens not only a globally significant ecosystem, but also a world-leading model of sustainability.

"This Gift to the Earth recognizes the many people who worked so hard to achieve success, as well as all British Columbians who view the central and north coast regions as a gift to the Earth with immense value within our province and far beyond our borders."

- Premier Gordon Campbell, on the occasion of receiving the WWF Gift to the Earth

Five years ago, WWF awarded its highest international accolade – the Gift to the Earth award – to the architects of the Canada's Great Bear Rainforest agreement (5). This award recognizes both the extraordinary global ecological significance of the region, and the policy, regulatory, and institutional innovations that established a world-leading model of sustainability – one that meshes ecological integrity, sustainable economic development, and human well-being. The award also acknowledges the commitments that were made by all parties – including First Nations, governments, conservation groups, and industry – to continue to work together to ensure that this model will endure.

The project now before this Panel threatens this Gift to the Earth.

WWF-Canada opposes the project as the risks to the environment, to BC's economy and to society outweigh the benefits. WWF-Canada strongly believes that the project is not in the public interest and will cause significant adverse impacts, and a huge range of negative environmental effects that cannot be adequately mitigated in this unique and extraordinary place. The Panel should not recommend approval of the project.

PART I: BENEFITS OF CONNECTED LAND, RIVERS, AND SEA – A VALUABLE ECOSYSTEM THAT SUPPORTS A HEALTHY ECONOMY

This section details the ecological values that are at risk from construction and operation of the project. It provides a context for Panel members to further appreciate the scope and depth of the conservation gains that have been made over the past decade in this part of Canada, and makes the case that the commitments and direction established in this region risk to be severely undermined by the project.

WILD RIVERS OF THE GREAT BEAR

As the Panel has heard, close to 1,000 rivers and streams — including two of the world's most important salmon rivers, the Fraser and the Skeena — will be at risk from pipeline oil spills if this project is constructed.

As shown in the map (Fig. 1), five of these large *free-flowing rivers*[1] - the Nass, Dean, Bella Coola, Wannock, and the Klinaklini – form one of only four major concentrations of large, free-flowing rivers remaining in Canada (the other three clusters are all in the Arctic or near-Arctic). Three other noteworthy free-flowing rivers, the Zymoetz, the Sustut and Kispiox, are upstream tributaries of the Skeena River. The Skeena – BC's second longest river – is the second-largest producer of sockeye salmon in BC, supports an abundant estuary, and is of key value to both sports and commercial fisheries. Other fish species in the Great Bear area include all five species of Pacific salmon, steelhead salmon, Pacific herring, Pacific halibut, sablefish and numerous rockfish. However, due to dams in the Babine, a major tributary to the Skeena, the entirety of the Skeena River is not classified as free-flowing. The Kitimat, a smaller free-flowing, river, completes the picture. It drains into the Pacific at the town of Kitimat and provides clean drinking water for the town.

BC is fortunate to have southern Canada's last wild free-flowing rivers, providing clean water and irreplaceable ecological services to the people who depend on them - for salmon and myriad other species, for livelihoods and spiritual sustenance.

Such wild rivers have become rare on a global scale. Recent research has found that over half of the world's large rivers have been subjected to dams. (6) Even in river-rich Canada, there are only a handful of places where wild rivers of this size and in this abundance flow unobstructed by dams from headwaters to the sea. As the other clusters are located in the Arctic, the Great Bear's wild rivers stand out as the only group below the tree line in Canada. While other industrialized regions in the United States and Europe contain some of the world's most fragmented rivers (7), BC is fortunate to have southern Canada's last wild free-flowing rivers, providing clean water and irreplaceable ecological services to the people who depend on them - for salmon and myriad other species, for livelihoods and spiritual sustenance. Rivers like the Nass, Skeena and Kitimat are an integral part of Canada's economy, history and culture.

This Panel has heard from scores of Canadians passionately attesting to the deep sustenance these rivers provide. It is crucial that the Panel understands that this depth of feeling is based upon a connection between people and a remarkable – and increasingly rare – freshwater ecosystem.

---

1 Any river that flows undisturbed from its source to its mouth, either at the coast, an inland sea or at the confluence with a large rive, without encountering any dams, weirs or barrages and without being hemmed in by dykes of levees (95).

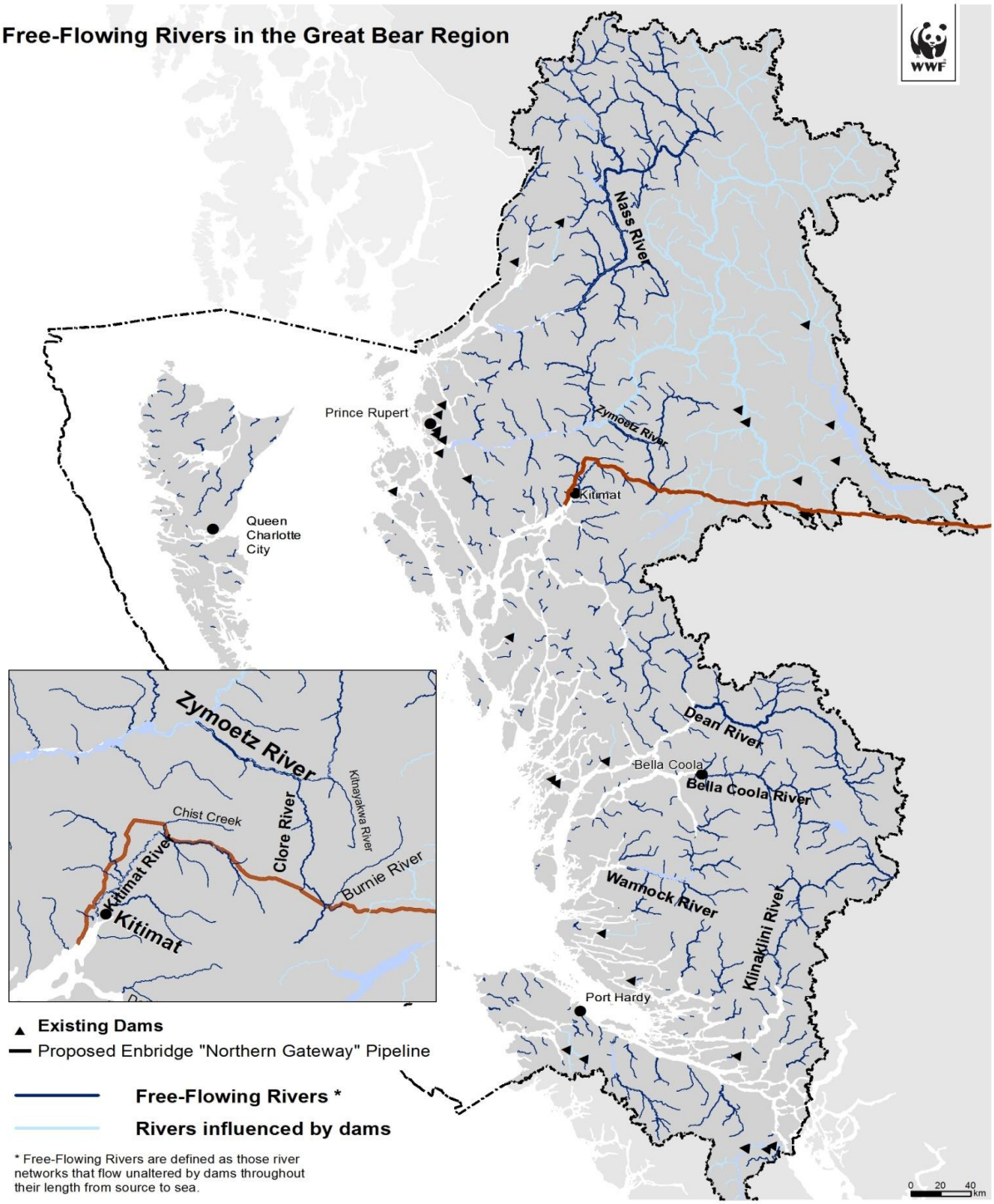


Figure 1. This map illustrates the free-flowing rivers in the Great Bear eco-region, as identified in a geometric network analysis of Canada's rivers using data from NRCan's National Hydro Network. Larger line widths correspond to larger rivers, as quantified by Strahler river order - a measure of the hierarchy of river tributaries. (James Snider, WWF-Canada, 2012)

THRIVING MARINE HABITATS

On the marine side, the Great Bear Region includes 88,000 km^2 of sea area that corresponds to the Pacific North Coast Integrated Management Area (PNCIMA). The PNCIMA region is defined by Fisheries and Oceans Canada as one of Canada's five priority ocean management areas due to its ecological importance. These are some of the world's most productive cold-water seas. They provide critical habitat for invertebrates, fish, and both aquatic and terrestrial mammals. The list of ecological values of this marine region is extensive (see text box insert).

Ecological Value of the Great Bear Sea

- More than 400 species of marine fish reside off the BC coast *(97)*.
- Home to three of BC's five major herring populations, and 88% of spawning rivers for eulachon in BC *(97)*
- Ecologically and Biologically Significant Areas (EBSAs) , areas worthy of enhanced management or risk aversion *(96)*, make up close to half - 44% - of the Great Bear Sea region *(93)*.
- Hundreds of watersheds in the region provide critical spawning habitat for approximately 58% of all anadromous salmon populations on the west coast of Canada *(97)*.
- Over 25 species of dolphins, porpoises, pinnipeds, and whales live here. *(97)*.
- Over one-half of marine bird species in BC (108 species) use habitats in the PNCIMA throughout their lifecycle. The region further supports 95% of the total breeding seabird population in BC *(97)*.
- Only known location in the world for 9,000-year old ancient sponge reefs, located in Hecate Strait and Queen Charlotte Sound, covering a known area of approx. 1000 km2 in PNCIMA *(97)*.
- Under the Wild Salmon Policy *(100)*, the Department of Fisheries and Oceans has grouped B.C. salmon into genetically defined conservation units. Out of the total of 423 conservation units of wild salmon, "groups of wild salmon sufficiently isolated from other groups that, if lost, would be unlikely to re-colonize naturally within an acceptable time frame," the areas of the Skeena, Kitimat, and upper Fraser that would be crossed by the Enbridge pipeline are home to at least 76 conservation units *(98)*.
- Thirty-nine species listed as threatened, endangered, or special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as recently as 2010. The number of at risk species may be higher because many of the species in the region have not been assessed by COSEWIC.

The ecological value of this marine region is also recognized globally. In 2005, the North American Commission for Environmental Cooperation (of which Canada is a member) identified 28 priority marine conservation areas stretching from southern Mexico to the Arctic Circle (8). Of those, just five are on Canada's Pacific coast. Three of those are in the Great Bear Sea. Those areas are Dixon Entrance, valued for supporting the highest marine species diversity along North America's pacific coast. Northern Queen Charlotte

Sound/Hecate Strait/Gwaii Haanas, valued for globally unique glass reefs and as breading habitat for over half of the world's remaining Ancient Murrelets. Scott Islands, valued for being the largest nesting colony of Cassin Auklet's on the planet.[2] These features of the Great Bear Sea deserve acknowledgement for the globally unique treasures that they are.

Gwaii Hanaas National Marine Conservation Area and National Park Reserve/ *SGang Gwaay*

Gwaii Haanas ("place of wonder") National Marine Conservation Area Reserve, National Park Reserve and Haida Heritage Site supports countless marine plants and animals, in habitats that range from deep sea coral reefs to kelp forests and eelgrass meadows. Animal species include economically important fish and shellfish, breeding populations of seabirds, and mammals such as whales, dolphins, and sea lions. *SGang Gwaay*, which includes the village of *Ninstints* (Nans Dins), located on a small island off the west coast of Haida Gwaii, is one of 17 UNESCO World Heritage Sites in Canada.

Bowie Seamount / *Sgaan Kinghlas*

Off British Columbia's west coast, 25 metres under the sea, lies an underwater mountain teeming with sea life and rising 3100 metres from the ocean floor. The largest in a protected chain of three underwater mountains, Bowie Seamount lies 180 kilometres west of Haida Gwaii. Sea stars, anemones, sponges, and coral beds flourish on Bowie's surface. It has an abundance and diversity of fish species - halibut, red rockfish, sculpin, prowfish and sablefish. *Sgaan Kinghlas* is also believed to be an frequented by Orca, Humpback and Northern Right whales, Stellar sea lions and migratory birds and fish. In 2008, Bowie Seamount and neighbouring Hodgkins Seamount were designated as a Marine Protected Area to be jointly managed by the Council of the Haida Nation and Canadian government. WWF-Canada has been working with First Nations, government agencies, and the fishing industry to establish a sound management plan that protects the unique value of this MPA.

Hexactinellid Sponge Reefs

Another globally unique feature found only in the waters of the Great Bear is the *hexactinellid sponge reefs*. These cold water reefs form part of an important aspect of BC biodiversity. In 2010 Fisheries and Oceans Canada developed the *Pacific Region Cold-Water Coral and Sponge Conservation Strategy* (9) which highlights the fact that "Coral and sponges are central to the Convention on Biological Diversity's (CBD) commitment to the protection of marine biodiversity."[3] This type of species is so important that the United Nations has taken steps to identify coldwater coral reefs, aggregations and individual corals "as meriting vulnerable marine ecosystem (VME) status."[4] These species are considered "ecosystem engineers which are species that create complex habitat either through their behavior or owing to their morphology […] Moreover, owning to the extended life history schedules of essentially all coldwater

---

[2] *Op cit.* (8), p. 49, p. 51, p.53
3 *Op cit.* (9), p.7
4 *Op cit.* (9), p.7

corals and many sponges, the sustainable rate of population loss is very small; certainly less than 5% per annum and in many cases 1% of less."[5]

A Stronghold for Marine Mammals

The Great Bear Sea comprises areas of important habitat for several species of marine mammal identified as being at risk (Endangered, Threatened, or Special Concern) in Canada (10) (11) (12). For example, areas in and around the Confined Channel Assessment Area (CCAA) have been identified as critical habitat, or critical habitat candidate areas, for Northern Resident Killer Whales (12), with critical habitat potential for "large portions" of the CCAA verified by independent data submitted as evidence to this panel (13). The region also includes regionally important habitat features for other at-risk whale species (11) and is showing year-over-year increases in fin and humpback whales numbers (14) (15). This represents a potential re-colonization of an area occupied by fin whales prior to their 20th century extirpation by commercial whaling (14).

Appendix 1 presents a map of important whale habitat relative to the proposed tanker route.

To varying degrees, marine species such as fin whale, humpback whale, and sea otter are recovering from decades or more of intensive hunting in this region (and worldwide), but such population recoveries may be slowed or reversed by the cumulative impacts of anthropogenic threats such as chronic or acute oil spills, underwater noise, or ship strikes (16) (17). It is important to note that for some species at low levels of abundance, especially those that are slow to reproduce (e.g., whales), it may be impossible to design mitigation measures that will keep any additional human-caused mortality at a level that will not affect population numbers. In other words, any additional mortality may affect a threatened population. For example, research has suggested that vessel strike mortality may already have placed BC killer whales at or beyond the limits of anthropogenic mortality that the population can absorb (17).

For cetacean and other marine mammal species, the Great Bear Sea is a haven offering diverse prey, a quiet acoustic environment, and relative freedom from disturbance.

"It is important to assess the potential economic cost of an oil spill now so the results can be included in the debate about potential costs and benefits of project implementation. These costs include social, environmental, and economic externalities of the project that would be incurred by communities along the North Coast. In order to adequately assess the benefits and costs of an oil spill, it is critical to estimate these externalities."

- Phase I Report: Values of ocean-based industries in the North Coast Region, British Columbia, Ngaio Hotte and U. Rashid Sumalia, Fisheries Economics Research Unit, UBC Fisheries Centre

Value of Ocean-Based Industries in the North Coast Region

Directly related to the ecological value of the region is the economic promise a healthy environment offers. BC has a global duty to steward this region which could be a model for sustainable economic development. The existing economy in the North Coast region is deeply connected to the oceans and ocean health. To better understand what would be at stake in the event of a major spill of diluted bitumen, WWF commissioned an expert report from the UBC Fisheries Centre (18) (See Appendix 3). The Draft Phase 1 report notes that:

"While the economic benefits of the project have been quantified by the proponents and the potential impacts of an oil spill within the confined channel area (CCA) of the Douglas Channel have been assessed, the potential economic costs of an oil spill in the Open Water Area (OWA) of the proposed shipping routes have not yet been identified.

5 *Op cit.* (101), p.2-3

Phase I of this study estimates the value of commercial fishing, ferry traffic, port shipping, local and tourism-based recreational fishing and other marine tourism within the North Coast region. Values are expressed in terms of direct, indirect and induced effects of employment, total output and contribution to gross domestic product. Preliminary analysis suggests that ocean-based industries contribute between 8,405 and 11,423 person years of employment, $1.1 to $1.4 billion (2011 CAD) in total output and $696 to $962 million (2011 CAD) to gross domestic product each year. These estimates will form the basis for computing the potential impact of an oil tanker spill within the OWA during Phase II of the project."[6]

SUMMARY: WHAT'S AT STAKE

The Great Bear region of north coastal British Columbia is a globally rare and extraordinary ecosystem. It is the meeting point of one of the world's last remaining large intact coastal temperate rainforests; some of the world's last large wild rivers; and some of the world's most productive cold-water seas. It is one of the richest ecosystems on Earth, supporting essential ecosystem processes and providing crucial habitat to rare and endangered marine, terrestrial, and freshwater species. The resources of the region represent a substantial bank of natural capital that supports a strong and diverse economy representing many thousands of permanent Canadian jobs.

This region is also of tremendous cultural importance – not only to First Nations, whose communities and traditions rely on healthy coastal ecosystems, but to all British Columbians and Canadians who value our natural heritage and a way of life that includes hunting, fishing, wilderness exploration, and outdoor recreation.

In short, the Great Bear is a global ecological treasure and a significant Canadian economic and cultural asset that demands the very highest standards of precaution and sound stewardship.

[6] *Ibid.*

PART II: RISKS TO ENVIRONMENT TOO GREAT

This section of our statement describes the risks that the project poses to this environment. It is WWF's firm conviction that the Great Bear region is no place for oil tankers or an oil pipeline. An analysis of evidence submitted to the Panel, supported by guidance from current best practices in conservation, confirms this stance. The risks are simply not acceptable.

DEFICIENCIES IN THE RISK ASSESSMENT APPROACH

The manner in which risk has been defined for this project is wholly inadequate in the context of the Great Bear, to the point of giving cause for serious concern regarding the environmental assessment application as a whole: an approach that repeatedly relies on circular arguments based on assumptions that a combination of technology, good intentions, and environmental conditions will minimize risk within "acceptable" limits. Critical information gaps and biases in methodology obfuscate rather than enable a clear-headed assessment of the real risks involved, and their consequences. While such deficiencies should raise warning flags for any project review process, to find them so extensively employed in the context of a massive infrastructure project in the Great Bear Region is, in WWF's view, wholly unacceptable. A brief summary of some of the more glaring deficiencies is merited here.

"The Nestucca spill in December 1988 released 5,500 barrels of heavy marine fuel oil with an API gravity of 12.1 three kilometers off Grays Harbor, Washington. The spilled oil quickly formed tar balls that moved below the water surface (i.e., were overwashed by waves) and could not be tracked visually. Two weeks later, oil unexpectedly came ashore along the coast of Vancouver Island, Canada, 175 kilometers north of the release site, contaminating 150 kilometers of shoreline (NOAA, 1992). The oil had a significant effect on the large number of marine birds wintering in the area. Of the 10,300 birds collected, about 9,300 were either already dead or died in treatment centers. Many more were believed to have died but were never collected"

- National Research Council (19)

MISREPRESENTATION OF BEHAVIOUR OF DILUTED BITUMEN

The project appears to have misrepresented oil spill behaviour for diluted bitumen in the marine environment. Evidence provided to the Panel on the subject fails to adequately acknowledge that Alberta bitumen is what is described as *a non-floating oil* (19). Well-documented research on the interaction of heavy oils and seawater simply does not corroborate the claims put forth in evidence submitted to the Panel: please see Appendix 3 for a more detailed explanation.

Further, the Panel has received scant evidence from the applicant concerning the prospects for recovering spilled hydrocarbons in the marine environment, other than the organizational arrangements and processes it would apply in the event of an emergency (20). Indeed, the potential consequences of spills of lighter (floating) hydrocarbons such as synthetic crude have not been adequately evaluated in light of the well-documented marginal prospects for marine oil spill recovery (21), including the logistic challenges, environmental response gap, and limited efficiencies of the available countermeasures (22). In the absence of a site-specific assessment, the Exxon Valdez incident is instructive. In that case only a small percentage of the oil was recovered over twenty years of cleanup. Far worse are the prospect for successful recovery of spills of non-floating oils such as bitumen: with few exceptions, they can neither be tracked nor contained. Submerged tar balls can travel undetected for weeks and hundreds of kilometers to foul a distant shoreline, as occurred in 1988 when submerged tar balls from the Nestucca spill in Washington State fouled beaches and killed birds 175 km north on Vancouver Island (23).

These deficiencies have been identified for the Panel by a number of intervenors (24) (25). In essence, we know that even our best plans will be incapable of dealing with the worst scenario, yet we are being asked to proceed and hope for the best. Such an approach represents a serious gap in the evidence needed to assess the risks associated with shipping bitumen in Canadian waters.

Responsible Oversight versus Wishful Thinking

The tendency to rely on wishful thinking instead of robust and defensible research also extends to a number of the documents submitted via federal agencies in relation to this project.

WWF notes with approval that the Panel has identified significant discrepancies (26), between the TERMPOL recommendations (27) and the proponent's responses, specifically with regards to the proponent's viable operational measures for dealing with unforeseen environmental conditions. We strongly encourage the Panel to pursue such inquiry, and further, to critically consider the serious doubts that these ambiguities have cast on of the adequacy of existing regulatory guidance for safe vessel navigation. In particular, it is surprising to note that the TERMPOL report actually states: "With respect to the oil tanker transits, the British Columbia Coast Pilots have *not yet determined the weather conditions and limits beyond which a pilotage assignment will be aborted*"[7] (emphasis added). This statement alone should raise serious warning flags for the Panel. WWF notes, however, that the same document effectively suggests that the project proponent play an advisory role "to set environmental limits (weather and sea conditions) on oil tanker navigation associated with the project"[8] – a surprising and disturbing recommendation, given the project proponent's lack of expertise in the field, vested interest in particular outcomes, and recent public record (28).

Similarly, the TERMPOL report acknowledges DFO's critique of the inadequacy of information concerning the potential impact of increased shipping on whales via ship strikes, but then acquiesces to the suggestion that the proponent intends to carry out a ship strike analysis and even equates this intention to enhanced protection: "The proponent's commitment to developing procedures to help minimize harmful effects on marine mammals will enhance the protection of the marine environment"[9].

This lack of meaningful risk assessment will only be exacerbated by recent cutbacks in science and monitoring capacity and drastic changes to the regulatory regime, which are to be applied to this assessment process retro-actively, despite being roundly condemned by the scientific community.

In summary, not only do the proponent's assurances amount to weak circular reasoning, they are being made at a time when the regulatory environment is in rapid transformation in a manner that undermines government capacity for meaningful analysis and oversight (29).

Managing Risk or Managing Perception of Risk

Broadly, there are two components to risk: the probability of an accident occurring, and the consequences when an accident does occur. While the project proponent has invested considerable resources to suggest that the frequency of accidents can be minimized, the intent seems to be to dismiss the significance of risk altogether, rather than clearly explore its implications. The Panel has itself pointed to the conflicting methodologies used to estimate possible spill frequencies (30). That differing methodologies exist is not surprising. However, that the project systematically employs

7 *Op cit.* (27), p. 21, paragraph 2.
8 *Op cit.* (27), Recommendation 9.
9 *Op cit.* (27), p. 29, bullet #7.

only those methodologies that produce results favourable to project approval should be cause for serious concern. Throughout, the framing of risk consistently dismisses the significance of *consequences of a spill*.

A comprehensive examination of the *consequences* of an eventual spill would include implications for ecosystem functions, species and habitat dependent on those ecosystems, and the whole range of cultural, social and economic practices that thrive on a healthy ecosystem. It would be based on scenarios endorsed by the experience of coastal residents. In short, a responsible analysis of risk needs to include a stark, honest look at *realistic worst case scenarios*.

Good intentions and wishful thinking fall woefully short of the robust, objective, and transparent analysis of costs versus benefits that the people of Canada deserve, and which this Panel is charged to ensure.

The overwhelming breadth of testimony on the threats posed by this project should serve as evidence of the proponent's failure to account for risk in terms that the Canadian public can accept and constructively deliberate on. WWF believes that risks have been grossly underestimated and fail to account for the full range of values at stake in the Great Bear: environmental, economic, and cultural.

Risks to Endangered Species

Canada has legal commitments contained in numerous international treaties regarding environmental protection. To take only one prominent example, the Convention on Biological Diversity commits Canada to "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources." (31)

These commitments are reflected in national laws. The *Canadian Environmental Assessment Act 2012* (32) states that: "(2) The Government of Canada, the Minister, the Agency, federal authorities and responsible authorities, in the administration of this Act, must exercise their powers in a manner that protects the environment and human health and applies the precautionary principle."[10]

Indeed the Government of Canada has created the *Species at Risk Act* (SARA) which directly references the CBD in the Act's preamble where the commitment to the environment is restated: "the Government of Canada is committed to conserving biological diversity."[11] The Government of Canada makes such commitments precisely because "Canada's natural heritage is an integral part of our national identity and history, wildlife in all its forms, has value in of itself and is valued by Canadian for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological and scientific reasons."[12] In other words, ***conserving and enhancing Canada's natural heritage is in the public interest*** and therefore a responsibility of the Government of Canada.

In light of the amount of territory the Northern Gateway Pipeline / Tanker Route would cross, it comes as no surprise that the project would potentially impact a large number

[10] *Ibid.* (32) Sec. 2.
[11] *Op cit.* (130), preamble.
[12] *Ibid.*

of vulnerable species. The proponent has the responsibility to ensure that any pipeline development occurs in a manner that will conserve and enhance the ability of these species to continue to be part of our national heritage. However, WWF-Canada believes that the project before this Panel fails to demonstrate an adequate understanding of the ecological significance of the region for which the project is proposed: First, by focusing only on Key Indicator species, the proposal fails to address the science pointing to the range of other species at risk along the pipeline route and the interconnectivity between species. Second, suggested mitigation actions fall far short of the actions need to conserve and enhance even the select species identified. As a whole, the submission fails to acknowledge the ecological uniqueness of the Great Bear region and the remarkable role it plays as a haven to some of Canada's most iconic species.

Piece-meal and selective approach to identification of species and habitats vulnerable to project impacts

The species diversity in this region means that any large project with an extensive footprint will impact a vast number of species. As such it is not unreasonable that project proponents seek to limit the number of species assessed for possible impacts. Instead there is a need to turn to proxies of possible impacts, or what are known as key indicator species. These are not selected because they are the most important but rather to reflect the full range of possible impacts. The process of selecting key indicator species is a critical one that can hide or emphasis potential impacts.

In the case of the proposal before the Panel, the initial list of impacted species in the application amounts to little more than a selection of some SARA-listed species that also happen to occur in regions that would be affected by the proposed project.

This approach is inadequate. A comprehensive approach would include an assessment of the full range of species identified by the scientific community[13], and comment on their vulnerability to project impacts. Appendix 4 provides an example of such a list. In total, 178 species of concern rely on habitat that would be impacted by the project. These include 14 marine mammals, 6 terrestrial mammals and 18 freshwater fish. Scientific assessments indicate that many of these species are put at risk by precisely the type of development activity envisioned through this proposed project.

As illustrated by Fig. 2, below, the proposed project identifies only a fraction of the species identified as being of conservation concern by the range of listing authorities.

[13] A range of parties have compiled such lists. The International Union for the Conservation of Nature (IUCN) is the foremost conservation organization that assesses species at a global level. Within Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) accesses species for potential listing under the *Species At Risk Act*. At a more localized level, both the government of Alberta and BC produce list of species that are of conservation concern within their jurisdiction.

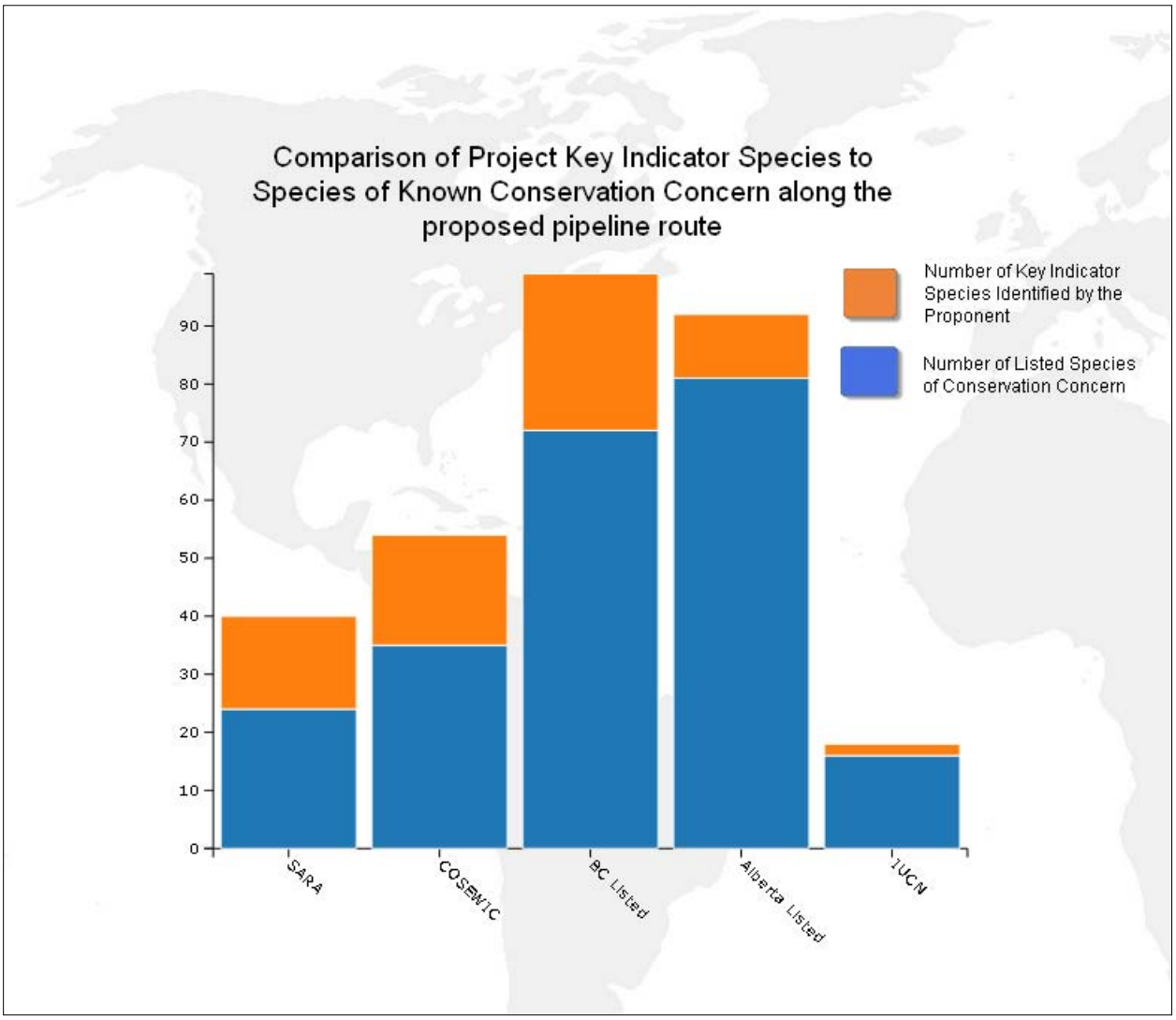


Figure 2: Comparison of Project Key Indicator Species to Species of Known Conservation Concern along the pipeline route. See table and end of document for details.

Most troubling is that the proponent has overlooked a number of SARA-listed species. WWF echoes the concerns of BC Nature and Nature Canada (33):

"Of particular concern to us is the consistent lack of thoroughness in the methodological approach used in the Application to identify important bird species, be they species at risk, or other species for which the area traversed represents a national, continental or global centre of abundance. This is evidenced by the occurrence of several Species at Risk Act (SARA) listed birds within the PEAA, REAA, CCAA and OWA that were not mentioned in the Application, but which do occur, as highlighted by evidence provided in subsequent information requests."[14]

Throughout, the proponent's submission underestimates potential effects on species warranting Canada's highest level of legal protection.

[14] *Op cit.* (33), page 30.

While even these highly protected species have not been given adequate consideration, many other species that form part of Canada's natural heritage appear to have been ignored altogether. Halibut, Eulachon, and Western Grebes were all missing from the original submission. The Gitga'at First Nation has noted that "the ENGP JRP Submission inadequately describes the baseline conditions for fish, invertebrates and marine seaweeds/plans within the ENGP Project Area … There is no description of the current population status of each of the five species of Pacific salmon or steelhead in terms of abundance or trends in abundance."[15]

Even the iconic Kermode Bear was overlooked: "The absence of a more detailed baseline overview [of] Kermode bear in the GAA is striking – especially considering (i) the high profile of this GNRV has in GFN culture, (ii) its role as a symbol for conservation on the Central Coast, (iii) that it has been the subject of numerous scientific investigations that have yielded peer re-viewed literature, and finally, (iv) that it has been designated the provincial mammal of B.C."[16] From WWF's stance, the stewardship of one of the world's most remarkable ecosystems merits an approach that goes well beyond minimum legal requirements.

The proponent does not address potential impacts to Sea Otters because "Sea otters are not known to be present in the Confined Channel Assessment Area"[17] However, eight years ago, the northern limit of this species' rapidly-expanding Canadian range was only 85 km to the south, and the proponent does acknowledges the possibility of Sea Otters expanding into the CCAA in future (16) (34). As oil spills are the greatest threat to sea otters and their recovery (10) (16), and as oil spills do not respect arbitrary geographical boundaries, it is a shortcoming of the ESA process that threats to sea otters have not been addressed."

With regards to the rare *hexactinellid sponge reefs* mentioned above, the proponent has identified "low-density, loose aggregations" of sponges within the area around the proposed terminal[18]. The assessment dismisses these aggregations as not having the same ecological value as reefs. In fact, recent science indicates that aggregations can actually be more ecologically productive than reefs[19]. The acute knowledge gaps and lack of monitoring for sponge reefs, noted by Fisheries and Oceans Canada, "make it difficult to fully assess the extent of anthropogenic impacts and other risks to cold-water corals and sponges including measures to enhance conservation"[20]. Given these gaps, a responsible application of the precautionary approach should prohibit damage to sponge aggregations. On this front DFO is to be applauded for asking for further details on the sponge aggregation found at the proposed terminal site (35). WWF is concerned that the aggregation of sponges in the southern part of the Marine Port Environmental Assessment Area (PEAA) has not been adequately explored to determine its structural characteristics. Evidence provided by the proponent shows both an aggregation and an accumulation of soft sediment on the associated rock pinnacle. In other parts of the province, such characteristics have indicated the presence of sponge reefs. In the

---

[15] *Op cit.* (105),page 16.
[16] *Op cit.* (105), page 5.
[17] (34), page 107, par. 3
18 Op cit. (102), p. 9-12, last paragraph
19 Op cit. (101), p.1
20 Op cit. (9), p.30.

absence of further knowledge and baseline data, a high level of precaution is warranted to protect this location from impacts.

The lack of understanding of this important ecological feature indicative of a general lack of knowledge about the Great Bear marine region. Whereas the Strait of Georgia has been subjected to surveys for exactly these types of features, management agencies responsible for this region are still in the preliminary stages of developing the baseline data need to manage the Great Bear Sea sustainably.

Indeed, there is a dearth of primary scientific research regarding many of the species found in the region, and we are far from understanding the specific impacts of any project on any individual species or on key ecological processes. If the project were small and the risk low, this might be acceptable; but the proposed pipeline is one of the largest infrastructure projects in this country's history. Given the extraordinary global significance of the Great Bear region, the risks associated with the proposed project are simply unacceptable. .

SUGGESTED MITIGATION ACTIONS FALL FAR SHORT

Even where SARA-listed species have been acknowledged, proposed mitigation strategies are inadequate to safeguard the long term viability of these species. WWF-Canada echoes the concerns of other conservation organizations that the proponent has failed to demonstrate that the proposed project will not have significant long-term or population-level impacts[21].

Sadly, such deficiencies concerning impacts on species and habitats occur throughout the project's EA documents. Although the proponent has responded to intervenor concerns on these and other deficiencies with commitments for follow-up research, such promises do not equate with due diligence in impact assessment.

[21] For instance, in Nature Canada's submission on the impacts on Caribou "We cannot find where the proponent has been able to reasonably demonstrate that these residual effects are not significant for caribou."*Op cit.* (33), page 5. Similar lapses occur in regards to listed marine mammals: "Although an estimate is given as to how long potential effects might last for the three example species (killer whale, harbor seal, and sea otter) no attempt was made to assess whether effects would be significant at the population level." (105), page xi. From the Raincoast Conservation Foundation submission on marine mammals (103): The project's main study on marine mammals: "*underestimates the importance of the study area to marine mammals, which suggests that the tanker route is used by fewer animals than it is really […] Essentially, the report should not be taken as an accurate baseline for marine mammals.*" (103), para.30. "*The report reveals an overall lack of familiarity with the scientific literature. For example, the authors note in section 3.2.3 that there are no abundance estimates for several cetacean species in BC. However, the paper cited earlier in the Enbridge report (Williams and Thomas 2007) provides abundance for seven cetacean species. Consequently, the authors could easily have achieved their main objective (estimating the fraction of the BC populations that use the proposed tanker route) if they had simply measured density, rather than reported minimum counts.*" (103)[21]… "*In other words, we know as little about the importance of the proposed oil tanker route to cetaceans now as we did before this study was conducted*" (103), para 30, 33, 35.

Risks from Increase in Tanker Traffic

Inevitability of Oil Spills

Oil tankers were banned from BC's north coast in 1972, as a result of concerns over oil spills. The voluntary Tanker Exclusion Zone applies to loaded crude oil tankers transiting from Alaska to California, and has been respected for the last four decades.

According to the Canadian Coast Guard, "the purpose of the tanker exclusion zone (TEZ) is to keep laden tankers west of the zone boundary in an effort to protect the shoreline and coastal waters from a potential risk of pollution." (36) At the time, Coastal First Nations, the public, and the provincial governments believed the risks of oil spills from tankers servicing the Trans- Alaska Pipeline system to be unacceptably high due to the treacherous nature of BC's Inside Passage, and so the ban was imposed. The project will require lifting of the current tanker moratorium and will render the TEZ pointless, putting the British Columbia coastline at serious risk of devastating environmental and economic damage from potential oil spills.

"Spills Are Inevitable. Even when every effort is made to prevent oil spills, accidents will happen"

- Environment Canada Website (38)

35 years ago, Andrew Thompson, Commissioner for the 1977 Canada West Coast Oil Ports Inquiry (37) characterized oil spills as *inevitable*, a view shared by Environment Canada (38). Moreover, recent pipeline breaks in Alberta, in Minnesota, in Michigan, and the marine spill disaster in the Gulf of Mexico in 2010, all confirm both the inherent risks of such infrastructure and our limited means of mitigating damage from spills.

This is not alarmism; it is merely a stark an honest statement based on evidence. Such directness enables society to deliberate in a realistic and clear-headed manner as to whether or not it is acceptable to introduce this risk ***into a particular region, given what's at stake***. The values outlined in the above sections – both ecological and economic – should serve to affirm what this Panel has heard directly from Canadians over the course of process Hearings: the values of the Great Bear region are immense, of global significance, and deeply entrenched in the cultural and economic identity of the region.

Use of Dispersants

Use of dispersants is a highly contested issue, particularly in the wake of the 2011 Deepwater Horizon spill in the Gulf of Mexico, where their use has contributed to the identification of numerous gaps in our knowledge on the effects of dispersants (39), including extensive effects on human health. In other jurisdictions, the use of dispersants has been counter-recommended altogether (40). With increasing doubt being cast by the scientific community on dispersant effects, it is surprising to note that in its submission, Northern Gateway challenged Environment Canada's approach to authorizing the use of dispersants:

In the Government of Canada's Written Evidence (A2K4U1), Volume 7, Part 2, p. 22, para. 74), Environment Canada stated that "[c]urrent Environment Canada guidelines (Environment Canada 1984) suggest that using dispersants in shallow waters or narrow embayments should be done with care. Current best practices in other jurisdictions are that dispersants not be applied within three nautical miles of the shore or in water shallower than 30 metres (100 feet). These guidelines would preclude the use of dispersants in all the Confined Channel Assessment Area scenarios prepared by the Proponent." Northern Gateway understands the aforementioned concerns raised by

Environment Canada regarding the use of dispersants in shallow waters, narrow embayments and in the presence of sensitive species. However, Northern Gateway believes it is important to note that in areas where pre-approval has not been granted; dispersant use should be considered on a case-by-case basis for all waters, regardless of depth and proximity to shore, as per international best practices.[22]

The pre-approval of dispersant use that Northern Gateway seeks would inappropriately delegate authority for the ultimate decision to deploy dispersants to a commercial entity that cannot be relied upon to act in the public interest. Any company embroiled in an environmental disaster is under pressure to demonstrate that it is doing something – anything - to respond to the crisis. The temptation to seize any pretext to claim that they are 'dealing with the problem' will be irresistible and it will not matter if an objective assessment would deem it futile or more harmful than helpful. Timely decisions are helpful. Premature decisions to relinquish authority to those who may place private interests ahead of the public interest are not helpful.

Further, the proponent's request for *a priori* approval of dispersant use illustrates two crucial issues: 1) oil spills are fully anticipated; 2) the response being advocated for by the proponent flies in the face of current thinking on the implications of dispersant use.

As with spills of diluted bitumen, the use of dispersants – and the controversy they entail – should be considered an inevitability, should this project go forward.

Cumulative effects on the Marine Ecosystems

Marine ecosystems are inherently complex, comprising multiple relationships between species, their habitats, and physical, chemical and oceanographic processes. Cumulative impacts from a development such as this will accrue over space and time and from multiple activities that are proposed and may occur together or separately, each affecting a part or multiple parts of an ecosystem. Further, project impacts must be considered in the context of the background of impacts from existing activities and proposed activities into the future. Such activities interact in often complex and unpredictable ways and their effects may be synergistic, additive or antagonistic (41). Current assessments of cumulative impacts in BC suggest that most of the continental shelf of Canada's Pacific is affected and under stress by multiple activities, with no active or effective mechanism for managing cumulative impacts (3) (42).

The approach to cumulative impacts for this project is limited to individual components of ecosystems and excludes the more explicit consideration of these ecosystem linkages and processes or interactions between activities and how they accrue to affect the marine ecosystem in question[23].

---

[22] (119), pages 2-1, 2-2.

[23] For instance, examining Valued Environmental Components (VECs) in isolation accounts only for the direct impacts to those VECs from the development, it doesn't consider the current level of stress on those VECs, nor what the full range of environmental conditions and requirements required to sustain those VECs may be, nor does it consider the effect of the project on those conditions. For example the proponent only considers ship strikes and underwater noise as the primary effects of the development on cetaceans. No consideration is given to the environmental quality of the habitat that supports these cetaceans including their food sources and the conditions required for such food sources (eg.: rearing and breeding habitats) that may be affected by the proposal. Furthermore only a very limited set of habitats are considered and broader environmental conditions such as

By treating complex ecosystems as separable and disconnected, this approach lends itself to a series of piece-meal "conclusions" of the nature: "project impacts are not likely to have significant effects on X species/component". The many iterations of this comment – found throughout the proponent's EA submission are based on partial or inadequate information and do more to obfuscate an understanding of impacts than to inform. It is an approach that goes against current thought on the functioning of marine ecosystems and instead shores up the adage 'death by a thousand cuts'.

Further, project impacts must be considered in the context of the background of impacts from existing activities and proposed future activities. Evaluating the effects of multiple activities on multiple ecosystem components without fully accounting for the interaction of these components requires multiple assumptions, and is necessarily fraught with uncertainty. This level of uncertainty and incompleteness in our knowledge **is the reality**. A responsible assessment process *must* acknowledge these inherent limitations. A responsible, informed deliberation around cumulative effects comes from a place of precaution and wisdom when data and information are not available or adequate on their own.

UNDERWATER NOISE

Cetaceans (whales, dolphins and porpoises) use sound in the marine environment in ways that are analogous to the human use of sight. Sound propagates far better in water than light does, and in the dark ocean, cetaceans have evolved to use sound for vital functions such as communication among social group members, navigation, locating mates, finding food, and avoiding predators. Human-made sound in the underwater environment can disrupt these activities in various ways, and over the past couple of decades underwater noise pollution has attracted growing concern as a conservation issue worldwide (43) (44) (45).

Commercial shipping is now a major source of chronic noise in the oceans (46), and shipping noise bandwidths strongly overlap those used by larger species of whales. This means that noise from vessels may drown out, or mask, the sounds that these whales must use to survive (47) (48), creating a sort of "acoustic smog" of competing sound. Although smaller cetaceans such as killer whales and harbour porpoises mainly vocalize at frequencies higher than the dominant frequencies of commercial vessels, these ships also generate high frequency noise (43) (12), as do smaller vessels such as those associated with port activities (43). Thus, the multiple vessel classes comprising the marine component of the NGP would potentially mask critical sounds for all cetacean species in the area. Other sources of underwater noise identified by the proponent include blasting, dredging, and port construction, all of which have the potential to mask cetacean vocalizations. Masking represents one of the major effects of chronic shipping noise on cetaceans and other marine animals (45) yet it is not assessed in the proponent's submitted documents dealing with noise effects (49).

The federal Recovery Strategy for Fin, Blue and Sei whales describes human-generated noise as the greatest threat after ship strikes (11), with increased background noise seen as something that can make habitat permanently or temporarily uninhabitable by

---

water quality, ambient noise levels that affect the character of the environment with implications for all species that depend on it remain vaguely treated or unanswered.

cetaceans. "The possibility that habitat degradation (or loss of use), through increased background noise levels, may limit the recovery of these species near shipping lanes and other areas of high noise production should...be considered a leading threat"[24]. As another example, harbour porpoises are thought to be particularly sensitive to unaccustomed sound and can be excluded from areas that see increases in chronic noise levels (50).

Underwater noise can also directly affect other marine animals (e.g., seals and sea lions, fish) in a variety of ways, leading to potential impacts at the level of food webs and entire ecosystems.

Enbridge Northern Gateway proposes to reduce "the likelihood and extent" of shipping noise in the CCAA by requiring reduced tanker speed (51). In stating that vessel-generated underwater noise increases with ship speed, the proponent cites a non-peer-reviewed conference presentation (52), but more recent and peer-reviewed literature, reporting results of research on noise from multiple commercial vessels and vessel types, found only limited support for this relationship (53). Vessel speed reduction may in fact not be an adequate mitigation strategy. Nor does the proponent address regionally significant aggregations of whales exposed to increased shipping outside of the CCAA (17).

WWF has invested significant efforts in the past year on the issue of ocean noise pollution, its effects and management. Our efforts have included: Convening leading experts for the first regional workshop Ocean Noise in Canada's Pacific (4); Commissioning two research studies by leading bioacoustics expert and team to understand the annual cumulative noise levels from shipping traffic on the pacific coast of Canada (54) and a recently completed study to quantify anticipated changes in the soundscape of Northern BC from the proposed and anticipated increased in ship traffic (55). WWF also retained the services of Dr. Rob McCauley at Curtin University in Australia to provide a review of the underwater noise related aspects of the NG proposal and ESA. That review is provided as an attachment to this report as an appendix (49).

We have distilled some key issues that relate to underwater noise aspects of the project and ESA drawn from the review by Dr. McCauley and other consultations, and we highlight them here as inadequacies.

QUANTIFICATION OF AMBIENT NOISE LEVELS

Ambient noise levels provided by the proponent (56) are based on hydrophone measurements for a very limited time window of 13 hrs (less than one full day). This is highly unusual: standard practice when quantifying a baseline for a study area is to draw measurements over much longer time periods, typically several months and seasons over a full year or longer. Nonetheless, the current limited recordings show ambient noise levels in the 82-84 dB re 1 μ Pa range as the background level of noise when no anthropogenic sources are present. Noting the limitations on methodology, this reflects what the natural state of the ocean in the project area would be in the absence of industrial activity and the conditions in which habitats would remain acoustically sound.

[24] *Op cit.* (11),page 18.

MARINE MAMMALS

The masking effects of noise on marine mammals are entirely not neglected within the project submissions and there is no quantification of the amount of 'communication space' lost from increases of underwater noise from the project. The potential loss of habitat due to underwater noise from shipping is not addressed nor is its effects on any of the cetacean species despite the importance of such habitat being highlighted and deemed critical within the recovery plans for the listed cetacean species. Without such an assessment the effects of masking cannot be deemed to be insignificant as asserted by the proponent. This is a major shortcoming.

The proponent's assessment selects Humpback Whales and Northern Resident Killer Whales as representative cetaceans on which to assess impacts (including of underwater noise) from the development. While Humpback Whales can be considered representative for large (baleen) whale species in some aspects, they are not a sufficient proxy with regard to underwater sound for recovering populations of Fin whales which are now increasing found at high abundances in the project area (13). Fin whales are known to produce and vocalize numerous low frequency sounds that are not within the same frequency range as humpback whales. (57) (58) (59). Recent research (60) has found that "*exposure to chronic low-frequency shipping noise may be associated with chronic stress in right whales, and state that this finding has implications for all low-frequency specialists in areas of heavy ship traffic. Like the right whale, fin whales are low-frequency sound specialists (Castellote et al. 2012). Fin whales have been found to alter their calling in response to shipping noise (Castellote et al. 2012)."*[25]

The potential effects of noise on prey (fishes) of listed marine mammals not assessed. The biological implications of potential reduction in prey densities or of underwater sound altering prey behaviour and availability for marine mammals has not been assessed. Given that viable prey fields are critical for all marine mammals that utilize the area, this is a serious shortcoming from an ecological standpoint and reflects the piece meal approach to assessment that is inadequate in considering the inter-linkages and connectivity within marine ecosystems.

It is clear from the proponent's assessment that there is a potential for negative implications for all marine mammal groups from underwater noise. By inclusion of wider populations of each animal group, the proponent underestimates and dismisses the potential for localized negative effects in the inland and coastal waterways of the study areas, and therefore fails to provide a complete picture or assessment of the potential impact of underwater noise on marine mammal species in the area.

INVERTEBRATES AND FISHES

The biological effects of noise generated from the proposed project have not been properly addressed for invertebrates and fishes. Literature pertaining to underwater noise effects on invertebrates and fishes was not adequately reviewed and was not quantified in terms of exposure durations and levels. Where threshold values were used they were for impulse measures, not for continual noise such as that produced by vessels. Given the crucial role of invertebrates and fishes to marine ecosystems, this is a significant gap in the assessment of potential impacts.

[25] *Ibid.*

CUMULATIVE NOISE LEVELS

The proponent's assessment has only partially considered the cumulative effects of noise from multiple sources or of noise exposures through time. The assessment was limited to separate sub-sections in assessing impacts on marine mammals and has not been presented with statistics of times of exposure above set thresholds in a section of its own with summary tables. There is no cumulative noise analysis for invertebrates or fishes.

For instance, the proponent when considering noise exposure to Killer Whales and Humpback Whales suggests that there is a consideration of cumulative effects of noise on these species. While it purports to treat cumulative effects of noise it only does on a daily exposure basis and the % area that is affected for one day. It does not assess how these daily exposures affect Northern Resident Killer Whales or Humpback Whales over multiple days of exposure or what the effect of such exposure (which represents a permanent noise source in the habitats for these species) on an annual basis will be.

These inadequacies in the assessment do not support the assertion made by the proponent that the effects of underwater noise from the project are insignificant and can be mitigated. In our assessment the lack of adequate quantification of cumulative noise exposures and masking does not allow any reliable assessment that there are no significant impacts.

From preliminary work completed (55) cumulative noise exposures and the duration of time for noise exposure can be determined for the project activities: the noise from projected vessel traffic that will result from the project will increase cumulative Sound Exposure Levels in a summer month between by an additional 0 to 22.9 dB re 1 μPa^2s. A preliminary map of where these increases are expected to occur are provided in Figure 2 which illustrates the increased sound levels with areas identified as potential or candidate critical habitat for Northern Resident Killer Whales and Humpback Whales.

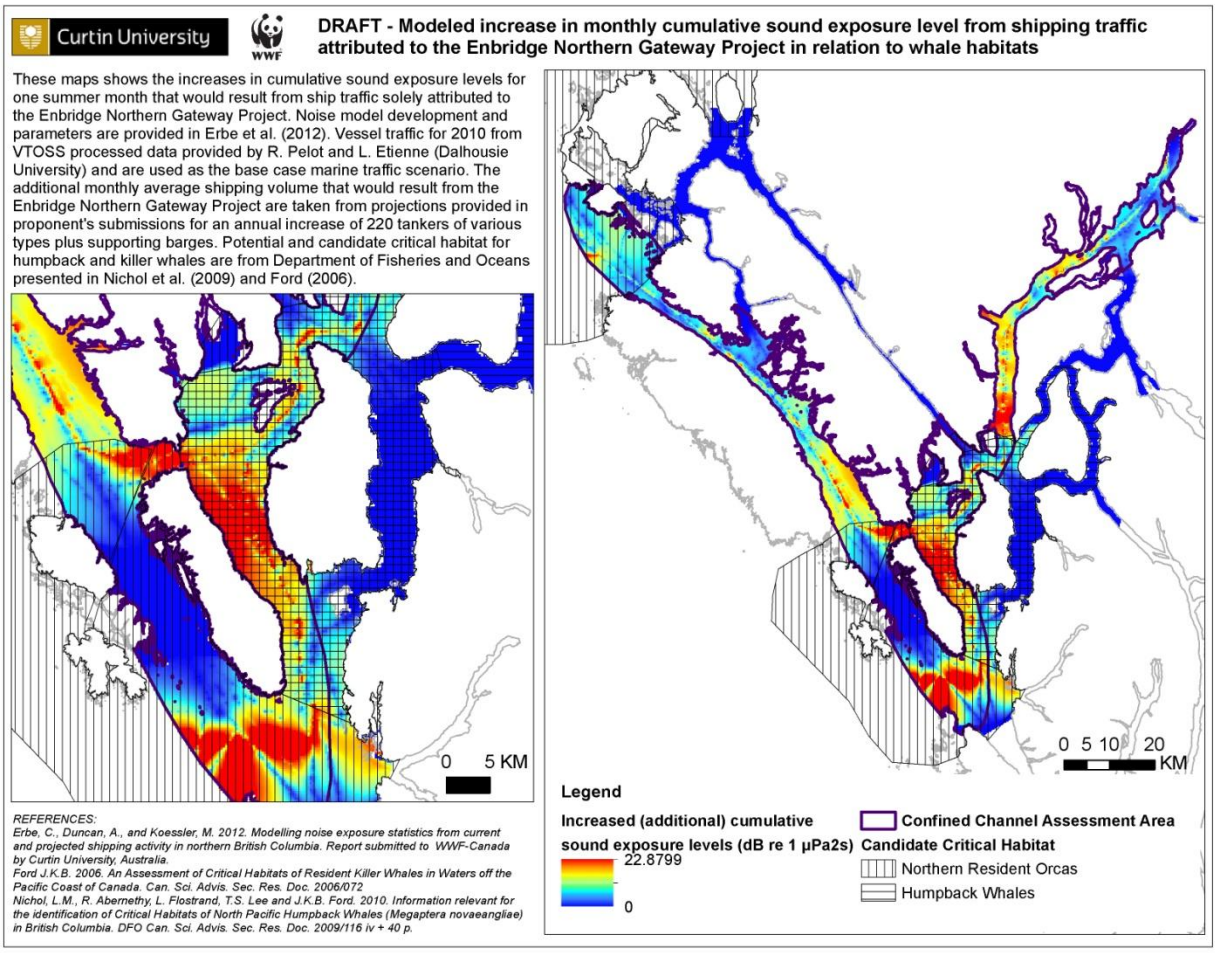


Figure 2: Modeled increase in monthly cumulative sound exposure level

Erbe, et al. (54) further indicates that a single projected vessel transit of a VLCC vessel with supporting tugs that takes approximately 9 hours to transit from Kitimat via the northern route will render sound levels in the CCAA up to 29.3% for that transit time to be above the natural background level of noise (natural ambient level of noise). This is assuming an ambient noise level of 100db dB re 1 µPa. If the ambient and natural background level of noise is considered to be around 85db dB re 1 µPa as alluded to in the-time limited baseline generated from the proponent's submitted assessment (61), then that percentage of time above ambient would be much greater. Such an increase over baseline levels from a single transit ought to raise significant concern, as to what sound exposure levels associated with shipping may be with multiple overlapping transits which have not been quantified or assessed by the proponent.

This work also indicates that for the same single vessel transit of a VLCC over 9 hours via the northern route will be audible to Killer Whales for anywhere between 0 to 26.7%[26]

[26] This estimate is for broadband frequencies of noise up to 2KHz that were modeled by Erbe et al. 2012. Killer Whales also vocalize and perceive sound at higher frequency levels and the noise energy generated from frequency bands higher than 2Khz is not included. This percentage time estimate for audibility by killer whales should be considered conservative and in reality will be higher than assessed here.

of the transit time depending on the area within the CCAA being considered. Within the area identified as candidate or potential critical habitat for Northern resident Killer whales this single vessel transit would be audible from between 0 to 21.6% of the transit time. For the same single vessel transit of a VLCC over 9 hours via the northern route will be audible to Humpback Whales for anywhere between 0 to 46.8% of the transit time depending on the area within the CCAA being considered. Within the area identified as candidate or potential critical habitat for Humpback Whales this single vessel transit would be audible between 0 to 17.2 % of the transit time. Such levels of audibility time associated with a single transit beg the question as to what levels will be with multiple daily transits and what the effects of increased audibility time will be.

The proponent dismisses behavioral change of humpbacks within the CCAA, deeming it *insignificant*, relying on the rationale that such change would have little effect on the wider range of North Pacific Humpback population. In other words, it appears that the proponent is suggesting that it is acceptable to disrupt a species and its local ecosystem in Canada because parts of the species range and its ecosystem outside of Canada are not at present disrupted. The shortfalls in this line of argument should be obvious: 1) it assumes the wider population outside of Canada will thrive now and into the future; 2) it suggests that there is no responsibility to exercise caution for the same system within Canada where we have the responsibility to protect it.

Ship Strikes and Cetaceans

Ship strikes are characterized as the most important threat to individual [large whales] in Pacific Canadian waters (11). Multiple studies have identified fin whales as the species most often struck by vessels, and grey and humpback whales are also frequently killed or injured by ship strikes (62) (63) (64) (17). The proposal does not assess ship strike risk to Orcas because the proponent believes they "are fast swimming and agile, enabling them to avoid approaching vessels"[27] , but a cursory review of the literature available prior to the assessment submission shows this statement to be false, with propeller wounds common on live Orcas in the region, and fatal collisions or serious injuries reported in BC and elsewhere (62) (64) (63) (17). This is an issue of concern particularly because mortality from ship strikes can jeopardize the persistence of small populations (65).

As a way of mitigating ship strikes, the proponent proposes vessel speed restrictions for certain areas at certain times of year. However, reduction of vessel speed does not eliminate whale strike occurrence, including strikes that result in death or serious injury to the whale (64) (63) (66). One database shows about one-quarter of all such collisions were with vessels travelling at 10 knots or less (63). Furthermore, mortality rate increases with increasing vessel length: death occurred in about 90% of collisions with vessels over 100 m and almost invariably resulted from strikes by vessels over 150 m (63). In other words, the proponent's suggested mitigation measures of reducing ship speed and using monitors will not eliminate ship strikes. The proponent's suggested "vessel strike analysis" (51) won't change this fact, and some of these cetacean populations may not be able to sustain additional anthropogenic mortality (17). It is worth restating the North Coast Cetacean Society's observation that Passive Acoustic Monitoring, recommended by the proponent for use at night and in bad weather,

[27] *Op cit.* (51), section 10.5.2.2

detected whales on only 12% of survey days, vs. detection on 74% of days using visual surveys (15).

The proponent has suggested that a Marine Mammal Protection Plan will be put into place six months before the development proceeds so that, it can "manage and monitor Project-related environmental effects on marine mammals associated with underwater noise, blasting, and other potential marine mammal-vessel interactions". Such monitoring and data gathering would be appropriate in a situation where there are no major deficiencies in the assessment and where the impacts from the development have been reliably assessed, and found to be low-impact, or otherwise amenable to mitigation. However, it cannot be deemed appropriate given the uncertainty around whether effective mitigation even exists for such threats as ship strikes, underwater noise, and oil pollution in this confined and sensitive environment. The marine mammal protection plan framework cannot replace the current lack of assessment and information that is critical to determining the impacts of this project.

Summary: Effects of Increased Shipping

In summary, the potential effects of a dramatic increase in shipping of this nature are manifold, from chronic effects such as noise and ship strikes, to catastrophic events such as oil spills and use of dispersants. Science suggests that these effects are either significant. Independent review of the proponent's submitted evidence confirms and extends critical submissions of registered intervenors in the process, pointing to inadequate baseline data, insufficient treatment of cumulative effects, and the inadequacy of proposed mitigation measures.

Risks from Oil Pipeline Spills

Risks to Rivers and Fish

The proposed pipeline would cross hundreds of streams and rivers in both Alberta and BC, including the Sutherland River, the Morice River and the Clore River, which feed into the salmon-rich Skeena in BC, according to DFO's evidence before this Panel.

The pipeline also crosses the Kitimat River, the main source of drinking water for the community of Kitimat. First Nations food, social and ceremonial (FSC) fisheries are conducted in the upper Fraser, Nechako and Stuart basins near to the proposed pipeline. An oil leak from a pipeline would have far-reaching harmful consequences.

The DFO did not conduct a review of all of the proposed pipeline stream crossings and was unable to respond fully to the Panel's Information Request to submit a comprehensive list of watercourse crossings with important anadromous fish habitat where DFO would have assigned a higher risk rating than was assigned by the proponent and where DFO thought the proposed crossing method ought to be reconsidered to better reflect the risk rating (66). DFO did identify some crossings where they may have categorized the risk higher than the proponent's assessment, including at least two important coho streams that are tributaries of the Kitimat River.

To avoid damaging fish habitat, DFO generally requires that construction work should take place in "Least Risk Periods" that it identifies with the relevant province. However, the Skeena generally lacks these periods, as DFO's evidence to this Panel notes (66).

The proponent proposes to limit pipeline spills to 2000 cubic meters (2 million litres), which, when a spill occurs would likely cause acute mortality of fish and other aquatic species. DFO recommends a lower volume threshold, and has warned that the Pine River oil spill in August of 2000, considered one of the worst inland spills in British Columbia to date, released 1000 cubic meters (1 million litres): "The severity of impact was due not only to the acute mortality of fish and other aquatic species, but also to the cleanup effort which resulted in serious and lasting impacts to the habitat and hydrology of the Pine River"[28]. The Pine River spill of approximately 500 m of oil resulted in a fish kill of approximately 50-70% of the fish present in the first 30 km downstream of the spill site (67). All the oil could not be cleaned up at the time of the spill so it was left in the river to break down over time. Five years after the spill, in 2005, a survey revealed that residual oil persisted in some bottom substrates of the Pine River[29]

In addition to the threats outlined above, WWF-Canada echoes the concerns raised in evidence submitted from a number of intervenors[30].

CHANGED REGULATORY LANDSCAPE WEAKENS PROTECTION FOR FISH

The changed regulatory landscape will limit protection for freshwater fish habitat. WWF-Canada is particularly troubled by 2012 changes to the federal *Fisheries Act* that appear partially directed at lessening protection for fish habitat in remote rivers like the Wild Rivers of the Great Bear.

The *Fisheries Act* is Canada's strongest environmental law, mainly because it prohibits HADD – "the harmful alteration, disruption, or destruction of fish habitat." (68) A habitat is a fish's home, or as the Act puts it: the "spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend

---

[28] *Op cit.* (66), pp. 20-21.
[29] *Ibid.*
[30] The Northwest Institute for Bioregional Research, and their experts on the risks to the Morice River (114): *"… a pipeline breach could have severely negative impacts on resident and anadromous fishes. Additionally, all the anadromous fish in the Babine, Bulkley, and Zymoetz systems have already been impacted by 130 years of relatively high exploitation rates due to coastal mixed-Analysis of Skeena River Tributaries stock fisheries. As well, all anadromous and freshwater resident fish have had varying degrees of habitat modification due to development activities, including linear perturbations such as railroad, highways, transmission and pipeline corridors, agriculture, urbanization, forestry, and mining, with particular impacts to the productive floodplain habitats. An oil spill or rupture from the proposed pipeline would have significant environmental effects within and beyond the Skeena River system*"' pp 6-7.
A pipeline rupture into the Morice River, according to expert evidence to the regulatory review for the project (116), would be toxic to fish and eggs and would cause longer-term habitat degradation; proposed clean-up methods would be ineffective because the "*Morice River is too large, the water velocities are too fast for much of the year, and the channels are too complex to use conventional containment booms, absorbents and skimmers*" (page 27).
Friends of the Morice/Bulkley and their expert on the risks to the Sutherland River (115): "*A significant leak or rupture of the proposed Northern Gateway Pipeline in the Sutherland Watershed poses a risk to the long-term viability of the Sutherland River rainbow trout, and would have a direct impact on Yekooche First Nations traditional use of these fish and the Babine Lake sport fishery*" (page 14).
The Gitga'at First Nation and their experts on the risks to eulachon. The Gitga'at First Nation notes in its written submission (105) that the presence of larval and juvenile eulachon in the surface waters of the area from April to July each year make this species particularly vulnerable to an accidental spill: Page iv.

directly or indirectly in order to carry out their life processes."[31] For the past thirty years the Act's blanket prohibition on HADD has been a powerful environmental protection tool especially when combined with the Department of Fisheries and Oceans' policy of "no net loss" of fish habitat. The changes to the Act, contained in the May 2012 budget bill will seriously weaken fish habitat protection.

All fish and fish habitat anywhere in Canada is currently protected by the HADD prohibition, but the changes to the Act may soon limit protection to those fish that are "part of a commercial, recreational or Aboriginal fishery." (69). Moreover, the government plans to replace the prohibition against HADD with a prohibition against "serious harm to fish,"[32] defined as "the death of fish or any permanent alteration to, or destruction of, fish habitat."[33] It's hard to prove permanent habitat destruction.

It is possible that as many of these waters that the proposed pipeline will cross are in remote areas that could soon be exempt from scrutiny. Or regulations may be passed so these waters are formally exempt from the Act[34].

In essence, the original project proposal was not only inadequate, but also included safeguards based on a regulatory regime that no longer applies.

More Enforcement is Both Unlikely and won't solve the problem

Stronger enforcement will not address the fundamental problem that this is the wrong project in the wrong place. Promises of stronger enforcement are also at odds with:

1) A poor federal record of enforcement (70): In 2010-11, across the country, two CEPA prosecutions occurred and zero convictions were obtained (71). Other federal laws such as the *Fisheries Act*, and the *Migratory Birds Convention Act*, more often result in fines and convictions. Environment Canada and Transport Canada's procedures have been questioned in recent years: not having thorough safety procedures in place (72), and not accounting for cumulative effects (73) of their projects on the environment.
2) Rarity of significant fines: From 2001-2009, the Federal government levied 99 environmental fines against polluters (corporations, businesses and municipalities), totaling over $4 million dollars with a median fine of $ 10,000. Since 2001, there has been no measurable upward trend in the number of fines or in the total amount fined by the Federal government (74) (An exception is the largest fine for an environmental offence in Canadian history - $3 million ordered against Syncrude in 2010 for failing to take adequate measures to prevent the death of more than 1,600 ducks that died after landing in a tailings pond north of Fort McMurray.)
3) Budget cuts for environmental protection. Environment Canada's overall budget was cut by 8.3% -$20 million this year rising to $80 million in 2014/15.

---

[31] *Ibid.* at Section 34(1)
[32] *Ibid.*
[33] *Ibid.*
[34] "The [Northern Gateway] pipeline goes over an estimated 1,000 waterways and [Fisheries Minister] Ashfield acknowledged that some of them won't fit the definition of a stream that is part of either of the three fisheries." (122)

A Cautionary Tale: The Enbridge Kalamazoo Spill

An oil spill into a wild river of the Great Bear could not only poison fish, but also contaminate the banks of the rivers, disrupting feeding cycles for bears and birds. The economies and livelihoods of those who live by the rivers could be devastated. Recent revelations about the 2010 Enbridge oil spill in the Kalamazoo River show just how severe the impacts can be. After two years, workers are still struggling to remove residual crude oil that has sunk into riverbed and wetlands. As of July 2012, approximately $800 million has been spent on a cleanup that is still not finished (75). It is the most expensive oil pipeline spill since the U.S. government began keeping records in 1968 (76).

The continent's largest-ever freshwater bitumen spill occurred in July 2010, from the Enbridge pipeline in Michigan. The spill poured more than 20,000 barrels of diluted bitumen into the Kalamazoo River. According to the U.S. National Transportation Safety Board (NTSB), responsible for investigating the spill, safety measures that could have reduced the impact of the spill were not followed. Enbridge pipeline controllers in Edmonton ignored repeated leak warnings for 17 hours before shutting down the pipeline that dumped 20,000 barrels of oil into the Kalamazoo River (28).

Between 1999 and 2010, Enbridge has been accountable for more than 800 spills that released 6.8 million gallons of hydrocarbons into the environment (77). The toxic nature of tar sands, operation and control failure and also human error made the Enbridge's Kalamazoo spill the largest inland pipeline accident in U.S. history (77).

Toxic nature of tar-sands bitumen

The substance that had been spilled into the Kalamazoo River was actually "dilbit," a toxic mixture of chemical diluents and bitumen, which has some different qualities from those of conventional crude oil. One such important quality of dilbit is that it contains much higher concentration of benzene and toluene. According to the American Cancer Society, benzene is a potentially dangerous chemical and is known to cause cancer (78). The main route of exposure to benzene is by inhaling contaminated air. About 320 people and 11 worksite employees reported symptoms consistent with benzene exposure in conjunction with the Kalamazoo dilbit spill in 2010 (79).

As mentioned above, another quality of dilbit is that, after the diluents portion of the mixture evaporates, the heavier bitumen gradually sinks into the water column, making it extremely difficult to clean-up.

Pipeline operation and maintenance

The pipeline and hazardous materials safety administration (PHMSA) of the United States generally relies on pipeline operators to monitor their pipelines and self-report any problems. One of the major concerns is corrosion, which can lead to spills or leaks if the corroded areas aren't repaired or replaced. When corrosion exceeds certain threshold, companies are supposed to repair the pipeline within 180 days. But the rules are flexible and negotiable. The defect that caused Michigan spill was detected at least three times before the pipeline ruptured, in 2005, 2007 and 2009, according to documents Enbridge filed with PHMSA over the years. But each time, Enbridge decided that the defect was not significant enough to require repairs within 180 days. Ten days before the 6B pipeline ruptured, Enbridge applied to PHMSA for another extension. It

asked for an additional two and a half years to decide whether 6B should be repaired or replaced (76).

The National Transportation Safety Board determines that the probable cause of the pipeline rupture was corrosion fatigue cracks that grew and coalesced from crack and corrosion defects under disbanded polyethylene tape coating, producing a substantial crude oil release that went undetected by the control center for over 17 hours (79). The rupture and prolonged release occurred because of organizational failures at Enbridge Inc. that included the following:

- *Deficient integrity management procedures, which allowed well-documented crack defects in corroded areas to spread until the pipeline failed.*
- *Inadequate training and mistakes of control center personnel, which allowed the rupture to remain undetected for 17 hours and through two startups of the pipeline.*
- *Insufficient public awareness and education, which allowed the release to continue for nearly 14 hours after the first notification of an odor to local emergency response agencies.*

HUMAN ERROR

According to NTSB, operators working for the pipeline company failed to maintain the company's 10-minute rule (28). Enbridge operators did not notice the 6B Line rupture and attempt to shut-down the pipeline for a full 17 hours despite repeated alarms and low pressure signals. In fact the company did not shut control valves until phone calls from a Michigan gas company alerted the company about the extensive odor complaints in the high impact marshy region. According to the same report, "The initial and subsequent alarms associated with the rupture were not recognized as a line-break throughout two start-up attempts and over multiple control centre shifts."

Despite the fact that Enbridge trained and prepared all its control room staff in five theory and practice phases for 6 months prior to starting the job in Edmonton control centre, the company was not successful in controlling and eliminating the human error factor. According to Enbridge's supervisor of training and compliance for control room, by the completion of the fifth phase of the training period, students were expected to recognize and respond appropriately to abnormal operating conditions, including column separation and leak scenarios (79). Additionally, operators and shift leads participated annually in simulator training where they were presented with leak and column separation scenarios, as well as other abnormal operating conditions. Apparently, at the time of incident, when the human error factored in, none of those trainings helped Enbridge to control and stop the spill.

WWF-Canada strongly believes that no matter what safety measures or staff training processes are going to be followed for the operation of proposed Northern Gateway pipelines, there will always be "human error" factor and small mistakes or big ones will continue to be made. Canada's precious Great Bear Rainforest has no room to test the high-cost "to be expected" human error.

RISKS OF INCREASED OIL SANDS PRODUCTION AND HARM FROM CLIMATE CHANGE

The Joint Review Panel ruled:

> *"In relation to our mandate under both the CEA Act and the NEB Act, we note that the application before us is for a transportation undertaking only, and Northern Gateway has not indicated any intention to develop any oil sands projects. …we do not consider that there is a sufficiently direct connection between the Project and any particular existing or proposed oil sands development, or other oil production activities, to warrant consideration of the environmental effects of such activities as part of our assessment of the Project under the CEA Act or the NEB Act."*[35]

WWF understands the practical need to limit the scope of any project review. In this instance, we agree that the connection between the proposed pipeline and 'any particular existing or proposed oil sands development' is not direct in the sense that the financial viability of the pipeline proposal does not rest with any particular oil sands development.

Yet there is a direct and unavoidable connection between the proposed project and additional oil sands production.[36] Only by shipping product that would not otherwise be produced for export can the pipeline project claim to create a net economic benefit. The anticipated economic benefit cannot be obtained without environmental impacts[37]. It will not do to acknowledge prospective economic benefits of the project that rely on additional oil sands development, yet fail to acknowledge the environmental consequences of that development.

It will not do to acknowledge prospective economic benefits of the project that rely on additional oil sands development, yet fail to acknowledge the environmental consequences of that development.

The proposed pipeline requires a cumulative additional production of 525,000 barrels per day. The environmental impacts and in particular the GHG emissions associated with that level of production can be estimated. The Sustainability Coalition estimates that the well-to-wheel emissions of the additional production associated with the pipeline would be 100 Mt CO_2eq/yr. (80)

What Does This Mean For the JRP's Review of the Pipeline Proposal?

Early in the 21st Century humanity faces a daunting challenge. Greenhouse gases released by burning coal, oil and gas are accumulating in the atmosphere, driving the global temperature higher. Geoscientists worry that several positive feedback mechanisms could be triggered, prompting abrupt and dangerous climate change. Humanity could be exposed to changes it is ill-equipped to endure: altered weather patterns that disrupt terrestrial ecosystems, agriculture and forestry; rising sea levels inundating low-lying coastal areas, displacing large numbers of people, and destroying rich agricultural deltas; and ocean acidification that disrupts marine ecosystems and fisheries. The scale of human suffering and ecological damage, including the loss of valuable biodiversity, could be severe.

---

[35] (123), page 13.
[36] This production is likely to involve Northern Gateway's 'funding participants,' including those companies that have not been forthcoming about their financial involvement (124).
[37] The environmental effects of the oil sands development have embroiled the industry in controversy. Broadly there are two categories of environmental impacts: regional effects on the boreal ecosystem and non-regional effects such as the impact of accelerating greenhouse gas production. The latter are understood to a reasonable approximation.

The international community committed in Copenhagen to limit the global temperature rise to 2° C, but failed to secure a workable plan to achieve that goal. The global temperature is now 0.8° C above the preindustrial level and will unavoidably rise to at least a 1.4° C above the preindustrial average. Canada abandoned its Kyoto protocol commitments adopting a more modest goal of reducing 2005 emissions 17% by 2020, a goal it will not achieve with current policy[38]. The oil sands industry, Canada's fastest growing source of greenhouse gases (81), is expected to account for fully a third of a 178 Mt overshoot of the 2020 target.[39]

The international and domestic failures to intercept the threat of dangerous climate change manifest the tragedy of the commons first described by Garrett Hardin in 1968. Fossil fuel producers and the nations that benefit from them pursue their individual interests and in so doing place millions at risk. As in all such cases, those who are part of the problem can argue that they are an insignificant part of the problem, and yet it is precisely the cumulative effect of many such impacts that now threatens to produce a global tragedy of the commons[40].

No one expects the JRP to remedy the deficiencies of international and domestic climate policy. What the JRP **can** do is identify that the project under review, in the context of insufficient international and domestic action to curtail GHG emissions, **will undermine efforts to avoid dangerous climate change**.

The International Energy Agency's chief economist Fatih Birol has warned that energy investment decisions that neglect the urgency of the situation could cripple our ability to prevent dangerous climate change:

"…the locking in of future emissions due to infrastructure investments represents a serious setback to our hopes of limiting the global rise in temperature to no more than 2° Celsius." (82)

The unmitigated climate impact of this project is yet another reason that it is not in the public interest.

PART III: BALANCING ENVIRONMENTAL, ECONOMIC AND SOCIAL INTERESTS - GUIDANCE FROM THE GREAT BEAR RAINFOREST AGREEMENT

Clear policy guidance at the outset is essential to productive deliberation on major projects. Such guidance provides a framework for consideration of advantages and disadvantages of any particular resource use decision. A recent report from the Canada West Foundation (83) describes what happens in the absence of clear policy guidance:

---

[38] The federal government has expressed its intention to regulate emission from this industry, but has taken no action. It recently indicated it would defer to Alberta, a province that continues to promote intensity-based standards while allowing its emissions to climb that will see emissions climb for years to come.

[39] The 62 Mt increase compared to the anticipated emissions overrun of 178 Mt. *Op cit.* (81)*, see also* (125).

[40] Canada simultaneously claims to be an emerging energy superpower based significantly on our hydrocarbon resources AND claims that we are too small in the grand scheme of things to matter when it comes to carbon emissions. Canadians have the third highest per capita carbon footprint of the OECD countries. Even on an absolute basis we produce more GHG's than all but six nations, all with vastly greater populations.

"We know there is a strong link between a healthy ecosystem, a healthy society and Canada's economic prosperity… This ambitious and collaborative initiative will achieve just that, and we are committed to work closely with First Nations and non-government organizations to bring it to life."

- John Baird, Minister of Environment, Jan 21, 2007 (111)

"The regulatory process gets overloaded and becomes the outlet for public hostility because the appropriate policies and governance structure have not been set up front."[41]

Policy guidance must be established at the outset of a major new process or project review, collaboratively, and not mid-stream, arbitrarily. This is precisely the kind of rational, interest-based multi-stakeholder planning that characterized the solution-building process that culminated in the 2006 Great Bear Rainforest Agreement, that WWF acknowledged with its international Gift to the Earth award, and that WWF-Canada and our partners have been pursuing in this region for over a decade.

The Great Bear region is one of the few places in the world where governments, First Nations, conservation groups, companies, and community interests have together established and formally committed to a shared large-scale conservation and sustainability vision. This vision is supported by thorough and independent science; is backed by legislation, policy, and regulation; and is being delivered through new governance and institutional arrangements.

The Agreement is further bolstered by the formalization, in 2007, of the Conservation Investments and Incentives Initiative, through which the Government of Canada, the Government of BC, and a consortium of private investors established investment funds to support new economic ventures and sustainable resource management throughout the Great Bear region.

While the Great Bear Rainforest Agreement focuses on management of terrestrial ecosystems, the sustainability vision, and associated policy and investment tools, explicitly extend further to encompass healthy coastal and marine ecosystems sustaining a diverse regional economy. The interconnection among rainforest, freshwater, and ocean ecosystems means that it is not possible to secure the health of the forests unless we also ensure the health of the rivers and the sea.

- The model/policy guidance: Sustainability vision over large-scale ecoregion
- Core protected area network
- Ecosystem-based management of working landscape, with requirement to aim for low overall risk to ecosystem integrity
- Recognition of First Nation rights and title
- Recognition of global ecological values – this region is essential to Canada's ability to deliver on its biodiversity commitments as well as to grow natural capital
- Recognition of value of diverse regional economy consistent with community values and aspirations
- Activities that threaten ecosystem health (eg.: large-scale clear-cuts) are simply not permitted

This is the model that has earned world-wide recognition as a leading example of sustainability, and to which the governments of Canada and British Columbia have committed to uphold. The proposed project runs counter to the region's sustainability vision, threatens ecological integrity and human well-being in the region, puts at risk a range of existing economic activities, and is firmly opposed by First Nations and local

[41] *Op cit.* (83), page 9.

communities. The project is clearly at odds with the vision and policy guidance contained in the Great Bear Rainforest Agreement.

CONCLUSION

The decision whether to recommend that a certificate should be issued for this project requires the Panel to be satisfied that the project is in the public interest.

"The public interest is inclusive of all Canadians and refers to a balance of economic, environmental, and social interests that changes as society's values and preferences evolve over time. The Board estimates the overall public good a project may create and its potential negative aspects, weighs its various impacts, and makes a decision." (84)

The balance of economic, environmental and social interests in this case is against project approval. The environmental costs are too great. Scientific evidence indicates that significant intensification of marine transportation and transport of heavy hydrocarbons through the Great Bear region poses severe ecological risks. The increase in oil tanker traffic along the northern British Columbia coast jeopardizes marine health, and the pipeline construction and operation would jeopardize the region's wild salmon producing rivers. This submission has pointed out numerous deficiencies in the assessment of environment impacts, underestimations of environmental risks, and over confidence in proposed untested mitigation measures.

The economic case for approval has not been established. These ecological risks threaten human well-being by putting at risk important food sources, jobs and the economy, cultural heritage, and spiritual values. The costs of an oil spill are long-lasting, and affect overall societal well-being.

The social impacts are too great. Overwhelmingly, local communities who would bear the brunt of any environmental and economic harm have rejected the project. First Nations whose traditional territory would be affected attest that the project does not fit their vision of sustainable development. WWF-Canada believes that recent legal changes have undermined the public's confidence in this regulatory approval process. The rules of this Panel changed halfway through the process with a new set of laws passed by Parliament this past spring. WWF-Canada asks the Panel to report to the public how the legal changes in the March 2012 "Jobs, Growth and Long-term Prosperity Act", have affected its carrying out of its' duties. The project and proponent's application were based on a regulatory regime and federal infrastructure, monitoring programs, and budgets that no longer exist. Changing the rules halfway through a process puts procedural fairness in question, and the use of a budget bill, with a much shorter timeline than regular bills, as well as less transparency, access to information, consultation and participation in the legislative process, negatively affects society's view of the project and the approval process.

WWF believes that the significant environmental, economic and social risks associated with this project outweigh the potential public good that the project may deliver.

These risks extend well beyond the boundaries of the proposed project activity. As noted above, the Great Bear region has been recognized as comprising globally significant marine, terrestrial, and aquatic ecological values, and is one of the last functioning coastal temperate rainforest ecosystems left on Earth. This region is a part

"What occurred in the Great Bear Rainforest is an internationally acclaimed model of sustainability and cooperation made possible through building trust, a commitment to conflict resolution and the transparent application of science and technical information.

It is a uniquely made-in-B.C. approach that reflects our values as British Columbians to balance ecological needs with the social needs of our communities while respecting the views of the international community."

-Ric Slaco, chairman of the Coast Forest Conservation Initiative Society, VP and chief forester, Interfor (129)

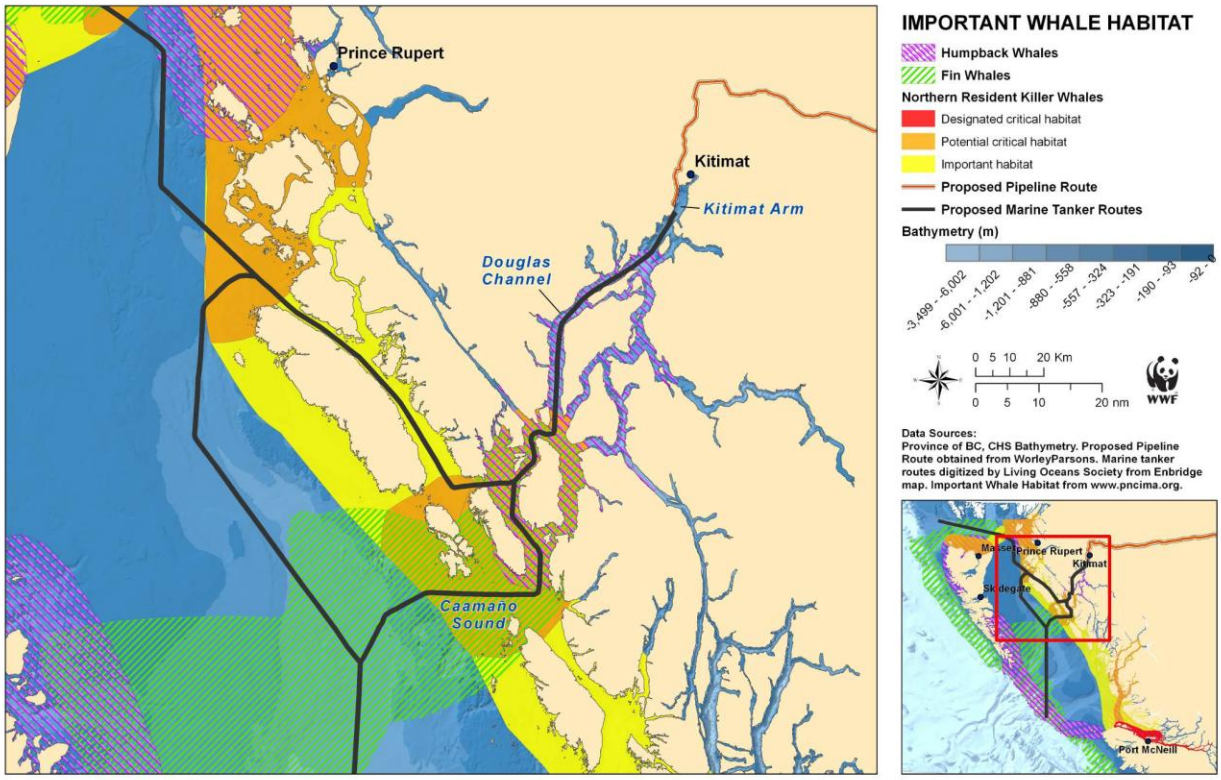
of our worldwide natural heritage, and its future is in Canada's hands. Canada has a responsibility to the world to secure the future of this unique and spectacular place.

WWF's 2012 Living Planet Report demonstrates that the world's biodiversity is under increasing pressure. A particularly important strategy for conserving and enhancing biodiversity – and therefore the natural capital that sustains all human prosperity – is the protection of regions where the human footprint has been the lightest. The Great Bear, one of the richest and most productive ecoregions on Earth, is such a region.

Canadians want to see this area and its remarkable wildlife and ecosystem protected to support the sustainable economy that now exists. This is the message that this Panel has repeatedly heard, through both intervenor evidence such as that noted in this submission, and through exhaustive testimony from Canadians living along the route.

For all the reasons contained in this statement, WWF-Canada urges the Panel to recommend against the project as it is not in the public interest.

APPENDIX 1: IMPORTANT WHALE HABITAT IN RELATION TO PROPOSED TANKER ROUTE



APPENDIX 2: VALUE OF OCEAN-BASED INDUSTRIES IN THE NORTH COAST REGION: EXECUTIVE SUMMARY

While the economic benefits of the project have been quantified by the proponents and the potential impacts of an oil spill within the confined channel area (CCA) of the Douglas Channel have been assessed, the potential economic costs of an oil spill in the Open Water Area (OWA) of the proposed shipping routes have not yet been identified. Phase I of this study estimates the value of commercial fishing, ferry traffic, port shipping, local and tourism-based recreational fishing and other marine tourism within the North Coast region. Values are expressed in terms of direct, indirect and induced effects of employment, total output and contribution to gross domestic product. Preliminary analysis suggests that ocean-based industries contribute between 8,405 and 11,423 person years of employment, $1.1 to $1.4 billion (2011 CAD) in total output and $696 to $962 million (2011 CAD) to gross domestic product each year. These estimates will form the basis for computing the potential impact of an oil tanker spill within the OWA during Phase II of the project.

It is important to assess the potential economic cost of an oil spill now so the results can be included in the debate about potential costs and benefits of project implementation. These costs include social, environmental, and economic externalities of the project that would be incurred by communities along the North Coast. In order to adequately assess the benefits and costs of an oil spill, it is critical to estimate these externalities.

Phase I of this study analyzes the value of ocean-based industries (i.e., commercial fishing, ferry traffic, port shipping, local and tourism-based recreational fishing and other marine tourism) within the North Coast region; Phase II will assess the potential impacts of an oil tanker spill within the OWA of the proposed Northern Gateway oil tanker shipping routes. Values are expressed in terms of direct, indirect and induced contributions of ocean-based industries to employment, economic output and gross domestic product (GDP). The scope includes economic activity that is generated within the region, undertaken by local residents as well as visitors and economic activity in other jurisdictions that result from ocean-related activities within the North Coast region. Values identified during Phase I will be used to assess the potential economic impacts of an oil tanker spill during Phase II. The potential impact of an oil tanker spill will be estimated based on assumed (i) durations of marine area closures; and (ii) species recovery times. Regional economic benefits will be calculated using projected employment provided by Northern Gateway Pipelines LLP to the National Energy Board (NEB) in project Application documents, available on the Public Registry.

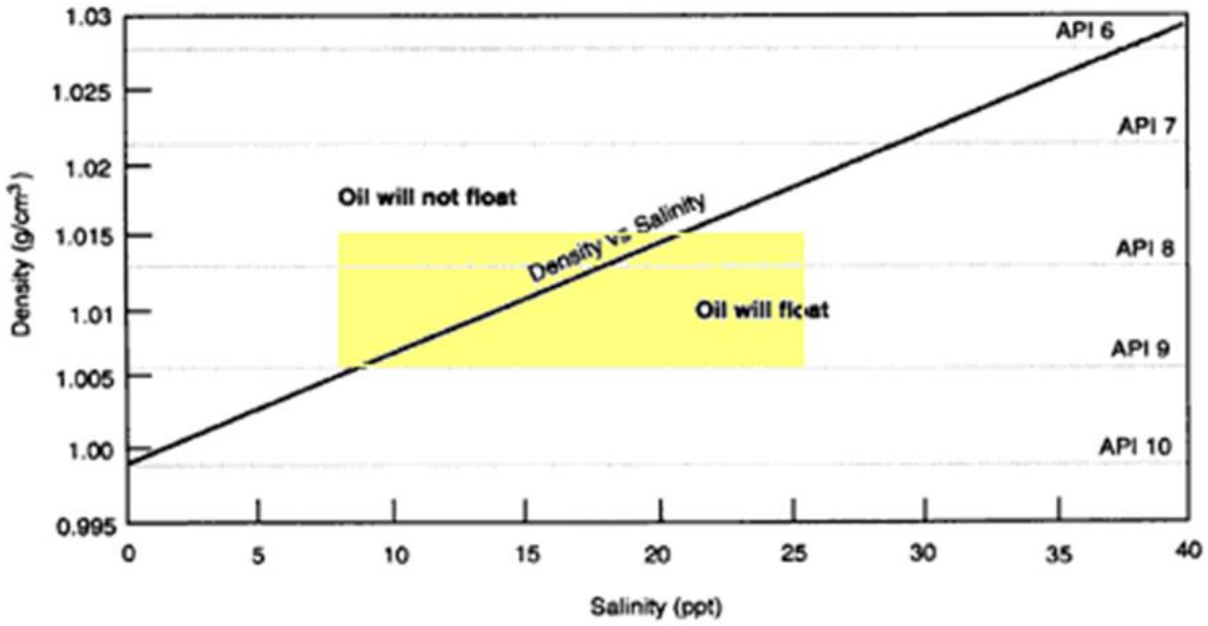
See appended full Draft of report.

APPENDIX 3: ALBERTA BITUMEN IS A NON-FLOATING OIL

Alberta bitumen is what is known as a non-floating oil *(19)*. The practical implications of this fact are so fundamental to understanding how bitumen might behave in the near-shore marine environment of coastal British Columbia that a brief excursion into technical language is warranted.

The relative densities of petroleum liquids and fresh water are measured on a scale devised by the American Petroleum Institute (API). Most forms of petroleum have an API gravity between 10 and 70 degrees. Petroleums with an API gravity below 10 degrees – the API gravity of fresh water – are described as extra heavy oil, group V oil or bitumen. Bitumens from Alberta's oil sands have API gravities ranging from 7.7 to 9 degrees (85). They sink in freshwater, as we saw in the case of Enbridge's spill into Michigan's Kalamazoo River, because they are denser than water. Alberta bitumen could float on seawater, which at 35 ppt[42] has an API gravity of 7. But this result will have little bearing on the potential behaviour of bitumen in coastal British Columbia for two reasons: first, the surface waters are significantly less saline than offshore seawater and second, minor differences in the relative densities of hydrocarbons and receiving waters will be overwhelmed by the physical process of surface mixing.

The relationship between density, salinity and API gravity is depicted in this figure adapted from the National Research Council Committee on Marine Transportation of Heavy Oils[43]:



The diagonal line represents the condition where the density of the hydrocarbon is equivalent to the density of the receiving water. If the ratio of the density of oil to the density of the receiving water is greater than 1.0, the oil will not float. If it is less than 1.0, the oil will initially float. However, if the density ratio is close to 1.0 – within a couple of percentages - the oil is very likely to become submerged by wave action[44].

---

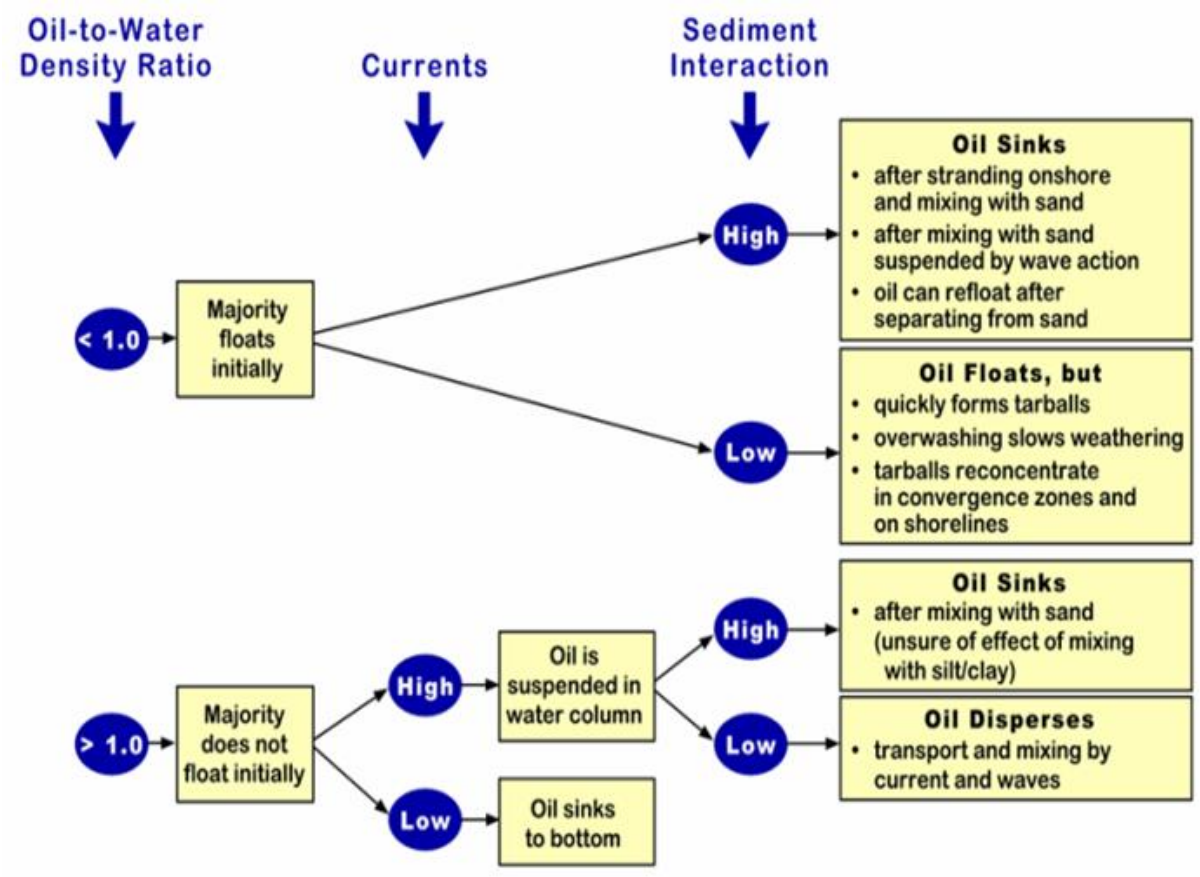
42 Parts per thousand (salinity)
43 Op cit. (19), p 21.
44 Op cit. (19), p 20.

The zone depicted by the coloured box is defined by the 7.7-9 degree range of API gravities of Alberta bitumen and the 8-26 ppt range of surface water salinities found in Douglas channel (86). Alberta bitumen spans the boundary between sinking and initial floating oil, within a couple of percentages of the receiving water densities – precisely the conditions under which floating oils are likely to be overwashed and become entrained in the water column (87), (88).

According to evidence submitted on behalf of Northern Gateway, the density of Mackay River Bitumen would reach roughly 1.01 g/cm3 10-24 hours after a dilbit spill (89)[45]. A hydrocarbon of this density could sink or become entrained in the water column in the lower salinity surface water of Douglas Channel.

The Potential Consequences of Non-Floating Oils Such as Bitumen Are Distinct from those of Floating Oils Such as Synthetic Crude

Spills of non-floating oils such as bitumen behave differently than spills of floating oils such as synthetic crude oil[46]. The model below, developed by the National Research Council's Committee on Marine Transportation of Heavy Oils, explains how heavy oils, including those that initially float, may sink or become suspended in the water column, depending on such environmental parameters a current and sediment interaction.



Adapted from: Lehmann, 2006 (90)

45 Op Cit (89) Fig4-23; 4-10 Oil of Emulsion Density (Winter and Fall Terminal Scenario) pp 4-16; 4-10.
46 Op cit. (19), pp 4,5.

The environmental consequences of non-floating oil spills are distinct from those of the more familiar floating oil spills, affecting primarily resources in the water column and the benthos. Additionally, overwashed tar balls may travel undetected for weeks and hundreds of kilometres before stranding on distant shores (19).

Northern Gateway's modeling of mass balances of hydrocarbons (20) includes one reference to sinking in Kitimat harbour, but otherwise appears to assume that bitumen will float. For example:

> *Dispersion of hydrocarbon droplets in the water column. Following the entrainment within the water column, small hydrocarbon droplets might remain submerged for a certain period of time, whereas larger hydrocarbon droplets would quickly resurface.*[47]

The implied assumption - that the hydrocarbons will be less dense than surface water – is simply not correct over much of the range of salinity values found in Douglas Channel. It explains why so little of the bitumen in the simulations becomes submerged. Droplets too large to remain in suspension may not resurface, as Northern Gateway's mass balance simulations assume. Similarly, Northern Gateway assumes that the hydrocarbon density must exceed that of seawater in order to sink:

> *Sinking of the surface oil. As the hydrocarbons in the surface oil weather, its [sic] density increases. If the density of the surface oil exceeds that of seawater, the surface oil is assumed to form globules that would sink to the subtidal sediment*[48].

Yet, as described above, density ratios indicative of sinking and submersion occur at much lower densities than that of seawater (1.025 g/cm3) in coastal inlet surface waters. Northern Gateway appears to have overlooked important heavy oil spill behaviours in its mass balance simulations. In so doing, they may have underestimated the potential for damage to resources in the water column and benthos, and the long range transport of submerged oil, which places a broader geography at risk.

The prospects for tracking and recovering non-floating oil from the environment are worse that the recovery rates achieved for floating oil spills (19), (91): "Although many technologies are available for containing and recovering subsurface oil, few are effective, and most work only in very limited environmental conditions."[49]

Recovery efforts may not be feasible due to the expense, marginal effectiveness and safety considerations:

> *A primary conclusion of this evaluation is that practical opportunities for dealing with submerged oil are few. Only in situations where the submerged or sunken oil can be accurately located or tracked and where recovery is a safe and practical operation is there a realistic expectation of recovery. Typically this situation can occur in shallow, sheltered waters where the oil is relatively stationary. In most other circumstances, it is not realistic to expect responders to contain or recover submerged or sunken oils.*[50]

In summary, significant consequences of potential bitumen spills associated with the Northern Gateway project have been overlooked in the assessment. The JRP should acknowledge that those consequences

---

47 Op cit. (20) p. 11-6
48 Op cit. (20) p. 11-7
49 Op cit. (19) p. 5
50 Op cit. (91)

could include damage to resources in the water column and benthos and the long distance transport of submerged tarballs.

Appendix 4: Project-Related Threats Identified in COSEWIC Assessments

Species	**Project-related threats identified in COSEWIC Assessments:** **All referenced in original COSEWIC Status Reports** (92)
Northern Goshawk	Breeding habitat loss or fragmentation, and its effect on prey availability and nesting habitat is the single most significant threat to the long-term viability of Northern Goshawk
Ancient Murrelet	Ancient Murrelets have been heavily impacted by spills in other regions because spills are a particular threat to species that congregate in one area. This might also increase what is a continual threat to these birds –small, low-level spills from ships moving through the region.
Pink-footed Shearwaters	Fouling of Pink-footed Shearwaters by petroleum products also represents a significant potential threat in many parts of the species' marine range, including the United States and Canada. … On the basis of the Pink-footed Shearwater's continental shelf distribution, and their tendency to investigate all vessels the potential therefore exists for fouling through either accidental of deliberate releases of petroleum products from offshore platforms, ships of terrestrial sources. As previously mentioned, oil pollution also has the potential to seriously impact the species' foraging habitats and/or prey within Canadian waters.
Basking Sharks	Human-induced mortality in Pacific Canadian waters is primarily from continued interactions with fishing gears as well as collisions with vessels (although there are only anecdotal records to verify this.)
Green Sturgeon	The long life span and late age of maturity make sturgeon make vulnerable to chronic and acute effects of bioaccumulation.
White Sturgeon	A fish contaminant survey of the Columbia River Basin between 1996 to1998 found white sturgeon to have the greatest contaminant concentration compared to all other species tested….
Lake Sturgeon	Threats to the lake sturgeon include overexploitation, dams, habitat degradation, contaminants, and introduced species.
Northern Fur Seal	Oil affects the insulative properties of Northern Fur Seal fur. … The routine discharge of oil, a chronic problem for seabirds, probably also affects Northern Fur Seals but fur seals may occur to far offshore for oiled carcasses to wash ashore.
Sea Otters	Oil is a significant threat to sea otters. It destroys the water-repellent nature of the pelage which eliminates the air layer, and reduces insulation by 70%. The result is hypothermia and death (Costa and Kooyman 1982; Williams *et al.* 1988). Once fouled, a sea otter grooms itself obsessively and stops feeding, resting and caring for young (Ralls and Siniff 1990). Furthermore as it grooms, the otter ingests oil and inhales toxic fumes which damages internal organs. Methods for cleaning and rehabilitating sea otters exist, but they are costly and the benefits at a population level are questionable (Estes 1991; Williams and Davis 1995). Several behavioural characteristics predispose sea otters to oil exposure. Sea otters typically rest in sexually-segregated aggregations (rafts) of up to 200 animals, meaning that large numbers of otters can be oiled simultaneously. In addition, rafts of otters often form in or near kelp beds, which accumulate and retain oil (Ralls and Siniff 1990). Finally, otters may be chronically exposed to oil through ingestion of contaminated prey (e.g. mussels) long after the spill has occurred (Bodkin *et al.* 2002).
Harbour Porpoises	Harbour porpoise appear to be easily disturbed by vessels as well as other sources of high-amplitude underwater sounds, such as acoustic deterrent devices associated with finfish aquaculture operations (Nichol and Sowden 1995).

Right Whales	Right whales are thought to use sound for communication, navigation, attracting mates, or detection of predators and prey (Clark 1994, McDonald and Moore 2002). Sources of ambient noise from human activity include seismic testing for oil and gas exploration, active sonar and explosives testing by the military, underwater noisemakers to deter marine mammals from fishing nets and fish pens, marine experiments that involve the use of loud sounds, and increasing levels of noise from everyday boat and ship traffic (Anonymous 2000). Man-made noise could potentially interfere with acoustic communication, particularly since the major sound energy from shipping overlaps the lower frequencies of right whale signals (Richardson *et al*. 1995, Kenney 2001). It is possible that high levels of ambient noise in the ocean could lead to displacement from migration routes or important habitats, disrupt the communication ability of right whales such as mating calls over large distances, perhaps reducing mating opportunities. Such activities should be of concern in Canadian waters, particularly in areas where oil and gas exploration, pipeline construction, high levels of marine traffic and military exercises are conducted or proposed.
Killer Whales	Awareness that underwater noise may be a significant threat to Killer Whales and other marine life has increased since COSEWIC last assessed Killer Whales (NRC 2003; Southall*et al.* 2007). Underwater noise can interfere with the ability of marine mammals to detect prey, communicate, and acquire information about their environment. It can also disrupt natural behaviour such as foraging (e.g., by displacing prey), impair hearing, and even cause physiological damage (NRC 2003). Measuring responses to acoustic disturbance is a challenge because reactions may be subtle or difficult to interpret, and animals may not show an obvious behavioural response yet still be affected (e.g.Todd *et al.* 1996). Vessel traffic is the primary source of chronic noise for Killer Whales. Vessel noise covers a broad band of frequencies and is the dominant source of ambient noise in the 0–200 Hz range (NRC 2003). The consequences of chronic noise for Killer Whales have not been assessed. As the focus of commercial whale–watching activities, Resident Killer Whales are exposed to vessel noise more than Transient or Offshore Killer Whales. In the Southern Resident population, increasing vessel noise caused the whales to increase the duration of their calls (Foote *et al.* 2004). Vessel noise may be more of a concern for Transient Killer Whales. They vocalize less frequently than Residents (Deecke *et al.* 2005) and chronic noise may mask cryptic calls used to communicate. Transients primarily detect their prey by listening for sounds produced by prey animals as they swim or vocalize, and increased noise likely reduces Transient foraging efficiency by masking such sounds (Barrett–Lennard *et al.* 1996). Killer Whales show little or no tendency to avoid oil spills, as demonstrated by a diesel fuel spill in August 2007 in an area designated as Critical Habitat in Johnstone Strait (CBC 2007) and by the *Exxon Valdez* crude oil spill in Prince William Sound, Alaska, in 1989 (Matkin *et al.* 2008). During the *Exxon Valdez* spill the Resident 'AB' pod was seen swimming in oil slicks immediately following the spill. This group experienced significant and unprecedented mortality (up to 18 times expected) in the months following oil exposure. Deaths were most likely due to the inhalation of petroleum vapours (Matkin *et al.* 2008). Mortality continued in the following year because mothers died leaving orphaned calves that subsequently died. Mortality in Transients in the AT1 population, which inhabits Prince William Sound, did not occur immediately, but 9 of the 22 whales in that population disappeared the following winter. They may have died from the protracted effects of inhaling toxic vapours or from feeding on heavily oiled Harbour Seals. Neither group ('AB' pod nor the AT1 population) has recovered since the 1989 spill (Matkin *et al.*2008) At least eight Killer Whales are known or suspected to have been struck by vessels off the Canadian west coast, judging by observed incidents, scarring or recovery of carcasses. Six of these strikes have occurred since 2002. The types of vessels involved range from small high–speed skiffs (6–8 m length) to 20m tug boats (CRP–DFO unpublished data). The risk of collisions may be increasing for Killer

	Whales with the increase in vessel traffic in areas frequented by them.
Humpback Whales	Threats to individual Humpback Whales in Canadian Pacific waters include vessel strikes, entanglement, and disturbance or displacement (usually temporary) due to underwater noise. Threats that are less regular or less well documented include toxic spills, persistent bioaccumulating toxins, biotoxins, and physical displacement (generally at least quasi-permanent as a result of habitat alteration). Cumulative effects of all of these factors could be important (Whitehead *et al*. 2000).
Caribou	Access and disturbance, fragmentation (isolation), and low caribou numbers are of high concern (Table 7) and all are increasingly a result of development and human activities rather than natural causes.
Cryptic Paw	Forest harvesting has resulted in two documented extirpations, and is very likely responsible for many more; it is a serious threat to this species.
Tailed Frogs	Large-scale habitat disturbance, loss and fragmentation through road-building and clear-cut logging are detrimental to the species. Survival to the adult stage appears to be low in second-growth forests which are predominant in its range.
Tiger Salamander	Major threats to the Tiger Salamander include loss of upland habitat due to encroachment and roads, and loss of breeding habitat due to fish stocking, chemical runoff, and draining of wetlands.
Sprague's Pipits	Although the rate of loss has slowed (Statistics Canada 1997), unprotected grasslands continue to be lost to cultivation, residential acreages, urban encroachment, and energy sector development (CPPF 2004).

See also appended summary list of species of conservation concern.

Appendix 5: Review of documents associated with assessing environmental impacts of underwater noise from the proposed Enbridge Northern Gateway project.

See appended full document.

REFERENCES

1. **WWF-Canada.** Canada's Great Bear Region Map. *WWF-Canada.* [Online] 2011. http://assets.wwfca.panda.org.wwf-web-1.bluegecko.net/img/original/great_bear_map.jpg.

2. **Okey, Thomas A, et al.** *Climate Change Impacts and Vulnerabilities in Canada's Pacific Marine Ecosystems.* Vancouver, BC : CPAWS BC and WWF-Canada, 2012.

3. *Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific waters as a case study.* **Ban, N C, Alidina, Hussein M and Ardron, J A.** s.l. : Marine Policy, 2010, Vol. 34.

4. *Summary Report: Ocean Noise in Canada's Pacific Workshop.* **Heise, Kathy and Alidina, Hussein M.** Vancouver : WWF-Canada, 2012.

5. **WWF Canada.** Canada's Great Bear Rainforest a "gift" to the Earth. *WWF Canada.* [Online] 2007. http://www.wwf.ca/newsroom/?1334.

6. *Fragmentation and Flow Regulation of the World's Large River Systems.* **Nilsson, et. al.** s.l. : Science, 2005, Vol. 15.

7. **Biodiversity Indicators Partnership.** Biodiversity Indicators Partnership. [Online] 2010. http://www.bipnational.net/.

8. **North American Marine Protected Areas Network.** CEC Knowledge Network. *North American Marine Protected Areas Network.* [Online] 2011. http://www2.cec.org/nampan/pcas.

9. **Fisheries and Oceans.** *Pacific Region Cold-Water Coral and Sponge Conservation Strategy 2010-2015.* Vancouver : Fisheries and Oceans Canada, 2010.

10. **COSEWIC.** *COSEWIC assessment and update status report on the sea otter (Enhydra lutris) in Canada.* Ottawa : COSEWIC, 2007.

11. **Gregr, E J, et al.** *Recovery Strategy for Blue, Fin, and Sei Whales (Balaenoptera musculus, B. physalus, and B. borealis) in Pacific Canadian Waters 2006-2011 In Species at Risk Act Recovery Strategy Series.* Vancouver : Fisheries and Oceans Canada, 2006.

12. **Fisheries and Oceans Canada.** *Recovery Strategy for the Northern and Southern Resident Killer Whales.* Ottawa : Fisheries and Oceans Canada, 2011.

13. **North Coast Cetacean Society.** *Humpback Whale - Written Evidence Submission to the Joint Review Panel Assessing the Northern Gateway Pipeline Application (Vol. 1).* 2011.

14. —. *Humpback Whale - Written Evidence Submission to the Joint Review Panel Assessing the Northern Gateway Pipeline Application (Vol. 2).* 2011.

15. —. *Humpback Whale - Written Evidence Submission to the Joint Review Panel Assessing the Northern Gateway Pipeline Application (Vol. 3).* 2011.

16. **Sea Otter Recovery Team.** *Recovery Strategy for the Sea Otter (Enhydra lutris) in Canada. Species at Risk Recovery Strategy Series.* Vancouver : Fisheries and Oceans Canada, 2007.

17. *Modelling ship strike risk to fin, humpback and killer whales in British Columbia, Canada.* **Williams, R and O'Hara, P.** 1, s.l. : Journal of Cetacean Research and Mangement, 2009, Vol. 11.

18. **Hotte, Ngaio and Sumaila, Rashid.** *Phase I Report: Values of ocean-based industries in the North Coast Region, British Columbia.* Vancouver : WWF-Canada, 2012.

19. **National Research Council, Marine Board Committee on Marine Transportation of Heavy Oils.** Spills of Nonfloating Oils. [Online] 1999. http://www.nap.edu/openbook.php?isbn=0309065909.

20. **Enbridge Northern Gateway Pipelines.** *General Oil Spill Response Plan.* s.l. : Enbridge Northern Gateway Pipelines, 2011.

21. **Oil Spill Commission.** National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. *Oil Spill Commission.* [Online] [Cited: 08 05, 2012.] www.oilspillcommission.gov.

22. **Powell, R D and Burkhart, D.** WWF Comments on the Response Gap Study Submitted to the National Energy Board. *WWF Canada.* [Online] 2010. http://awsassets.wwf.ca/downloads/wwf_canada___letter_of_comment___sl_ross_spill_response_gap_study_for_the_canadian_be.pdf.

23. **National Oceanic and Atmospheric Administration (NOAA).** *Oil Spill Case Histories, 1967-1991. .* Seattle, WA. : NOAA Hazardous Materials Response and Assessment Division, 1992.

24. **Living Oceans Society.** *Written Evidence of Living Oceans Society.* Vancouver : Living Oceans Society, 2011.

25. **Nuka Research and Planning Group, LLC.** *Preliminary Analysis and Observations regarding Enbridge Northern Gateway Project Proposal Documents - Oil Spill Contingency Planning.* s.l. : Prepared for Haisla Nation Council, 2011.

26. **Enbridge Northern Gateway Project Joint Review Panel.** Information Request No. 11 to Northern Gateway. *National Energy Board.* [Online] [Cited: 08 21, 2012.] https://www.neb-one.gc.ca/LL-ENG/LIVELINK.EXE/FETCH/2000/90464/90552/384192/620327/624909/843281/PANEL-COMMISSION_-_LETTER_AND_INFORMATION_REQUEST_NO._11_TO_NORTHERN_GATEWAY_-_A2X0H6?NODEID=843282&VERNUM=0&redirect=3.

27. **Transport Canada.** *TERMPOL Review Process Report on the Enbridge Northern Gateway Project.* s.l. : Transport Canada, 2012.

28. **National Transportation Safety Board.** *Control Room and Supervisory Control and Data Acquisition (SCADA) Group Chairman Factual Report.* 2012.

29. **Canadian Press.** DFO review of Northern Gateway will come too late, critics warn. *Maclean's.* [Online] 09 19, 2012. [Cited: 09 19, 2012.] http://www2.macleans.ca/2012/08/19/dfo-review-of-northern-gateway-will-come-too-late-critics-warn/.

30. **Enbridge Northern Gateway Project Joint Review Panel.** Application for the Enbridge Northern Gateway Pipeline Project. *National Energy Board Site.* [Online] 2012. https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624909/843281/Panel-Commission_-_Letter_and_Information_Request_No._11_to_Northern_Gateway_-_A2X0H6?nodeid=843282&vernum=0.

31. **United Nations.** Convention on Biological Diversity. *Convention on Biological Diversity.* [Online] 1992. http://www.cbd.int/doc/legal/cbd-en.pdf.

32. **Department of Justice.** Canadian Envrionmental Assessent Act, 2012 (S.C. 2012, c.19, s. 52). *Department of Justice.* [Online] 2012. [Cited: 08 21, 2012.] http://laws-lois.justice.gc.ca/eng/acts/C-15.21/page-2.html.

33. **BC Nature and Nature Canada.** *In the Matter of the Enbridge Northern Gateway Project Joint Review Panel: Written Evidence on the Intervenors BC Nature and Nature Canada.* 2010.

34. **Enbridge Northern Gateway Pipelines.** *Northern Gateway Response to Gitxaala Nation IR No. 1.* NEB File OF-Fac-Oil-N304-2010-01.

35. **Department of Justice Canada.** Information Request No.1 to Northern Gateway. *National Energy Board.* [Online] 2011. [Cited: 07 12, 2012.] https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624911/718030/710118/E9-2-1_-_Government_of_Canada_-_Letter_and_Information_Request_No_1_to_Northern_Gateway_-_A2C4I8.pdf?nodeid=710006&vernum=0&redirect=3.

36. **Canadian Coast Guard.** Tanker Exclusion Zone. *Canadian Coast Guard.* [Online] [Cited: 08 21, 2012.] http://www.ccg-gcc.gc.ca/E0003909.

37. **Thompson, Andrew.** *West Coast Oil Ports Inquiry: Statement of Proceedings.* s.l. : Government of Canada, 1978.

38. **Environment Canada.** Oil water and Chocolate Mousse. *Environment Canada.* [Online] [Cited: 08 18, 2012.] http://www.ec.gc.ca/ee-ue/default.asp?lang=En&n=7C882684-1&offset=3&toc=show.

39. **NOAA / Coastal Response Research Center.** *The Future of Dispersant Use in Oil Spill Response Initiative.* s.l. : NOAA, 2012.

40. **Lindgren, Charlotte, Lager, Helene and Fejes, Jonas.** *Oil spill dispersants: Risk assessment for Swedish waters: Report commissioned for the Swedish Environmental Protection AGency.* Stokholm : s.n., 2001.

41. *Interactive and cumulative effects of multiple human stressors in marine systems.* **Crain, C M, Kroeker, K and Halpern, B S.** s.l. : Ecology Letters, 2008, Vol. 11.

42. *How wild is the ocean? Assessing the intensity of anthropogenic activities in British Columbia, Canada.* **Ban, N and Alder, J.** 1, s.l. : Aquatic Conservation: Marine and Freshwater Ecosystems, 2008, Vol. 18.

43. *Overview of the impacts of anthropogenic underwater sound in the marine environment.* **Götz, T and others, and 8.** London : OSPAR Commission, 2009.

44. *Scientific synthesis on the impacts of underwater noise on marine and coastal biodiversity and habitats.* **Convention on Biological Diversity.** 2012.

45. *The impacts of anthropogenic ocean noise on cetaceans and implications for management.* **Weilgart, L S.** 11, s.l. : Canadian Journal of Zoology, 2007, Vol. 85. doi:10.1139/Z07-101.

46. *A push for quieter ships.* **Malakoff, D.** 5985, s.l. : Science, 2010, Vol. 328. doi:10.1126/science.328.5985.1502.

47. *Acoustic masking in marine ecosystems: intuitions, analysis, and implication.* **Clark, C W, et al.** s.l. : Marine Ecology Orogress SEries, 2009, Vol. 395. doi:10.3354/meps08402.

48. *Quantifying Loss of Acoustic Communication Space for Right Whales in and around a U.S. National Marine Snctuary.* **Hatch, L T, et al.** 12, s.l. : Conservation Biology, 2012, Vol. 1. doi:10.1111/j.1523-1739.2012.01908.x.

49. **McCauley, R.** *Review of documents associated with assessing environmental impacts of undewater noise from the porposed Enbridge Northern Gateway project. Prepared for the World Wildlife Fund Canada.* 2012.

50. **Fisheries and Oceans Canada.** *Management Plan for the Pacific Harbour Porpoise (Phocoena phocoena) in Canada.* Ottawa : Fisheries and Oceans Canada, 2009.

51. **Enbridge Northern Gateway Pipelines.** *Framework for the Marine Mammal Protection Plan - Reply to JRP IR (Vol. 8).* 2012.

52. **Fischer, R W and Brown, N A.** *Factors affecting the underwater noise of commercial vessels operating in environmentally sensitive areas. .* s.l. : OCEANS 2005 Proceedings of MTS/IEEE 3: 1982-1988., 2005.

53. *Underwater radiated noise from modern commercial ships.* **McKenna, M F, et al.** 1 (92-103), s.l. : Journal of the Acoustical Society of America, 2012, Vol. 131. doi:10.1121/1.3664100.

54. **Erbe, C, MacGillivray, A and Williams, R.** *Mapping Ocean Noise: Modelling Cumulative Acoustic Energy from Shipping in British Columbia to Inform Marine Spatial Planning. Report Submitted to WWF Canada by Curtin University, Australia.* 2012.

55. **Erbe, C, Duncan, A and Koessler, M.** *Modelling noise exposure statistics from current and projected shipping activity in northern British Columbia. Report Submitted to WWF Canada by Curtin University, Australia.* 2012.

56. **AMEC Earth & Envrionmental.** *Technical Data Report: Acoustic Environment Enbridge Northern Gateway Project.* 2010.

57. *Sounds from Bryde's Balaenoptera edeni, and finback, B. physalus, whales in the Gulf of California.* **Cummings, W C, Thompson, P O and Ha, S J.** pp 359-70., s.l. : Fisheries Bulletin, 1986, Vol. 84.

58. *Characteristics of finback Balaenoptera physalus vocalizations in the St. Lawrence Estuary.* **Edds, P L.** s.l. : Bioacoustics, 1988, Vols. 1: 131-49.

59. *Blue (Balaenoptera musculus) and fin (B.physalus) whale vocalisations measured from northern latitudes of the Atlantic Ocean.* **Boisseau, O, et al.** 1:23-30, s.l. : Journal of Cetacean Research and Management, 2008, Vol. 10.

60. *Evidence that ship noise increases stress in right whales.* **Rolland, R, Parks, S and Hunt, K.** s.l. : Proceedings of the Royal Society B, Early online eidition, 2012. doi:10.1098/rspb.2011.2429.

61. **Chorney, N, Warner, G and Austin, M.** *Technical Data Report: MArine Acoustics Modelling Study 2010 Enbridge Northern Gateway Project.* Victoria, BC : Jasco Applied Sciences, 2010.

62. *Collisions between ships and whales.* **Laist, D W, et al.** January, s.l. : Marine Mammal Science, 2001, Vol. 17.

63. **Van Waerebeek, K and Leaper, R.** *Second Report on the IWC Vessel Strike Data Standardisation Working Group.* s.l. : IWC unpubl. report, 2008.

64. **Jensen, A S and Silber, G K.** *Large Whale Ship Strike Database. NOAA Technical memorandum.* s.l. : NOAA, 2004.

65. *Demography of the endangered North Atlantic right whale.* **Fujiwara, M and Caswell, H.** 6863, s.l. : Nature, 2001, Vol. 414. doi:10.1038/35107054.

66. **Fisheries and Oceans Canada and Canadian Coast Guard.** *Enbridge Northern Gateway Project Joint Review Panel - Fisheries and Oceans Canada:Response to the Joint Review Panel's Information Request No. 1 to Fisheries and Oceans Canada s.* 2012.

67. **Bacante, N.** *Preliminary report on fish mortalities in the Pine River, near Chetwynd, BC, following an oil spill from Pembina's pipeline on August 1, 2000.* s.l. : MELP internal fisheries report, 2000.

68. **Department of Justice.** Fisheries Act (R.S.C., 1985, c. F-14). *Department of Justice.* [Online] 2012. [Cited: 08 08, 2012.] http://laws-lois.justice.gc.ca/eng/acts/F-14/.

69. **Government of Canada.** *Bill C-38, An Act to Implement Certain Provisions of the Budget Tabled in Parliament on March 29, 2012 and Other Measures, 1st SEssion, 41st Parl. 2012, CL 142(2).* Ottawa : Government of Canada, 2012.

70. **Office of the Auditor General of Canada.** December 2011 Report of the Auditor General: Commissioner of the Environment and Sustainable Development's Opening Statement. *Office of the Auditor General of Canada.* [Online] 2011. [Cited: 08 21, 2012.] http://www.oag-bvg.gc.ca/internet/English/osm_20111213_e_36076.html.

71. —. *Report of the Commissioner of the Environment and Sustainable Development.* s.l. : Government of Canada, 2011.

72. —. *2010 Fall Report of the Commissioner of the Environment and Sustainable Development: Chapter 1 - Oil Spills from Ships.* 2010.

73. —. *2011 October Report of the Commissioner of the Environment and Sustainable Development: Chapter 2 - Assesing Cumulative Environmental Effects of Oil Sands Projects.* 2011.

74. **Nimonik.ca.** *Environmental Fines in Canada 1990-2009.* s.l. : Nimonik.ca, 2010.

75. **National Wildlife Federation.** *Importing Disaster: The Anatomy of Enbridge's Once and Future Oil Spills.* s.l. : National Wildlife Federation, 2012.

76. **McGowan, Elizabeth and Song, Lisa.** The Dilbit Disaster: Inside the Biggest Oil Spill You've Never Heard Of. *Inside Climate News.* [Online] 2012. http://insideclimatenews.org/news/20120626/dilbit-diluted-bitumen-enbridge-kalamazoo-river-marshall-michigan-oil-spill-6b-pipeline-epa.

77. **Girard, Richard and Davis, Tanya Roberts.** *Out on the Tar Sands Mainline.* s.l. : Polaris Institute, 2012.

78. **American Cancer Society.** Carcinogens/IntheWorkplace/benzene. *American Cancer Society.* [Online] 2012. http://www.cancer.org/Cancer/CancerCauses/OtherCarcinogens/IntheWorkplace/benzene.

79. **National Transportation Safety Board.** *Enbridge Incorporated Hazardous Liquid Pipeline Rupture and Release, Marshal Michigan, July 25, 2010, Pipeline Accident Report.* Washington, D.C. : National Transportation Safety Board, 2012.

80. **Zickfeld, Kirsten.** *Greenhouse gas emission and climate impacts of the Enbridge Nothern Gateway pipeline.* 2011.

81. **Environment Canada.** *National Inventory Report 1990-2009: Greenhouse Gas Sources and Sinks in Canada.* 2011.

82. **International Energy Agency.** Prospect of limiting the global increase in temperature to 2ºC is getting bleaker. *International Energy Agency.* [Online] 05 30, 2011. [Cited: 08 21, 2012.] http://www.iea.org/index_info.asp?id=1959.

83. **Worbits, Barry and Roach, Robert.** *Keeping Pace: Improving Environmental Decision-Making in Canada.* Calgary : Canada West Foundation, 2012.

84. **National Energy Board.** Pipeline Regulation in Canada: A Guide for Landowners and the Public. *National Energy Board.* [Online] [Cited: 07 01, 2012.] http://www.neb-one.gc.ca/CLF-NSI/RTHNB/PBLCPRTCPTN/PPLNRGLTNCND/PPLNRGLTNCND_C01-ENG.HTML#Q1.

85. **Environment Canada.** Oil Properties. *Environment Canada.* [Online] [Cited: 08 12, 2012.] http://www.etc-cte.ec.gc.ca/databases/Oilproperties/pdf/WEB_Athabasca_Bitumen.pdf.

86. **ASL Environmental Sciences.** *Techincal Data Report: Marine Physical Environment, Enbridge Northern Gateway Project.* 2010.

87. **Lee, S C, et al.** *A Study of the Long-Term Weathering of Submerged and Overwashed Oil.* Ottawa : Environment Canada, 1989.

88. **Lee, S C, Shui, W Y and Mackay, D.** *A Study of the Long-Term Fate and Behavior of Heavy Oils.* Ottawa : Environment Canada, 1992.

89. **Ross, S L.** *Techincal Data Report: Properties and Fate of Hydrocarbons Associated wiht Hypothetical Spills at the MArine Terminal and in the Confined Channel Assessment Area.* 2010.

90. **Lehmann, S.** NOAA Presentation to the Submerged Oil Workshop, Coastal Response Research Centre. *Coastal Response Research Centre for Spills in the Environment.* [Online] 2006. [Cited: 08 12, 2012.] http://www.crrc.unh.edu/workshops/submerged_oil/lehman_presentation.pdf.

91. **Owens, E.H.** Oil spill resonse for non-floating oils. *US Environmental Protection Agency Emergency Management.* [Online] [Cited: 08 12, 2012.] http://www.epa.gov/oem/docs/oil/fss/fss00/suboil.pdf.

92. **COSEWIC.** Species at Risk Public Registry: COSEWIC Status Reports. *Species at Risk Public Registry.* [Online] 2012. [Cited: 08 01, 2012.] http://www.sararegistry.gc.ca/search/advSearchResults_e.cfm?stype=doc&docID=18.

93. **Dunstan, Piers K, et al.** *Identifying Ecologically and Biologically Significant Areas on Seamounts: Workshop Report.* Gland, Switzerland : IUCN, 2011.

94. **Broadbent, Sean and Gunton, Thomas.** *A Review of Potential Impacts to Coastal First Nations from an Oil Tanker Spill Assoiated with the orthern Gateway Project, Prepared for Coastal First Nations.* 2012.

95. **WWF.** *Free-flowing rivers: Economic luxury or ecological necessity?* Zeist, Netherlands : WWF-Global Freshwater Programme, 2006.

96. **Clarke, CL and Jamieson, GS.** *Identification of Ecologically and Biologically Significant Areas in the Pacific North Coast Integrated Management Area: Pase 1 - Indetification of important areas. Canadian Technical Report of Fisheries and Aquatic Sciences 2667.* Vancouver : Fisheries and Oceans Canada, 2006.

97. **Lucas, B G, Verrin, S and Brown, R.** *Ecosystem Overview: Pacific North Coast Integrated Mangement Area (PNCIMA) Canadian Technical Report Fisheries and Aquatic Sciences 2667.* Vancouver : Fisheries and Oceans Canada, 2007.

98. **Levy, David.** *Pipelines and Salmon in Northern British Columbia.* s.l. : Pembina Institute et al., 2009.

99. **Fisheries and Oceans Canada.** *Identification of ecologically and biologically significant areas.* s.l. : DFO Canadian Science Advisory Sectretariat Publication, 2004.

100. —. *Canada's Policy for Conservation of Wild Pacific Salmon.* Vancouver : Fisheries and Oceans Canada, 2005.

101. *Biodiversity and rockfish recruitment in sponge gardens and bioherms of southern British Columbia, Canada.* **Marliave, J, et al.** s.l. : Marine Biology, 2009, Vol. 156. DOI 10:1007/s00227-009-1252-8.

102. **Enbridge Northern Gateway Pipelines.** *Volume 6B: Environmental and Socio-Economic Assessment (ESA) - Marine Terminal.* 2010.

103. **Raincoast Conservation Foundation.** *Written Submission of Raincoast Conservation Foundation, Part 2.* 2011.

104. **Brown, J F and Jeo, R M.** International Congress for Conservation Biology 2010 abstracts: SY 19. *Society for Conservation Biology.* [Online] 2010. http://www.conbio.org/images/content_conferences/2010Abstracts.pdf. page 115, Session SY 19.

105. **Bocking, R, et al.** *Review of the Enbridge Northern Gateway Project Submission to the Join Review Panel and Assessment of the Project Effect on Gitga'at Natural Resource Values.* 2011.

106. **Environment Canada.** *Recovery Strategy for the Sea Otter in Canada.* s.l. : Fisheries and Oceans Canada, 2007.

107. —. *Recovery Strategy for the Short-tailed Albatross and Pink-footed Shearwater in Canada.* s.l. : Environment Canada, 2008.

108. **Canadian Council of Ministers of the Environment.** *Potential Models for a One Project-One Environmental Assessment Approach: Discussion Paper for Public Consultation.* s.l. : CCME, 2009.

109. **Oliver, Joe.** An Open Letter from the Honourable Joe Oliver, Minister of Natural Resources, on Canada's commitment to diversify our energy markets and the need to further streamline the regulatory process in order to advance Canada's national economic interest. *Natural Resources Canada.* [Online] 01 09, 2012. [Cited: 08 08, 2012.] http://www.nrcan.gc.ca/media-room/news-release/2012/1/3520.

110. **Coyne, Andrew.** C-38 makes a mockery of the role of Parliament. *The Vancouver Sun.* [Online] 05 1, 2012. [Cited: 08 08, 2012.] HTTP://WWW.VANCOUVERSUN.COM/MAKES+MOCKERY+ROLE+PARLIAMENT/6545111/STORY.HTML#IXZZ1TEJAURZD.

111. **Environment Canada.** News Release: Canada's New Government Signals Investment of $30 Million to Support Sustainable Economy in British Columia's Spirt Bear Rainforest. *Environment Canada: News Releases.* [Online] 01 21, 2007. [Cited: 08 21, 2012.] http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=B629D4BB-B126-491B-847B-C3C42F5F1C69.

112. **Committee on the Status of Endangered Wildlife in Canada.** *COSEWIC Assessment and Status Report on the Humpback Whale (Megaptera novaeangliae) North Pacific Population.* s.l. : COSEWIC, 2011.

113. **Enbridge Northern Gateway Pipelines.** *Volume 1: Overview and General Information: Enbridge Northern Gateway Project Sec. 52 Application.* 2010.

114. **Stanford, Jack A and Whited, Diane C.** *Analysis of Skeena River Tributaries Downstream From the Proposed Enbridge Pipeline.* 2011.

115. **Hagen, John.** *Rainbow Trout of the Sutherland River in the Babine Lake Watershed, British Columbia, and Risks Associated with the Proposed Northern Gateway Pipeline.* 2011.

116. **Bustard, David and Miles, M.** *Potential Effects of an Oil Pipeline Rupture on Reach 2 of Morice River: A Submission to the Joint Review Panel Enbridge Northern Gateway Project.* 2011.

117. **Office of the Auditor General of Canada.** *Report of the Commissioner of the Environment and Sustainable Development to the House of Commons.* 2010.

118. **Environment Canada.** *Written Evidence Submission of Environment Canada.* Ottawa : Environment Canada, 2011.

119. **Enbridge Northern Gateway Pipelines.** *Effects of Dispersants on the Environment - Pepared by Stantec Consulting Ltd.* 2012.

120. **Associated Press.** Energy & Environment. *The Washington Post.* [Online] 08 15, 2012. [Cited: 08 18, 2012.] http://www.washingtonpost.com/national/energy-environment/study-off-mass-coast-says-increasing-underwater-noise-threatening-rare-whale-population/2012/08/15/da3739ce-e743-11e1-9739-eef99c5fb285_story.html.

121. *Incidence of ship strikes of large whales in Washington State.* **Douglas, A B, et al.** 06, s.l. : Journal of the MArine Biological Association of the United Kingdom, 2008, Vol. 88. doi:10.1017/S0025315408000295.

122. **O'Neil, Peter.** Fishereis Act changes introduced amid debate over new law's intent. *The Vancouver Sun.* [Online] 04 26, 2012. [Cited: 08 21, 2012.] http://www.vancouversun.com/Fisheries+changes+introduced+amid+debate+over+intent/6525454/story.html.

123. **Enbridge Northern Gateway Project Joint Review Panel.** *Panel Session Results and Decision: 19 January 2011 Executive Summary.* 2011.

124. **Vanderklippe, Nathan.** Oil giants back Gateway pipe. *The Globe And Mail.* [Online] 01 05, 2012. [Cited: 08 23, 2012.] http://www.theglobeandmail.com/report-on-business/oil-giants-back-gateway-pipe/article2291407/.

125. **NRTEE.** *Reality Check: The State of Climate Progress in Canada.* s.l. : NRTEE, 2012.

126. **COSEWOC.** *Assessment and Update Status Report on the sea otter Enhydra lutris in Canada.* Ottawa : COSEWIC, 2007.

127. *Acoustic and behavioural changes by fin whales (Balaenoptera physalus) in response to shipping and airgun noise.* **Catellote, M, Clark, C W and Lammers, M O.** 1:115-122, s.l. : Biological Conservation, 2012, Vol. 147. doi:10.1016/j.biocon.2011.12.021.

128. **Environment Canada.** Canada's New Government Signals Investment of $30 Million to Support Sustainable Economy in British Columbia's Spirit Bear Rainforest. *Environment Canada: News Release.* [Online] 01 21, 2007. [Cited: 08 21, 2012.] http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=B629D4BB-B126-491B-847B-C3C42F5F1C69.

129. **Slaco, Ric.** Irony in the Great Bear Rainforest: Western portion of Northern Gateway plan travels through an area of unprecedented conservation significance. *The Vancouver Sun.* [Online] 08 23, 2012. [Cited: 08 23, 2012.] http://www.vancouversun.com/Opinion/Op-Ed/Irony%2BGreat%2BBear%2BRainforest/7136854/story.html.

130. **Department of Justice.** Species at Risk Act (S.C. 2002, c.29). *Department of Justice.* [Online] 2002. [Cited: 08 12, 2012.] http://laws-lois.justice.gc.ca/eng/acts/S-15.3/page-1.html.

DRAFT Phase I Report: Values of ocean-based industries in the North Coast Region, British Columbia

Ngaio Hotte and U. Rashid Sumaila, Fisheries Economics Research Unit, UBC Fisheries Centre, Vancouver, BC, V6T 1Z4

Abstract

The Northern Gateway pipeline and tanker route, proposed by Northern Gateway Pipelines Limited Partnership, would transport 525,000 barrels of diluted bitumen per day from Alberta to Kitimat, British Columbia, for shipment via oil tankers. While the economic benefits of the project have been quantified by the proponents and the potential impacts of an oil spill within the confined channel area (CCA) of the Douglas Channel have been assessed, the potential economic costs of an oil spill in the Open Water Area (OWA) of the proposed shipping routes have not yet been identified. Phase I of this study estimates the value of commercial fishing, ferry traffic, port shipping, local and tourism-based recreational fishing and other marine tourism within the North Coast region. Values are expressed in terms of direct, indirect and induced effects of employment, total output and contribution to gross domestic product. Preliminary analysis suggests that ocean-based industries contribute between 8,405 and 11,423 person-years of employment, $1.1 to $1.4 billion (2011 CAD) in total output and $696 to $962 million (2011 CAD) to gross domestic product each year. These estimates will form the basis for computing the potential impact of an oil tanker spill within the OWA during Phase II of the project.

1. Introduction

The North Coast region of British Columbia encompasses coastal and inland areas and is bordered to the west by the Pacific Ocean and to the east by the Nechako region. The regional population of 56,145[1] is distributed between the Skeena-Queen Charlotte and Kitimat-Stikine Regional Districts, and includes the coastal communities of Kitimat (pop. 9,200) and Prince Rupert (pop. 12,900) on the mainland and Haida Gwaii (pop. 6,700), formerly known as the Queen Charlotte Islands. Economic activity is predominantly resource-based,[2] with significant commercial fishing and processing, a growing tourism sector and expanding industrial development.

The economies of coastal and First Nations communities, including Kitamaat Village, Hartley Bay, Metlakatla, Lax Kw'alaams, Skidegate and Old Masset, are directly impacted by ocean-based activities. Inland areas are influenced by the marine environment, particularly through the relationship between freshwater salmon spawning and marine habitat, but are less dependent on the marine environment.

The Northern Gateway pipeline and tanker route, proposed by Northern Gateway Pipelines Limited Partnership (Northern Gateway LLP), would transport 525,000 barrels of diluted bitumen per day from Alberta to Kitimat, British Columbia, for shipment via oil tankers. Oil tankers departing the proposed

terminal at the private Port of Kitimat will navigate a 290-kilometer route through the Douglas Channel before following either a northern route to access Asian markets [3] or a southern route to access trade partners in the USA.[4] The majority of oil tanker traffic is expected to follow the northern route.[5] Condensate will also be shipped to Kitimat along the proposed northern route and transported from Kitimat via pipeline.

Proponents expect the project to stimulate economic growth in northern and First Nations communities along the pipeline route and at the proposed Kitimat shipping terminal. While the economic benefits of the project have been quantified by the proponents,[6] and the potential impacts of an oil spill within the confined channel area (CCA) of the Douglas Channel have been assessed,[7] the potential economic costs of an oil spill in the Open Water Area (OWA) of the proposed shipping routes have not yet been identified. It is important to assess the potential economic cost of an oil spill now so the results can be included in the debate about potential costs and benefits of project implementation. These costs include social, environmental, and economic externalities of the project that would be incurred by communities along the North Coast. In order to adequately assess the benefits and costs of an oil spill, it is critical to estimate these externalities. While some of the potential impacts can be assessed using existing market values, many require non-market valuation methodologies.

Phase I of this study analyzes the value of ocean-based industries (i.e., commercial fishing, ferry traffic, port shipping, local and tourism-based recreational fishing and other marine tourism) within the North Coast region; Phase II will assess the potential impacts of an oil tanker spill within the OWA of the proposed Northern Gateway oil tanker shipping routes. Values are expressed in terms of direct, indirect and induced contributions of ocean-based industries to employment, economic output and gross domestic product (GDP). The scope includes economic activity that is generated within the region, undertaken by local residents as well as visitors and economic activity in other jurisdictions that result from ocean-related activities within the North Coast region. Values identified during Phase I will be used to assess the potential economic impacts of an oil tanker spill during Phase II. The potential impact of an oil tanker spill will be estimated based on assumed (i) durations of marine area closures; and (ii) species recovery times. Regional economic benefits will be calculated using projected employment provided by Northern Gateway Pipelines LLP to the National Energy Board (NEB) in project Application documents, available on the Public Registry.[8]

2. Background

2.1. Commercial fishing

North Coast commercial fisheries include 49 species of salmon (*Oncorynchus* spp.: Chinook, chum, coho, pink and Sockeye salmon), herring (*Clupea* spp.: roe, spawn-on-kelp), rockfish (*Sebastes* spp.), halibut (*Hippoglossus stenoleptis*), sablefish (*Anoplopoma fimbria)*, lingcod (*Ophiodon elongatus*), spiny dogfish (*Squalus acanthias*), arrowtooth flounder (*Atheresthes stomias*), southern rock sole (*Lepidopsetta bilineata*), shellfish (e.g. Dungeness crab, red and green sea urchin, geoduck, sea cucumber, shrimp, prawn) and skates (*Raja* spp.: big, black and longnose). Commercial fishing occurs within DFO Management Areas 1-6 (near shore) and 101-106 and 140 (offshore).

Industries indirectly impacted by the commercial fishing sector include seafood processing, marketing, transportation, wholesale, retail and services. The seafood processing sector in Prince Rupert, in particular, has undergone considerable changes within the past two years. Most recently, the closure of the J.S. McMillan Ltd. processing plant in October 2011, the merger of Ocean Fisheries Ltd. and Canadian Fishing Company Ltd. (Canfisco) in June 2011 and the subsequent closure of the Ocean Fisheries Ltd. processing plant in May 2012 has reduced the volume of seafood processed in the North Coast region and shifted processing activities south, to the Lower Mainland of British Columbia. Because the value of seafood processing is indirectly linked to commercial fish catch within the North Coast region, the value that is generated in other jurisdictions is traced back to the original source (i.e., the North Coast), where the fish are caught.

2.1.1. Aquaculture

DFO (2012) lists six aquaculture license holders in the North Coast region,[9] four of which are developing facilities and do not currently produce a commercial harvest. The two producing facilities are located on Porcher Island, near Prince Rupert, and in Skidegate Inlet, on Haida Gwaii. The Porcher Island facility produces Littleneck clam (*Protothaca staminea*), Manila clam (*Venerupis philippinarum*), Pacific oyster (*Crassostrea gigas*), Western blue mussel (*Mytilus trossulus*), while the Skidegate Inlet facility produces Pacific Oyster (*Crassostrea gigas*) and Pacific scallop (*Patinopecten* sp.). Both facilities are small-scale and employ fewer than 10 full-time staff.

The Haida Nation and Metlakatla Band have invested in development of shellfish aquaculture facilities, with inaugural harvests beginning in 2013 and extending through 2023. The Haida Nation is anticipating initial production of 10 million scallops per year at its site, ramping up to 40 million scallops per year with potential to diversify into geoduck cultivation.[10] Coastal Shellfish Corp., based in Prince Rupert, has partnered with the Metlakatla Band to establish a facility to produce Pacific scallop (*Patinopecten* sp.), Manila clam (*Venerupis philippinarum*), Geoduck clam (*Panopea abrupta*) and Pacific oyster (*Crassostrea gigas*) near Prince Rupert. The Metlakatla Band is also developing sites to produce Pacific Scallop (*Patinopecten* sp.) and Japanese scallop (*Patinopecten yessoensis*) at Stephen's Passage and Wolfe Island.

Due to the small scale nature of aquaculture operations currently producing shellfish on the North Coast, the value of aquaculture has not been included in this study, however, the economic contribution of aquaculture is expected to grow considerably over the coming decades.

2.1.2. Hatchery production

DFO operates a salmon and trout hatchery at the mouth of the Kitimat River, which releases approximately 8.5 million juvenile Chinook, coho, chum, steelhead and cutthroat trout each year.[11] A second hatchery, located at Marie Lake on Graham Island, Haida Gwaii, is operated jointly by DFO and the Old Masset Village Council and targets annual production of 300,000 Chinook and coho smolts.[12] While trout are released into the freshwater environment, a portion of the salmon released from the hatchery is caught by commercial and recreational fishermen in the region. Thus, the value of the Kitimat hatchery is captured in the current study through its effect on commercial fisheries and tourism-based recreational fishing.

2.1.3. Monitoring and enforcement

DFO employs 80 staff in Prince Rupert and ten on Haida Gwaii and the Canadian Coast Guard employs 19 staff at its Prince Rupert location and eight staff on Haida Gwaii.[13,14] The Haida Fisheries Program employs an additional 12 part-time and 25-30 full-time staff.

Research, monitoring and enforcement related to fisheries are indirectly linked to commercial and tourism-based recreational fishing activities. It should be noted that the value of research, monitoring and enforcement is not included in this study.

2.2.FSC fishing

The legal right of First Nations to fish for food, social and ceremonial (FSC) uses was enshrined by the Supreme Court of Canada in 1992.[15] FSC fisheries have priority over commercial and recreational fisheries and are managed jointly by DFO and First Nations in the North Coast region, including the Haisla (Kitamaat Village) and Haida (Old Masset Village Band and Skidegate Band Council) Nations and four of seven bands of the Tsimshian First Nation (Lax Kw'alaams, Metlakatla, Gitxaala and Gitga'at Nation). The traditional territory of the Kitasoo/Xaisxais Band encompasses a portion of the North Coast region, but the community is physically located on the Central Coast.

FSC catch databases are maintained independently by each First Nation and data is shared with DFO, however, this information is highly sensitive to First Nations and DFO recognizes that reported data is of limited accuracy. DFO provides annual FSC salmon catch for sockeye, Chinook, coho, chum and pink salmon and on its website[16] and maintains some records of thirteen additional species including rockfish, sablefish, halibut and lingcod.[17] A detailed assessment of FSC catch is available for only the Gitaga'at Nation (Hartley Bay). This study details average annual catch of 45 species,[18] with listed annual catch for salmon species more than four times greater than those reported in DFO salmon catch estimates for the Gitga'at Nation.

The results of the Gitga'at FSC catch cannot be used to estimate catch for other First Nations due to considerable variation in the species composition and proportions between traditional use areas.[19] Additionally, the value of FSC catch cannot be estimated using methods applied to commercial catch (i.e., ex-vessel prices) because of the many social, cultural, educational and other benefits associated with FSC fishing.[20] First Nations Councillors and Fisheries Managers within the North Coast assert that FSC fishing is invaluable to the health and well-being of their communities[21,22,23] and that the educational, social and cultural values of FSC fishing activities are irreplaceable.[24] In the absence of adequate valuation methods to account for these benefits, it is only possible to conclude that in one year, the Gitga'at (population 155)[25] catch approximately 200,000 pieces of fish and other seafood, and that nearly 10,000 members of the Haisla, Haida and Tsimshian First Nations are similarly dependent on marine resources within the North Coast region.

2.3. Port activities

The North Coast region hosts two of the three most active ports in British Columbia at the publicly-owned Port of Prince Rupert and the private port at Kitimat.

The Port of Prince Rupert includes five shipping terminals as well as the Northland Cruise Terminal, [26] which serves as a port-of-call for cruise ships and smaller "pocket cruises" en route between Seattle or Vancouver and Alaska.[27] The number of calls by cruise ships varies considerably between years, with competition for cruise traffic shared by the Port of Victoria.

The private port at Kitimat is currently used exclusively by Rio Tinto Alcan and employment, revenue and GDP information associated with shipping operations are combined with data for plant operations and considered proprietary.[28] The port was used by Methanex Corp. to ship methanol and ammonia until 2005 and by West Fraser Timber's Eurocan pulp and paper mill until 2010.[29] The Methanex site has been purchased by Royal Dutch Shell and the Eurocan site by Apache Canada Ltd., EOG Resources Canada Inc. and Encana Corp., which own Kitimat LNG. Redevelopment of the Kitimat LNG site began in 2012.[30] These industries are expected to contribute significantly to the local economy through export of LNG, primarily to Asian markets, but are not currently operational and are excluded from this analysis.

2.4. Ferry transportation

British Columbia Ferry Services (BC Ferries), the public ferry service provider throughout British Columbia, operates three routes within the North Coast region, between Port Hardy and Prince Rupert (Route 10), Prince Rupert and Skidegate (Route 11) and Skidegate and Alliford Bay (Route 26). The service provides transportation for local residents as well as a considerable number of tourists during summer months (May-September).

2.5. Tourism-based recreational fishing

Marine recreation encompasses activities undertaken by both residents and non-residents (i.e. tourists).[31] Expenditure by residents produces an induced effect on the tourism industry, while tourism expenditure can be considered an export of goods and services resulting in direct economic impact. Only tourism activity produces a gain or loss in the local economy, while recreation by residents creates a transfer of revenue within the region but no associated gain or loss. Thus, the present analysis is limited to tourism-based recreational fishing.

A literature scan[32,33] and review of local tourism websites and guides indicates at least 74 fishing charter operators within the areas of Haida Gwaii (8), Prince Rupert (51) and Kitimat (13). The majority of these businesses operate seasonally and are owner-operator based, with few or no additional staff. Nevertheless, the cumulative effects of these operations contribute to the local economy and draw in revenue from outside the region. Recreational fishing activities support and are supported by the existence of eleven harbour authorities or public wharves, two marinas and four marine fuel service stations within the region.[34]

2.6. Other marine tourism

Marine tourism describes activities by non-residents that occur in the marine environment, including recreational boating, beach activities, whale and marine-based wildlife watching, kayaking, sailing tours and mothershipping tours.[35] There is evidence of recreational diving activity within the region, however, only a few operators offer tours. Gardner Pinfold Consulting (2010) reports 37 businesses in the marine tourism sector and an additional eight businesses that provide marine transport on Haida Gwaii,

including kayak mothershipping, kayak tours, powerboat tours and sailboat tours.[36] Business size ranges from very small (i.e. one owner/operator) to large, with activity largely seasonal. Some tourism operators generate additional revenue through marine transportation, which presents a challenge when allocating employment by marine sector. Indirect employment and revenues related to the sector are received by transportation providers, local retailers and the hospitality.

Many tourism operators within the North Coast region are based in other areas of British Columbia, Alaska, Washington, or elsewhere in the USA. The direct economic output enjoyed by these operators is included in this study because the initial value is generated within the North Coast region.

There is little evidence of formal ocean-based tourism activity near Kitimat beyond periodic boat charters for wildlife viewing. Only one privately-owned dock, M.K. Marina, operates near Kitamaat Village, outside Kitimat. The absence of a public dock limits recreational boating opportunities. Kayaking in the Douglas Channel, near Kitimat, can be unsafe due to north-south winds and waves.[37] Gregory *et al.* (2011) report that at least eight sailing tour companies and three fishing lodges operate within the traditional territory of the Gitga'at Nation, around Hartley Bay.[38] The Haisla Nation is currently working to develop tourism within the region, and offers some guided cultural tours in traditional canoes.[39] Between 200 and 250 participants, including local residents, participate in traditional canoe tours each year.[40] The Haisla Nation maintains a list of tour guides who are employed casually, as needed.[41] Based on this information, it is reasonable to conclude that recreational boating contributes to the economy within Gitga'at Territory and near Kitimat.

3. Methods

The values from commercial fishing, port activities, ferry transportation, tourism-based recreational fishing and other marine tourism (i.e., recreational boating, beach activities, whale and marine-based wildlife watching, kayaking, sailing tours, mothershipping tours) in the North Coast region were characterized using the indicators of employment (in person years, 'PYs'), total revenue (value of total output) and contribution to GDP (value of total output less cost of intermediate inputs, 'GDP'). Employment, output and contribution to GDP were evaluated using methods previously employed by Cisernos-Montemayor and Sumaila (2010),[42] Dyck and Sumaila (2010),[43] Harper et al. (2010)[44] and Sumaila et al. (2012).[45] These values are classified as 'direct', 'indirect' and 'induced'.

Direct effects measure the economic activities of businesses operating within the industries analyzed. Indirect values encompass the economic contribution of these industries on goods and services provided by businesses in other related industries.[46] The commercial fishing industry, for example, supports firms involved in seafood processing, marketing, distribution and retail. Induced effects result from expenditure of income and wages earned through direct and indirect employment by ocean-based industries.[47]

Due to significant changes in the regional economy over the past decade (i.e., growth of the tourism sector, expansion of port activities) average output from the most recent 3-6 years have been employed for each industry included in this study. Direct effects have been assessed using estimated and reported

employment, total output and contribution to GDP for each ocean-based industry analyzed. Total output was calculated as the product of ex-vessel price and catch in the case of commercial fisheries; and the product of average daily per capita expenditure, average duration of stay in the region, proportion of total tourism and average reported annual tourism participation for tourism-based recreational fishing and other marine tourism.

Employment, total output and contribution to GDP were obtained from previous estimates of the value of port activities; and total revenue was previously reported for ferry transportation. Employment in commercial fishing was estimated using the Provincial Input-Output multiplier for fishing, hunting and trapping published by Statistics Canada (2012).[48]

Indirect and induced values of commercial fishing and ferry transportation are estimated using Provincial and National Input-Output multipliers, respectively, published by Statistics Canada (2012).[49,50] In the case of tourism-based recreational fishing and other marine tourism, direct employment as well as induced and indirect values were estimated using multipliers derived from Tourism BC (2004).

A detailed description of analytical methods is included by industry in the following sections.

3.1. Commercial fishing

Each of the indicators (i.e. employment, total output, GDP) is assumed to be related to total commercial catch (C) as follows:

total output = $C \bullet p$

employment = $C \bullet p \bullet M_{1,2,3}$

GDP = $C \bullet p \bullet M_{4,5,6}$

Where p is the ex-vessel price per tonne and $M_{1,2,3}$ and $M_{4,5,6}$ represent the economic impact multipliers for direct, indirect and induced employment ($M_{1,2,3}$) and GDP ($M_{4,5,6}$) related to fisheries provided by Statistics Canada (2012). Provincial multipliers are used for direct impacts and National multipliers are used for indirect and induced impacts.

Several data-related limitations resulted in the need to derive a range of catch values, reported as "low" and "high". Catch data for species with coast-wide licenses, including shellfish, sablefish and groundfish trawl, are only publicly available from the Department of Fisheries and Oceans Canada (DFO) for the whole of the BC coast. While catch data for some other species, such as salmon, are reported by DFO by area for near shore Areas 1-6, these data are not provided for offshore Areas 101-106 and 140. Commercial catch data by area are available for a fee by formal request under the Freedom of Information and Protection of Privacy Act, but the data may not be available for several months. Catch from fisheries operated by fewer than three vessels cannot be disclosed by DFO as per the "three-party rule".[51]

"Low" catch data were compiled for the years 2008-2011 from commercial catch data provided in DFO fishery management plans[52,53,54,55,56,57,58,59,60,61] and post-season fishery reviews,[62,63,64,65,66] reports from

the International Pacific Halibut Commission[67] and catch data by management area (Areas 1-6 and 101, 102 and 142) previously requested under the Freedom of Information Act.[68] Data were used to calculate three-year average catch values by species for each DFO Management Area within the region.

"High" catch data was estimated by fishery based on catch per area or per vessel reported in Nelson (2011b)[69] and total allowable catch by area or license reported in DFO fishery management plans.

Ex-vessel prices were calculated based on total landings and landed values reported for 2008-2010 by the British Columbia Ministry of Environment (BC MOE 2011).[70] Clam prices for 2005-2010 were reported by DFO.[71] Ex-vessel prices, adjusted to 2011 CAD using the Consumer Price Index (CPI) for British Columbia provided by Statistics Canada (2012),[72] were applied to low and high catch estimates to calculate values.

Employment figures as well as indirect and induced economic impacts of the commercial fishing sector were estimated using input-output multipliers provided by Statistics Canada (2012) for British Columbia (direct; direct and indirect effects) and Canada (direct, indirect and induced effects) with medium aggregation.[73,74]

3.2. Port activities

Direct, indirect and induced employment, output and GDP attributed to shipping and cruise ship traffic were reported in InterVISTAS Consulting (2012).[75] The study employed a survey-based approach including twenty on-site and off-site businesses that comprise the majority of direct port-related employment. The authors used Statistics Canada economic multipliers for British Columbia from the 2008 Interprovincial Input-Output model, updated with Consumer Price Indices to account for inflation, to estimate indirect and direct economic effects of port activities. The scope of the study by InterVISTAS Consulting (2012) included shipping and cruise ship operations and supporting businesses, as well as induced expenditures by employees of these businesses.

3.3. Ferry transportation

BC Ferries publishes Annual Reports to the British Columbia Ferry Commissioner, which are available on the British Columbia Ferry Commission website. Total operating revenues for each of the three North Coast routes for 2009-2011[76,77] were used to calculate three-year average output for BC Ferries. Employment and GDP were estimated using output and the direct value multipliers provided by Statistics Canada (2012) for British Columbia.[78]

3.4. Tourism-based recreational fishing

Because tourism affects multiple sectors (e.g., transportation, retail, hospitality), goods (e.g., souvenirs, clothing, electronics) and service providers (e.g., airlines, tour companies), total output is most easily and accurately estimated using average daily per capita tourism expenditure. This approach eliminates the need to evaluate the relative contributions of tourists versus local residents to each business or sector individually.

Each of the indicators (i.e., employment, total output, GDP) is assumed to be related to average daily client expenditure (*E*) as follows:

total output = $E \bullet (n \bullet r) \bullet d$

employment = $E \bullet (n \bullet r) \bullet d \bullet M_{7,8,9}$

GDP = $E \bullet (n \bullet r) \bullet d \bullet M_{10,11,12}$

Where *n* is the total average number of tourists per year, *r* is the participation rate in tourism-based recreational fishing and *d* is the average length of stay. $M_{7,8,9}$ and $M_{10,11,12}$ represent economic impact multipliers for direct, indirect and induced employment ($M_{7,8,9}$)and GDP ($M_{10,11,12}$) derived using a ratio of client spending to employment and GDP, respectively, for the tourism sector based on data reported in Tourism BC (2004), adjusted to 2011 CAD.[79] Where the number of anglers per year is known, this figure replaces the product of *n* and *r* in the equation for total output.

Low ($133.42) and high ($353.30) daily per capita expenditures for non-resident anglers on Haida Gwaii were obtained from Tourism BC (2003).[80] Non-resident anglers were assumed to visit Haida Gwaii for an average ten days and comprise 23.8% of all tourism participants (Tourism BC 2003).[81]

Low ($254.04) and high ($340.84) daily per capita expenditures for non-resident anglers in Prince Rupert, including accommodations, were obtained from Counterpoint Consulting (2008)[82] while average ($261.40) daily per capita expenditure was obtained from Tourism BC (2008).[83] An average of 5.8 tourism days per angler, including 3.1 fishing days, and a total of 15,003 anglers per year was assumed (Tourism BC 2008).[84]

Based on similarities between participation rates in non-resident recreational fishing for Haida Gwaii (8.1%) and Prince Rupert (7.9%), to be conservative, an average participation rate of 7.9% was assumed for Kitimat. The total average number of tourists per year was estimated based on three-year average traffic statistics for the Kitimat visitor centre for 2008-2011.[85] Average daily per capita expenditure was assumed to be similar to Prince Rupert ($261.40).

Total output attributed to non-resident recreational fishing was calculated using the average number of anglers per year (Prince Rupert) and by multiplying the total average number of tourists per year by participation rates for recreational fishing (Haida Gwaii and Kitimat) and multiplying this figure by the average length of stay in the region and low, average and high daily per capita expenditures. Per capita expenditures for Haida Gwaii, Prince Rupert and Kitimat were adjusted to 2011 CAD.

Employment, in person-years (PYs) was estimated based on a ratio of client spending to employment calculated for the tourism sector using data reported in Tourism BC (2004) and adjusted to 2011 CAD.[86] Indirect and induced economic impacts were estimated using multipliers for employment, output, and GDP generated based on the results from Tourism British Columbia (2004).[87]

3.5. Other marine tourism

Indicators for other marine tourism activities are estimated using the methods outlined above for tourism-based recreational fishing, which is accounted for independently of other marine tourism activities due to availability of specific regional data.

Low ($133.42) and high ($353.30) per capita daily expenditures for tourism on Haida Gwaii were obtained from Tourism BC (2003) and adjusted to 2011 CAD. Length of stay on Haida Gwaii was assumed to be an average of ten days (Tourism BC 2003).[88] All expenditures are inclusive of tax, thereby reflecting combined private and public revenues. The number of visitors to Haida Gwaii was estimated based on three-year average traffic statistics from the Queen Charlotte visitor centre for 2009-2011[89] and the proportions of visitors participating in beach activities, kayaking and boating were obtained from Tourism BC (2003).[90] Visitor centre traffic statistics represent a very conservative estimate of annual tourism because they are based on the number of visitors who speak to a representative at each Tourism BC Visitor Centre; actual participation in tourist activities is likely much higher.

Total participation in "overnight leisure" tourism, participation rates of overnight leisure travellers in wildlife viewing, kayaking and canoeing and recreational boating and average ($201) daily per capita expenditure for overnight leisure travellers to Prince Rupert was obtained from Tourism BC (2008).[91]

Average annual person-days of recreational boating, average expenditure per person per sailing tour operator and average annual revenues for sailing tours within Gitga'at Territory were provided in Gregory et al. (2011).[92]

All low, average and high daily per capita expenditures were adjusted to 2011 CAD. Total output from marine tourism for Haida Gwaii, Prince Rupert and Gitga'at Territory was calculated as the product of total visitors, the participation rate for each ocean-based activity, the average daily per capita expenditures and the average length of stay in the region.

Employment, in person-years (PYs), was estimated for each of the activities included in the marine tourism analysis based on a ratio of tourism expenditure to employment calculated based on findings reported in Tourism BC (2004) and adjusted to 2011 CAD.[93] GDP was calculated using a multiplier developed using total client spending and total GDP reported in Tourism BC (2004).

Indirect and induced economic impacts were estimated using multipliers for employment, output, and GDP generated based on the results from Tourism British Columbia (2004).[94]

4. Results

4.1. Commercial fishing

Table 1: Direct, indirect and induced values of commercial fishing in the North Coast region.

	Employment (PYs)		Output (2011 CAD, millions)		GDP (2011 CAD, millions)	
Type of Impact	**Low**	**High**	**Low**	**High**	**Low**	**High**
Direct	275	728	83	220	37	99
Direct and Indirect	776	2,056	135	357	101	266
Direct, Indirect, Induced	1,632	4,324	156	414	143	379

Data from Gislason & Associates (2004) indicate employment in the North Coast region of 1,025 person-years (PYs) for fish harvesting, 220 PYs for recreational fishing and 480 PYs for seafood processing.[95] Gardner Pinfold Consulting (2010) estimates that commercial fisheries provide 115 direct jobs on Haida Gwaii and 250 indirect jobs in seafood processing,[96] but do not estimate person-years of employment. Monitoring, research and enforcement associated with fisheries and the marine environment by organizations including DFO and the Haida Fisheries program provides 58 jobs on Haida Gwaii alone.[97] Previous estimates from GSGislason & Associates (2002) suggest that commercial fisheries in the North Coast region provided 1,000 PYs of employment, of which 105 PYs occurred on Haida Gwaii.[98]

The present analysis suggests comparatively lower employment in the commercial fishing sector than previous estimates, and offers a very conservative estimate of total employment based on average annual catch. This likely reflects limitations associated with use of commercial catch data by area for the North Coast region due to reporting restrictions (i.e. three-party rule) and limited access to DFO catch data.

Indirect and induced values reflect the relatively greater contribution of commercial fishing to the regional economy per unit output in contrast to other industries due employment, output and GDP generated in the seafood processing, transport, distribution, marketing and sales sectors.

4.2. Port activities

Table 2: Direct, indirect and induced values of activities at the Port of Prince Rupert.

Type of Impact	**Employment (PYs)**	**Output (2011 CAD, millions)**	**GDP[1] (2011 CAD, millions)**
Direct	2,220	550	290
Direct and Indirect	3,500	690	360
Direct, Indirect, Induced	4,550	800	420

[1] These figures were reported by InterVISTAS Consulting (2012). A range of values was not provided.

Port activities support indirect employment related to forklift operation and loading, storage (warehousing), freight forwarding, trucking, construction, security (marine, rail, road, customs), maintenance and repairs, logistics, banking, cleaning, management and administration.[99] Many of the existing marine tourism operators based in Prince Rupert supplement revenues by providing marine transport services to vessels associated with the port.

The data from InterVISTAS (2012) reports the combined economic impacts of shipping and cruise ship traffic at the Port of Prince Rupert. A study by Scarfe (2011)[100] suggests negative net economic impacts of cruise ship traffic on the City of Victoria, a port-of-call for cruise ships on Vancouver Island, British Columbia. The study reports that cruise ship tourism has a net negative impact on Victoria of approximately $4 million per year due to social and environmental costs associated with marine effluents, atmospheric emissions, traffic congestion, traffic noise and infrastructure related costs. No study has yet been conducted to assess these impacts in Prince Rupert. Additionally, this study focuses on the impacts of industry, and does not attempt to evaluate environmental costs. A relevant finding for this study is that home port cities, such as Seattle, reap greater benefits from tourism than port-of-call cities, such as Prince Rupert.[101]

4.3. Ferry transportation

Table 3: Direct, indirect and induced values of ferry transportation in the North Coast region.

Type of Impact	Employment (PYs)	Output (2011 CAD, millions)	GDP[2] (2011 CAD, millions)
Direct	235	18	7
Direct and Indirect	582	33	29
Direct, Indirect, Induced	1,157	46	39

Output from ferry transportation suggests a modest contribution to the regional economy. Due to low ridership and passenger revenues during non-summer months, these three routes return negative average annual net revenues and rely on large provincial and federal government subsidies to provide essential services to regional communities. Government subsidies act to redistribute revenue from other regions of the province and country to activities within areas service by ferry transportation.

4.4. Tourism-based recreational fishing

Table 4: Direct, indirect and induced values of tourism-based recreational fishing in the North Coast region.

	Employment (PYs)		Output (2011 CAD, millions)		GDP (2011 CAD, millions)	
Type of Impact	Low	High	Low	High	Low	High
Direct	265	358	20	31	9	15
Direct, Indirect	314	434	27	42	14	22

[2] These figures were reported by the British Columbia Ferry Commission (2012). A range of values was not provided.

Direct, Indirect, Induced	340	476	36	56	17	27

Gislason & Assocates (2004) reported 245 PYs of employment at fishing lodges on Haida Gwaii shared between 520 individuals at 18 lodges, representing a portion of the indirect impacts of tourism-based recreational fishing by non-residents of the region.[102] Due to ownership and management of fishing lodges by non-residents of the region, only 50 PYs of employment were held by 115 local individuals. Gardner Pinfold Consulting (2010) reported 625 jobs in recreational fisheries on Haida Gwaii.[103] Comparison of the current findings with previous estimates suggests that this study provides a conservative estimate of total employment. Visitor centre traffic statistics are based on the number of visitors who speak to a representative at each Tourism BC Visitor Centre and offer a very conservative estimate of annual tourism because they; actual participation in tourist activities is likely much higher

4.5. Other marine tourism

Table 5: Direct, indirect and induced values of other marine tourism in the North Coast region.

	Employment (PYs)		Output (2011 CAD, millions)		GDP (2011 CAD, millions)	
Type of Impact	**Low**	**High**	**Low**	**High**	**Low**	**High**
Direct	446	562	35	44	16	21
Direct, Indirect	627	790	53	67	42	53
Direct, Indirect, Induced	726	915	63	80	77	97

Employment related to recreational boating sector was previously estimated by The Economic Planning Group (2003) at 100 PYs on Haida Gwaii and 120 PYs elsewhere in the North Coast region.[104] Gardner Pinfold Consulting (2010) reported 182 jobs related to marine tourism on Haida Gwaii[105] and Misty Isles Economic Development Society (2011) indicate 480 jobs in the marine tourism rector, including sport fishing and guiding.[106] Results of the current analysis appear consistent with jobs and employment estimated for other marine tourism activities within the region.

4.6. All ocean-based industries

Estimated annual direct, indirect and induced economic values of ocean-based industries in the North Coast region are provided in **Error! Reference source not found.**.

Table 6: Direct, indirect and induced values of ocean-based industries in the North Coast region.

	Employment (PYs)		Output (2011 CAD, millions)		GDP (2011 CAD, millions)	
Type of Impact	**Low**	**High**	**Low**	**High**	**Low**	**High**
Direct	3,441	4,103	706	863	361	432
Direct and Indirect	5,799	7,362	938	1,189	545	730
Direct, Indirect, Induced	8,405	11,423	1,102	1,396	696	962

Based on a proportion of working age individuals of 69% and an unemployment rate of 9.3%,[107] ocean-based industries are estimated to directly employ 10% to 12% of the regional population. When indirect

and induced values are also considered, ocean-based industries provide employment for an equivalent of 24% to 33% of the regional population. The comparatively high regional unemployment rate, in contrast to the provincial rate of 6.6%,[108] suggests that ocean-based industries are critical to the regional economy and wellbeing of communities.

The contributions of the five ocean-based industries analyzed during this study (i.e. commercial fishing, port activities, ferry transportation, tourism-based recreational fishing, other marine tourism) to the total values are reported in the following sections.

5. Conclusions

Ocean-based industries are estimated to directly employ 10% to 12% of the population in the North Coast region. When indirect and induced values are also considered, ocean-based industries provide employment for an equivalent of 24% to 33% of the regional population. The comparatively high regional unemployment rate, in contrast to the provincial rate of 6.6%,[109] suggests that ocean-based industries are critical to the regional economy and wellbeing of communities.

The values presented in this study provide a very conservative estimate of total employment, output and contribution to GDP resulting from ocean-based activities within the North Coast region. In particular, where tourism estimates are applied, actual annual expenditure is likely much higher than reported. The actual value of commercial fishing activities is also believed to be higher than reported due to limited availability of commercial catch data.

The contribution of FSC fishing by First Nations communities cannot be accurately evaluated using existing valuation methods, due to high non-market values related to social, educational and cultural values and well-being. First Nations Councillors and Fisheries Managers perceive a very high value associated with FSC fishing and consider FSC fishing opportunities to be irreplaceable to their communities.

References

[1] Statistics Canada (2012) Vital Census. 2011 Census. Ottawa, Canada. Released May 29, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/vc-rv/index.cfm?Lang=ENG&TOPIC_ID=2&GEOCODE=01.

[2] British Columbia Government (2011a) A Guide to the BC Economy and Labour Market. North Coast & Nechako. http://guidetobceconomy.org/bcs_economy/north_coast-nechako.htm

[3] Northern Gateway Pipelines Inc. (2010a) TERMPOL Surveys and Studies. Section 3.2: Origin, Destination & Marine Traffic Volume Survey. https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624798/691974/B23-3_-_TERMPOL_Surveys_and_Studies_-_Section_3.2_-_Origin_Destination_-_Marine_Traffic_Volume_Survey_A1Z6I7?nodeid=691981&vernum=0

[4] Northern Gateway Pipelines LLP (2010a).

[5] Northern Gateway Pipelines LLP (2010a).

[6] Northern Gateway Pipelines LLP (2010b) Volume 2: Economics, Commercial, and Financing. Enbridge Northern Gateway Project. Sec. 52 Application. https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624798/619886/B1-4_-_Vol_2_%96_Gateway_Application_%96_Economics,_Commercial_and_Financing_(Part_1_of_1)_-_A1S9X7_.pdf?nodeid=619772&vernum=0

[7] Stephenson, M., St-Armand, A., & Mazzocco, P. (2010) Technical Data Reprt: Risk Assessment of Hypothetical Spill Examples at the Kitimat Terminal and in Wright Sound. Stantec Consulting. http://www.northerngateway.ca/assets/pdf/tdr/Risk%20Technical%20Data%20Reports/Risk%20Assessment%20of%20Spills_TDR.pdf.

[8] National Energy Board (2012) Enbridge Northern Gateway Project Joint Review Panel, Public Registry. http://gatewaypanel.review-examen.gc.ca/clf-nsi/pblcrgstr/pblcrgstr-eng.html

[9] DFO (2012d) Current Valid British Columbia Shellfish Aquaculture License Holders. http://www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/docs/shell-conch-processors-transformateurs-eng.pdf.

[10] Personal communication with John Disney, Economic Development Officer, Old Masset Village Council, June 29, 2012.

[11] Watson, T. (2010) Marine Fisheries Technical Data Report. Triton Environmental Consultants Ltd. and Jacques Whitford Axys. http://www.ceaa.gc.ca/050/documents_staticpost/cearref_21799/2424/marine_fisheries.pdf.

[12] DFO (2012) Yakoun River, Marie Lake Hatchery Project. http://www.pac.dfo-mpo.gc.ca/sep-pmvs/projects-projets/cedp-pdec/Yakoun-eng.htm

[13] Gardner Pinfold Consulting (2010) Haida Gwaii Marine Market Sector Analysis. Final Report submitted to Haida Oceans Technical Team, Haida Fisheries Program. https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624910/702795/776392/Council_of_the_Haida_Nation_-_Haida_Gwaii_Marine_Market_Sector_Analysis_Final_Report_-_A2K2X1.pdf?nodeid=776464&vernum=0.

[14] Misty Isles Economic Development Society (2011) Haida Gwaii - Investment-Ready Community Profile. http://www.mieds.ca/images/uploads/Community%20Profile-Haida%20Gwaii.pdf

[15] Robinson Consulting & Associates Ltd. (2012) PNCIMA Socio-economic Cultural Overview & Assessment Report http://pncima.org/media/documents/secoa/secoa-final-mar-1-12.pdf

[16] DFO (2012c) Salmon Catch Statistics & Logbook Reports. Commercial Salmon Catch Statistics by Year (Provided by Fisheries Management). http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/fisheries-peches/stats-donnees-eng.htm

[17] FSC catch data, Areas 1-6. Requested under the *Freedom of Information and Privacy Act*. Information Request #6626, submitted by Sean Broadbent. Response received from Laurie Biagini, Manager, Regional Data Services Unit, DFO on August 23, 2011.

[18] Gregory, R., Failing, L., and Joseph, C. (2011) Economic Impacts of the Enbridge Northern Gateway Project on the Gitga'at First Nation. https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90464/90552/384192/620327/624910/697575/777619/Gitga'at_First_Nation_-_Gitga_at_ENGP_Economic_Impact_Report_FINAL_-_A2K4W9.pdf?nodeid=777704&vernum=0

[19] Bruce Watkinson, Fisheries Manager, Gitxaala Nation. Personal communication, June 26, 2012.

[20] Bruce Watkinson, Fisheries Manager, Gitxaala Nation. Personal communication, June 26, 2012.
[21] Bruce Watkinson, Fisheries Manager, Gitxaala Nation. Personal communication, June 26, 2012.
[22] Ellis Ross, Chief Councillor, Haisla Nation. Personal communication, June 25, 2012.
[23] Bill Shepert, Fisheries Resource Manager, Lax Kw'alaams Band. Personal communication, June 27, 2012.
[24] Bruce Watkinson, Fisheries Manager, Gitxaala Nation. Personal communication, June 26, 2012. Cite the FN Fisheries Managers, Ellis Ross, and John Disney.
[25] BC Stats (2012) Aboriginal Community Data Initiative. http://www.bcstats.gov.bc.ca/StatisticsBySubject/AboriginalPeoples/AboriginalReports.aspx
[26] InterVISTAS Consulting (2012) Port of Prince Rupert Economic Impact Study Update - Final Report. Prepared for the Prince Rupert Port Authority. http://www.rupertport.com/documents/economic-impact-study-2012/pdf(http://www.rupertport.com/media/Port_of_Prince_Rupert_Economic_Impact_Study.pdf
[27] Robinson Consulting & Associates Ltd. (2012).
[28] Email communication with Paul Henning, vice president, B.C. Operations and Strategic Development, Western Canada, Rio Tinto Alcan, on June 20, 2012.
[29] Schrier, D. (2012) Kitimat Poised to see Resurgence in Exports. BC Stats. http://www.bcstats.gov.bc.ca/.../KitimatPoisedtoSeeResurgenceinExports.pdf
[30] Ibid.
[31] Robinson Consulting & Associates Ltd. (2012).
[32] Misty Isles Economic Development Society (2011).
[33] Gregory et al. (2011).
[34] British Columbia Marine Conservation Analysis (2012) Tourism & Recreation Marinas and Coastal Facilities. http://bcmca.ca/datafiles/bcmca_hu_tourismrec_marinas_atlas.pdf
[35] Cisneros-Montemayor & Sumaila (2010).
[36] Gardner Pinfold Consulting (2010).
[37] Personal communication with Marc-André de Launière, Haisla Tourism, July 3, 2012.
[38] Gregory et al. (2011).
[39] Gregory et al. (2011).
[40] Gregory et al. (2011).
[41] Gregory et al. (2011).
[42] Cisneros-Montemayor, A., & Sumaila, U.R. (2010) The economic value and potential threats to marine ecotourism in Belize. In Palomares, M., & Pauly, D. (Eds.), Too Precious to Drill: the Marine Biodiversity of Belize. *Fisheries Centre Research Reports*, Vol. 19, No. 6, 161-166.
[43] Dyck, A., and Sumaila, U.R. (2010) Economic impact of ocean fish populations in the global fishery. *Journal of Bioeconomics* 12: 227-243.
[44] Harper, S., Zeller, D., Sumaila, U.R., (2011) Under the threat of oil: assessing the value and contribution of Belizean fisheries. In: Palomares, M.L.D., D., Pauly, D. (Eds.), Too Precious to Drill: the Marine Biodiversity of Belize. *Fisheries Centre Research Reports*, Vol. 19, No. 6, 152-160.
[45] Sumaila, U.R., Cisneros-Montemayor, A.M., Dyck, A., Huang, L., Cheung, W., Jacquet, J., Kleisner, K., Lam, V., McCrea-Strub, A., Swartz, W., Watson, R., Zeller, D., & Pauly, D. (2012) Impact of the Deepwater Horizon well blowout on the Economics of U.S. Gulf fisheries. *Canadian Journal of Fisheries and Aquatic Sciences* 69: 499-510.
[46] BC Ministry of Environment (2007) British Columbia's Fisheries and Aquaculture Sector, 2007 Edition, Chapter 10. Input/Output Multipliers. Victoria, BC: BC Stats. http://www.env.gov.bc.ca/omfd/reports/BC-Fisheries-Aquaculture-Sector-2007.pdf
[47] BC Ministry of Environment (2007).
[48] Statistics Canada, Industry Accounts Division (2012a) Provincial Input-Output Multipliers, 2008. British Columbia.
[49] Statistics Canada, Industry Accounts Division (2012a).
[50] Statistics Canada, Industry Accounts Division (2012b) National Input-Output Multipliers, 2008.
[51] Laurie Biagini, Manager, Regional Data Services Unit, DFO. Personal communication, April 5, 2012.
[52] DFO (2010a) Pacific Region Integrated Fisheries Management Plan – Intertidal Clams. January 1, 2010 to December 31, 2012. http://www.dfo-mpo.gc.ca/Library/338991.pdf

[53] DFO (2010b) Pacific Region Integrated Fisheries Management Plan – Crab by Trap. January 1, 2011 to December 31, 2011. http://www.dfo-mpo.gc.ca/Library/342457.pdf
[54] DFO (2006) Pacific Region Integrated Fisheries Management Plan – Euphausiids. January 01, 2007 to December 31, 2012. http://www.dfo-mpo.gc.ca/Library/329395.pdf
[55] DFO (2011a) Pacific Region Integrated Fisheries Management Plan – Geoduck and Horse Clam. January 1 to December 31, 2012. http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/2012/geoduck-panope-2012-eng.pdf
[56] DFO (2011b) Pacific Region Integrated Fisheries Management Plan – Prawn and Shrimp by Trap. May 1, 2011 to April 30, 2012. http://www.dfo-mpo.gc.ca/Library/343253.pdf
[57] DFO (2011c) Pacific Region Integrated Fisheries Management Plan – Sea Cucumber by Dive. October 1, 2011 to September 30, 2012. http://www.dfo-mpo.gc.ca/Library/344264.pdf
[58] DFO (2011d) Pacific Region Integrated Fisheries Management Plan – Red Sea Urchin. August 1, 2011 to July 31, 2012. http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/red_urchin_2011-12.pdf
[59] DFO (2011e) Pacific Region Integrated Fisheries Management Plan – Shrimp by Trawl. April 1, 2011 to March 31, 2012. http://www.dfo-mpo.gc.ca/Library/343050.pdf
[60] DFO (2012a) Pacific Region Integrated Fisheries Management Plan – Groundfish. February 21, 2011 to February 20, 2013, Version 2.1. http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/ground-fond_2012-13.pdf
[61] DFO (2011f) Pacific Region Integrated Fisheries Management Plan – Pacific Herring. November 7, 2011 to November 6, 2012. http://www.dfo-mpo.gc.ca/Library/344588.pdf
[62] DFO (2011g) 2011 Post Season Review. Salmon. North Coast Areas 1-6 & Central Coast Areas 7-10. http://www.pac.dfo-mpo.gc.ca/northcoast/post-seasonreview/docs/2011/2011-Salmon_Post_Season_Review.pdf.
[63] DFO (2012b) Preliminary Summary Commercial Statistics 2009-2011. http://www.pac.dfo-mpo.gc.ca/stats/comm/summ-somm/index-eng.htm
[64] DFO (2012c) Final Hook and Line Summary Report, 2010-2011. http://www.pac.dfo-mpo.gc.ca/fm-gp/commercial/ground-fond/docs/2010-2011_Hook_Line_Catch_Summary_Report.pdf
[65] DFO (2011h) Final Hook and Line Summary Report, 2009-2010. http://www.pac.dfo-mpo.gc.ca/fm-gp/commercial/ground-fond/docs/2010-2011_Hook_Line_Catch_Summary_Report.pdf
[66] DFO (2011i) 2011 Post Season Review. Salmon. North Coast Areas 1-6 & Central Coast Areas 7-10 http://www.pac.dfo-mpo.gc.ca/northcoast/post-seasonreview/docs/2011/2011Salmon_Post_Season_Review.pdf
[67] Geernaert, T., Clark, B., and Gilroy, H. (2011) Commercial halibut catch and effort for IPHC statistical areas on the B.C. coast (Regulatory Area 2B). International Pacific Halibut Commission. http://www.iphc.int/documents/commercial/bc/2B_WPUE_1980-2010.pdf
[68] Commercial catch data, Areas 1, 2, 101, 102 and 142. Requested under the *Freedom of Information and Privacy Act*. Information Request #6627, submitted by Sean Broadbent. Response received from John Davidson, Regional Data Services, DFO on April 18, 2012.
[69] Nelson (2011a) West Coast Fishing Fleet: Analysis of Commercial Fishing Licence, Quota, and Vessel Values. Prepared for DFO, Pacific Region. http://www.pac.dfo-mpo.gc.ca/fm-gp/picfi-ipcip/docs/2011-value-valeur.pdf
[70] BC Ministry of Environment (2011) British Columbia Seafood Industry - 2010 Year in Review. http://www.env.gov.bc.ca/omfd/reports/YIR-2010.pdf
[71] DFO (2010a).
[72] Statistics Canada (2012) Table 326-0021, Consumer Price Index (CPI), 2009 Basket. http://www5.statcan.gc.ca/cansim/a26;jsessionid=AD769D9A9E3DD7863B9BDAC22B232DE4
[73] Statistics Canada, Industry Accounts Division (2012) Provincial Input-Output Multipliers, 2008. British Columbia.
[74] Statistics Canada, Industry Accounts Division (2012) National Input-Output Multipliers, 2008.
[75] InterVISTAS Consulting (2012).
[76] British Columbia Ferry Services Inc. (2010) 2009/10 Annual Report to the British Columbia Ferry Commissioner. P. 22. http://www.bcferrycommission.com/wp-content/uploads/2011/05/asp/BCFSReport_to_Commiss0910.pdf
[77] British Columbia Ferry Services Inc. (2011) 2010/11 Annual Report to the British Columbia Ferry Commissioner. http://www.bcferrycommission.com/wp-content/uploads/2011/04/BCFS-FY2011-Annual-Report-to-BCFC.pdf
[78] Statistics Canada, Industry Accounts Division (2012) Provincial Input-Output Multipliers, 2008. British Columbia.

[79] Tourism British Columbia (2004) Economic Value of the Commercial Nature-Based Tourism Industry in British Columbia. Table 4: Economic impacts of commercial nature-based tourism businesses in British Columbia. http://www.jti.gov.bc.ca/research/ResearchbyActivity/pdfs/land_based/Economic_Impacts_of_Commercial_Nature-Based_Tourism_Report.sflb.pdf
[80] Tourism BC (2003) Value of the Queen Charlotte Visitor Centre Study Results http://www.jti.gov.bc.ca/research/ResearchByRegion/pdf/northern_bc/2002_-_Queen_Charlotte_City.sflb.pdf
[81] Tourism BC (2003).
[82] Counterpoint Consulting (2008) Skeena Economic Dimensions 2008. http://www.psf.ca/edswsf.pdf
[83] Tourism British Columbia (2008) 2007 Prince Rupert Visitor Study Findings. http://www.jti.gov.bc.ca/research/ResearchByRegion/pdf/northern_bc/Final_Report_for_the_2007_Prince_Rupert_Visitor_Study.sflb.pdf
[84] Tourism British Columbia (2008).
[85] Tourism BC (2012) Visitor Centre Network Statistics Program Year Over Year Report 2012. https://www.networkstats.tourismbc.com/reportdefinition.aspx
[86] Tourism British Columbia (2004).
[87] Tourism British Columbia (2004).
[88] Tourism BC (2003) Value of the Queen Charlotte Visitor Centre Study Results http://www.jti.gov.bc.ca/research/ResearchByRegion/pdf/northern_bc/2002_-_Queen_Charlotte_City.sflb.pdf
[89] Tourism BC (2012).
[90] Tourism BC (2003).
[91] Tourism British Columbia (2008).
[92] Gregory et al. (2011).
[93] Tourism British Columbia (2004).
[94] Tourism British Columbia (2004).
[95] GSGislason & Associates (2004) British Columbia Seafood Sector and Tidal Water Recreational Fishing: A Strengths, Weaknesses, Opportunities, and Threats Assessment. BC Ministry of Agriculture, Food and Fisheries. http://www.agf.gov.bc.ca/fisheries/cabinet/FULL_Report.pdf
[96] Gardner Pinfold Consulting (2010).
[97] Gardner Pinfold Consulting (2010).
[98] Gislason & Associates Ltd. (2002) BC Seafood and Recreational Fishing SWOT. http://www.agf.gov.bc.ca/fisheries/cabinet/FULL_Report.pdf
[99] InverVISTAS (2006).
[100] Scarfe, B. (2011) Costs and Benefits of Cruise Ship Tourism in Victoria. James Bay Neighbourhood Association. http://www.jbna.org/2011_cruise_ships_synopsis_april.pdf
[101] Scarfe, B. (2011).
[102] GSGislason & Associates (2004).
[103] Gardner Pinfold Consulting (2010).
[104] The Economic Planning Group (2003) Economic Impact Analysis of Outdoor Recreation on British Columbia's Central Coast, North Coast and Queen Charlotte Islands/Haida Gwaii. Outdoor Recreation Council of British Columbia. http://torc.linkbc.ca/torc/downs1/CoastRecReport.pdf
[105] Gardner Pinfold Consulting (2010).
[106] Misty Isles Economic Development Society (2011).
[107] British Columbia Government (2011a).
[108] British Columbia Government (2011b) Economic Indicators. http://www.gov.bc.ca/keyinitiatives/economic_indicators.html
[109] British Columbia Government (2011b).

Appendix I: Data sources

Source types are: (1) peer-reviewed publication; (2) government agency report; (3) government agency website; (4) Independent consultant report; (5) NGO report; (6) newspaper source; (7) commercial or public website.

Industry	Source	Source type (1-7)
Commercial fishing	DFO (2010) Pacific Region Integrated Fisheries Management Plan – Intertidal Clams. January 1, 2010 to December 31, 2012. http://www.dfo-mpo.gc.ca/Library/338991.pdf	2
	DFO (2010) Pacific Region Integrated Fisheries Management Plan – Crab by Trap. January 1, 2011 to December 31, 2011. http://www.dfo-mpo.gc.ca/Library/342457.pdf	2
	Pacific Region Integrated Fisheries Management Plan – Euphausiids. January 01, 2007 to December 31, 2012. http://www.dfo-mpo.gc.ca/Library/329395.pdf	2
	DFO (2011) Pacific Region Integrated Fisheries Management Plan – Geoduck and Horse Clam. January 1 to December 31, 2012. http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/2012/geoduck-panope-2012-eng.pdf	2
	DFO (2011) Pacific Region Integrated Fisheries Management Plan – Prawn and Shrimp by Trap. May 1, 2011 to April 30, 2012. http://www.dfo-mpo.gc.ca/Library/343253.pdf	2
	DFO (2011) Pacific Region Integrated Fisheries Management Plan – Sea Cucumber by Dive. October 1, 2011 to September 30, 2012. http://www.dfo-mpo.gc.ca/Library/344264.pdf	2
	DFO (2011) Pacific Region Integrated Fisheries Management Plan – Red Sea Urchin. August 1, 2011 to July 31, 2012. http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/red_urchin_2011-12.pdf	2
	DFO (2011) Pacific Region Integrated Fisheries Management Plan – Shrimp by Trawl. April 1, 2011 to March 31, 2012. http://www.dfo-mpo.gc.ca/Library/343050.pdf	2

Commercial fishing (cont'd)	DFO (2012) Pacific Region Integrated Fisheries Management Plan – Groundfish. February 21, 2011 to February 20, 2013, Version 2.1. http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/ground-fond_2012-13.pdf	2
	DFO (2011) Pacific Region Integrated Fisheries Management Plan – Pacific Herring. November 7, 2011 to November 6, 2012. http://www.dfo-mpo.gc.ca/Library/344588.pdf	2
	DFO (2011) 2011 Post Season Review. Salmon. North Coast Areas 1-6 & Central Coast Areas 7-10. http://www.pac.dfo-mpo.gc.ca/northcoast/post-seasonreview/docs/2011/2011-Salmon_Post_Season_Review.pdf.	2
	DFO (2012) Preliminary Summary Commercial Statistics 2009-2011. http://www.pac.dfo-mpo.gc.ca/stats/comm/summ-somm/index-eng.htm	2
	DFO (2012) Final Hook and Line Summary Report, 2010-2011. http://www.pac.dfo-mpo.gc.ca/fm-gp/commercial/ground-fond/docs/2010-2011_Hook_Line_Catch_Summary_Report.pdf	2
	DFO (2011) Final Hook and Line Summary Report, 2009-2010. http://www.pac.dfo-mpo.gc.ca/fm-gp/commercial/ground-fond/docs/2010-2011_Hook_Line_Catch_Summary_Report.pdf	2
	DFO (2011) 2011 Post Season Review. Salmon. North Coast Areas 1-6 & Central Coast Areas 7-10 http://www.pac.dfo-mpo.gc.ca/northcoast/post-seasonreview/docs/2011/2011-Salmon_Post_Season_Review.pdf	2
	Geernaert, T., Clark, B., and Gilroy, H. (2011) Commercial halibut catch and effort for IPHC statistical areas on the B.C. coast (Regulatory Area 2B). International Pacific Halibut Commission. http://www.iphc.int/documents/commercial/bc/2B_WPUE_1980-2010.pdf	2
	Commercial catch data, Areas 1, 2, 101, 102 and 142. Requested under the *Freedom of Information and Privacy Act*. Information Request #6627, submitted by Sean Broadbent. Response received from John Davidson, Regional Data Services, DFO on April 18, 2012.	2

Commercial fishing (cont'd)	Nelson (2011b) West Coast Fishing Fleet: Analysis of Commercial Fishing Licence, Quota, and Vessel Values. DFO, Pacific Region. http://www.pac.dfo-mpo.gc.ca/fm-gp/picfi-ipcip/docs/2011-value-valeur.pdf	2
	BC Ministry of Environment (2011) British Columbia Seafood Industry - 2010 Year in Review. http://www.env.gov.bc.ca/omfd/reports/YIR-2010.pdf	2
	GSGislason & Associates (2011) Economic Impacts from a Reduced BC Groundfish Trawl Fishery in British Columbia. BC Ministry of Environment. http://www.env.gov.bc.ca/omfd/reports/groundfish-trawl-fishery-economic-impacts.pdf	2
	Nelson (2011a) Pacific Commercial Fishing Fleet: Financial Profiles for 2009. Prepared for Fisheries and Oceans Canada, Pacific Region. Pacific Commercial Fishing Fleets Financial Profiles Series, 2011-4. 160 pp. http://www.dfo-mpo.gc.ca/Library/343762.pdf	2
	Nelson (2011b) West Coast Fishing Fleet: Analysis of Commercial Fishing Licence, Quota, and Vessel Values. http://www.pac.dfo-mpo.gc.ca/fm-gp/picfi-ipcip/docs/2011-value-valeur.pdf	2
	DFO (2012c) Salmon Catch Statistics & Logbook Reports. Commercial Salmon Catch Statistics by Year (Provided by Fisheries Management). http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/fisheries-peches/stats-donnees-eng.htm	3
Port activities	InterVISTAS Consulting (2012) Port of Prince Rupert Economic Impact Study Update - Final Report. Prepared for the Prince Rupert Port Authority. http://www.rupertport.com/documents/economic-impact-study-2012/pdf(http://www.rupertport.com/media/Port_of_Prince_Rupert_Economic_Impact_Study.pdf	4
Ferry transportation	British Columbia Ferry Services Inc. (2010) 2009/10 Annual Report to the British Columbia Ferry Commissioner. P. 22. http://www.bcferrycommission.com/wp-content/uploads/2011/05/asp/BCFSReport_to_Commiss0910.pdf	2
	British Columbia Ferry Services Inc. (2011) 2010/11 Annual Report to the British Columbia Ferry Commissioner. http://www.bcferrycommission.com/wp-content/uploads/2011/04/BCFS-FY2011-Annual-Report-to-BCFC.pdf	2

Tourism-based recreational fishing	Tourism BC (2003) Value of the Queen Charlotte Visitor Centre Study Results http://www.jti.gov.bc.ca/research/ResearchByRegion/pdf/northern_bc/2002_-_Queen_Charlotte_City.sflb.pdf	2
	Counterpoint Consulting (2008) Skeena Economic Dimensions 2008. http://www.psf.ca/edswsf.pdf	4
	Tourism British Columbia (2008) 2007 Prince Rupert Visitor Study Findings. http://www.jti.gov.bc.ca/research/ResearchByRegion/pdf/northern_bc/Final_Report_for_the_2007_Prince_Rupert_Visitor_Study.sflb.pdf	2
Other marine tourism	Tourism British Columbia (2008) 2007 Prince Rupert Visitor Study Findings. http://www.jti.gov.bc.ca/research/ResearchByRegion/pdf/northern_bc/Final_Report_for_the_2007_Prince_Rupert_Visitor_Study.sflb.pdf	2
	Tourism BC (2012) Visitor Centre Network Statistics Program Year Over Year Report 2012. https://www.networkstats.tourismbc.com/reportdefinition.aspx	2
	Tourism British Columbia (2004) Economic Value of the Commercial Nature-Based Tourism Industry in British Columbia. Table 4: Economic impacts of commercial nature-based tourism businesses in British Columbia. http://www.jti.gov.bc.ca/research/ResearchbyActivity/pdfs/land_based/Economic_Impacts_of_Commercial_Nature-Based_Tourism_Report.sflb.pdf	2
	Tourism BC (2003) Value of the Queen Charlotte Visitor Centre Study Results http://www.jti.gov.bc.ca/research/ResearchByRegion/pdf/northern_bc/2002_-_Queen_Charlotte_City.sflb.pdf	2

Species listed as being of conservation concern that occur along the project route.

Name of Species	SARA Listed	COSEWIC Listing	BC Listing	Alberta Listing	IUCN Listing	Conservation Concern	Count	Key Indicator Species
Marine Species								
Sockeye Salmon					X	X	1	
Coastal Cutthroat Trout			X			X	2	
Eulachon		X	X			X	3	X
Rougheye Rockfish Type 1	X	X				X	4	
Rougheye Rockfish Type 2	X	X				X	5	
Canary Rockfish		X				X	6	
Bocaccio		X			X	X	7	
Albacore Tuna			`		X	X	8	
Olympia Oyster	X	X				X	9	
Green Sturgeon	X	X	X		X	X	10	
							11	
Longspine Thornyhead	X	X				X	12	
Coral					X	X	13	
Sponge					X	X	14	X
Northern Abalone	X	X				X	15	
Basking Shark	X	X			X	X	16	
Bluntnose Sixgill Shark	X	X			X	X	17	
Tope Shark	X	X			X	X	18	
Seabirds								
Western Grebe		X	X			X	1	
Surf Scoter			X			X	2	X
Long-tailed Duck			X			X	3	
Pink Footed Shearwater			X			X	4	
Flesh-footed Shearwater	X	X	X			X	5	

Buller's Shearwater			X			X	6	
Brandt's Cormorant			X			X	7	
Double-crested Coromrant			X			X	8	
Pelagic Cormorant			X			X	9	
California Gull			X			X	10	
Common Murre			X			X	11	
Thick-Billed Murre			X			X	12	
Marbled Murrelet	X	X	X			X	13	X
Ancient Murrelet	X	X	X			X	14	
Cassin's Auklet			X			X	15	
Horned Puffin			X			X	16	
White Winged Scoter				X		X	17	X
Tufted Puffin			X			X	18	
Waterbirds								
Canada Goose			X			X	1	
American Avocet			X			X	2	
Black-crowned Night-Heron			X			X	3	
Trumpeter Swan				X		X	4	X
Tundra Swan			X			X	5	
Birds of Prey								
Osprey				X		X	1	
Bald Eagle				X		X	2	X
Northern Harrier				X		X	3	
Northern Goshawk	X	X	X			X	4	X
Broad-winged Hawk				X		X	5	
Swaison's Hawk			X	X		X	6	
Golden Eagle				X		X	7	

Peregrine Falcon	X	X	X	X		X	8	
Western Screech Owl	X	X	X			X	9	X
Short Eared Owl	X	X	X	X		X	10	X
Birds								
American Bittern			X			X	1	X
Bank Swallow	X	X				X	2	
Barn Swallow	X	X	X			X	3	
Bay Breasted Warbler			X			X	4	X
Belted Kingfisher			X			X	5	
Black-throated Green Warbler			X			X	6	X
Canada Warbler	X	X	X			X	7	X
Cape May Warbler			X			X	8	X
Connecticut Warbler			X			X	9	X
Le Conte's sparrow			X			X	10	X
Nelson's Sparrow			X			X	11	X
Olive sided Flycatcher	X	X	X			X	12	X
Rusty Blackbird	X	X	X			X	13	X
Sprague's Pipit	X	X		X		X	14	X
Yellow Rail	X	X	X			X	15	X
Game birds								
Sharp-tailed Grouse				X		X	1	X
Wading Birds								
Great Blue Heron	X	X	X			X	1	X
Red-necked Phalarope			X			X	2	
Sandhill Crane				X		X	3	X
Amphibians								

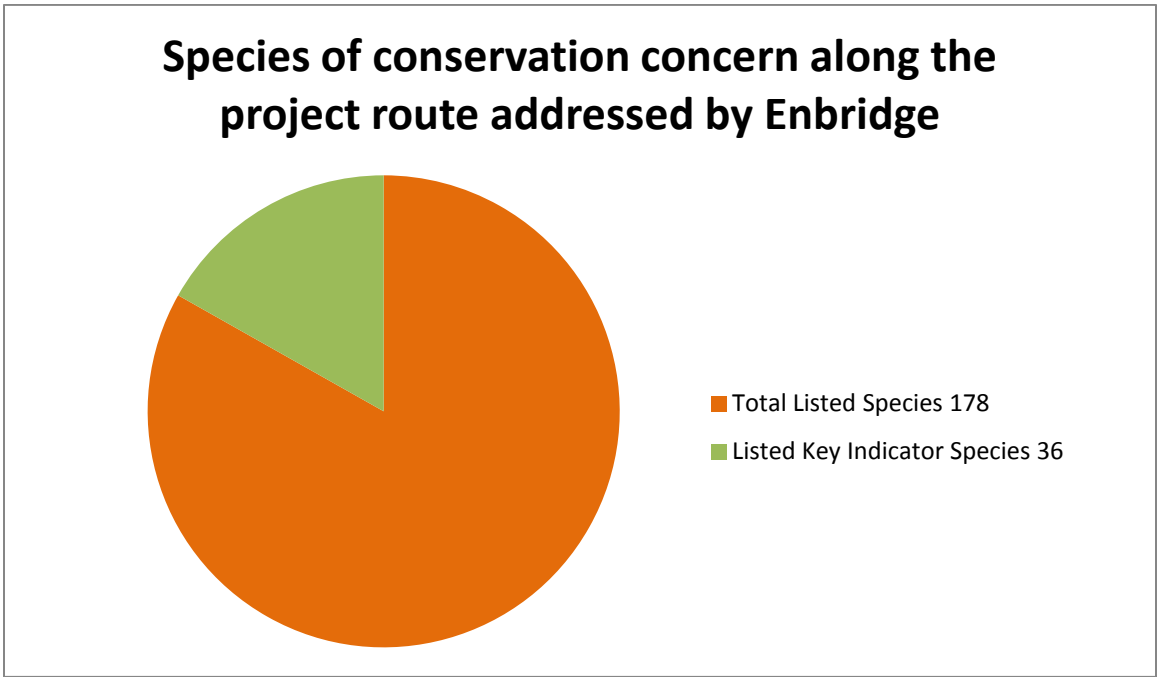
Tiger Salamander	X	X	X			X	1	
Long-toed salamander				X		X	2	
Canadian Toad				X		X	3	X
Western Toad	X	X	X	X		X	4	X
Coastal tailed frog	X	X	X			X	5	X
Columbia Spotted frog				X		X	6	
Red-legged frog	X	X	X			X	7	
Plants								
Lakeshore sedge			X	X		X	1	
Poverty oat grass				X		X	2	
Tall blue lettuce				X		X	3	
Um Moss				X		X	4	
Flagon-fruited splachnum				X		X	5	
Narrow-Fruited fork Moss				X		X	6	
Trapeliopsis flexuosa				X		X	7	
Spike redtop				X		X	8	
Short beaked riged screw moss				X		X	9	
Aloe-like rigid screw moss				X		X	10	
Sharp-pointed weissia				X		X	11	
Lapland reed grass				X		X	12	
Small bitter cress				X		X	13	
Hairy-fruited sedge				X		X	14	
Golden saxifrage				X		X	15	

Green Saxifrage				X		X	16	
Goldthread				X		X	17	
Awl-leaved fork moss				X		X	18	
Nevada rush				X		X	19	
Tall blue lettuce				X		X	20	
Lecania dubitans				X		X	21	
Pinesap				X		X	22	
Small northern grass of parnassus				X		X	23	
Northern beech fern				X		X	24	
Physcia tenella				X		X	25	
Leafy pondweed				X		X	26	
Hairy buttercup				X		X	27	
Prairie wedge grass			X	X		X	28	
Wavy leaved chickweed				X		X	29	
Smooth woodsia				X		X	30	
Northern bog bedstraw			X	X		X	31	
Whitish Rush			X	X		X	32	
Marsh muhly			X	X		X	33	
Small-flowered lousewort			X	X		X	34	
Nuttall's orache				X		X	35	
Dainty moonwort			X	X		X	36	
Least moonwort			X	X		X	37	
Yellow marsh-marigold			X	X		X	38	
Iowa golden-saxifrage			X	X		X	39	
Small-fruited willowherb			X	X		X	40	

Northern bog bedstraw			X	X		X	41	
Slender-spiked mannagrass			X	X		X	42	
Northern Jacob's ladder			X	X		X	43	
Bog rush			X	X		X	44	
Birdfoot buttercup			X	X		X	45	
Meadow Willow			X	X		X	46	
Rock selaginella			X	X		X	47	
American sweet-flag			X	X		X	48	
Canada anemone			X	X		X	49	
Long-bracted frog orchid				X		X	50	
Arctic Rush			X	X		X	51	
Oniongrass			X	X		X	52	
Snow bramble			X	X		X	53	
Alpine sorrel			X	X		X	54	
Rivergrass				X		X	55	
Thick-leaved thelypody			X	X		X	56	
Alpine cliff fern				X		X	57	
Holboell's rockcresss				X		X	58	
Freshwater Fish								
River shiner				X		X	1	
Redside shiner				X		X	2	
Largescale Sucker				X		X	3	
Silver redhorse				X		X	4	
Shorthead redhorse				X		X	5	
Mooneye				X		X	6	
Rainow trout				X		X	7	
Bull Trout		X	X	X		X	8	
Northern redbelly dace			X	X		X	9	
Pearl Dace			X	X		X	10	

Finescale dace				X		X	11	
Quillback				X		X	12	
Spoonhead sculpin				X		X	13	
Northern Pikeminnow				X		X	14	
Coastal cutthroat trout			X			X	15	
Dolly Varden			X			X	16	
White sturgeon	X	X	X			X	17	
Williston watershed Arctic grayling			X			X	18	
Terrestrial mammals								
Fisher			X			X	1	X
Wolverine		X	X			X	2	X
Grizzly Bear		X	X	X		X	3	X
Caribou	X	X	X	X		X	4	X
Mountain goat						X	5	X
Least weasel		X				X	6	
Marine Mammals								
Blue Whale	X	X	X		X	X	1	
Fin Whale	X	X	X		X	X	2	
Sei Whale	X	X	X		X	X	3	
Humpback Whale	X	X	X			X	4	X
North Pacific Right Whale	X	X	X		X	X	5	
Sperm Whale			X		X	X	6	
Killer Whale - Southern Resident	X	X	X			X	7	
Killer Whale - Northern Resident	X	X	X			X	8	X
Killer Whale - Transient	X	X	X			X	9	
Killer Whale - Offshore	X	X	X			X	10	
Harbour Porpoise	X	X	X			X	11	

Steller Sea Lion	X	X	X		X	X	12	X
Northern Fur Seal		X	X		X	X	13	
Sea otter	X	X	X		X	X	14	
Sea Turtle								
Leatherback Turtle	X	X	X		X	X	1	
Total Species							178	36



Centre for Marine Science and Technology

Review of documents associated with assessing environmental impacts of underwater noise from the proposed Enbridge Northern Gateway project

By: Robert D McCauley

Centre for Marine Science and Technology (CMST)
Curtin University, GPO Box U1987,
Perth, Western Australia, 6845.

August 2012

Prepared for: World Wildlife Fund Canada

PROJECT CMST 1123
REPORT R2012 - 41

Contents

1 Executive Summary

This document presents a review of multiple documents prepared to define the environmental impacts of underwater noise associated with increased shipping and construction activities from the proposed Enbridge Northern Gateway terminal. This proposed terminal development intends to ship petroleum product through coastal and inland waterways of British Columbia (CCAA) resulting in a significant increase of the number of large tankertransits to the inland port of Kitimat. Six documents were involved in the review with a somewhat confused (to the reviewer at least) history of how they linked to the project. The documents and sections which have been read, the reviewer's description of what information they contained and the essence of the review results are listed in Table 1.

The review aims were identified as (text paraphrased from work outline):

The Primary Contributor will provide a reading and independent review of the merit of the manner in which underwater noise and acoustics are treated as part of the environmental assessment for the proposed project. The review will address (but will not be limited to) the following key questions:

1. *If the quantification of noise exposure levels from proposed activities of this project are accurate, sufficient and/or adequate, and why the Primary Contributor considers it so.*
2. *If the biological effects of noise generated from the proposed project and the noise exposure levels have been adequately identified and quantified, and why the Primary Contributor considers it so.*
3. *If the quantification of noise levels and assessment of biological effects adequately considers cumulative levels and effects of noise on animals and the environment, and why the Primary Contributor considers it so.*
4. *If the thresholds for noise levels that are used to determine impacts and effects on species and/or the environment, and the proposed mitigation measures are sufficient/adequate, and why the Primary Contributor considers it so.*
5. *If the proposed mitigation measures are sufficient to adequately reduce impacts, and why the Primary Contributor considers it so.*

The reviewer's response to the key questions are:

If the quantification of noise exposure levels from proposed activities of this project are accurate, sufficient and/or adequate, and why the Primary Contributor considers it so.

This reviewer considers the modelling of noise exposure accurate, sufficient and adequate. Modelling sound fields from various vessel combinations in environments with complex bathymetry is not easy and can always be criticised at some level. But, given inherent variability in vessel source levels, that one never knows the seabed geoacoustic parameters extensively from a spatial perspective, and that water column sound speed profiles change seasonally, then the modelling carried out can be considered an initial estimate of vessel noise and is indicative of the magnitude of levels which may be encountered. The modelling should not be considered an exact description of underwater sound levels likely to be produced by vessel transits (this would apply for all modelling exercises).

The sound field modelling could have been improved considerably if the authors had presented standard format tables which quantified ranges along channel for different received levels for the modelled vessel scenarios in different locations. Comparing the output of the three modelling reports was confusing and was not adequately summarised anywhere.

If the biological effects of noise generated from the proposed project and the noise exposure levels have been adequately identified and quantified, and why the Primary Contributor considers it so.

The biological effects of noise generated from the proposed project have not been properly addressed for invertebrates and fishes. Literature pertaining to underwater noise effects on invertebrates and fishes was not adequately reviewed, was not quantified in terms of exposure durations and levels, and where threshold values were used they were for impulse measures, not for continual noise such as that produced by vessels. Given that viable prey fields are critical for all marine mammals, which utilise the area, this is a serious shortcoming from an ecological standpoint.

The biological effects of noise generated from the proposed project have been assessed reasonably well for marine mammals from the response of individual marine mammals. But, the biological implications of potential reduction in prey densities or of underwater sound altering prey behaviour so that it is more or less available for marine mammals has not been assessed. The issue of masking of sound used by marine mammals has not been assessed. The environmental conclusions are that - there are, or are the potential for, negative implications for all marine mammal groups. These implications have been partly dismissed by the document authors who assert that a potential loss of habitat related to this project will not have a significant impact on the wider population across the whole of the north western Canada and Alaska. This argument ignores the potential for localised negative effects in the inland and coastal waterways of the project area and is made with no knowledge of local population fidelity and genetic localisation. No supporting evidence is provided on the population structure for the marine mammal species assessed.

If the quantification of noise levels and assessment of biological effects adequately considers cumulative levels and effects of noise on animals and the environment, and why the Primary Contributor considers it so.

The underwater acoustic modelling documents do not consider cumulative noise impacts nor do they factor in time, they merely present model outputs and most of this in the form of numerous one-page figures. There was no scenario modelled of two vessels passing in a channel, which will occur given existing traffic levels.

The ESA document has and has not, considered the cumulative effects of noise from multiple sources or of noise exposures through time. The cumulative noise assessment was confined to separate sub-sections in assessing impacts on marine mammals and would have been better presented with statistics of times of exposure above set thresholds in a section of its own with summary tables. There was no cumulative noise analysis for invertebrates or fishes. The cumulative noise impacts, which were assessed numerically, focused entirely on the proponent's proposed activities; the inclusion of existing vessel traffic was largely ignored except where the ESA authors calculated the proponent's % contribution to expected cumulative noise (i.e., there were no calculations of the time of total vessel noise exposure and no scenarios of multiple vessels using the channels modelled).

Overall the ESA document was lacking in its assessment of cumulative noise, did not present this well, did not consider multiple vessels passing each other in a channel and did not factor time into impacts except for isolated cases.

If the thresholds for noise levels that are used to determine impacts and effects on species and/or the environment, and the proposed mitigation measures are sufficient/adequate, and why the Primary Contributor considers it so.

There were no thresholds used in assessing noise impacts on invertebrates.

The threshold used for assessing noise impacts on fishes of 208 dB re 1µPa was designed for physiological impacts from impulse sounds, not continual sounds. No thresholds appropriate for fish and continual noise were used in the assessment. The modelling and ESA document produced estimates of weighted sound fields for different fish types but did not use these in their environmental assessment.

The thresholds used for determining impacts of underwater sound on marine mammals were in general conservative and appropriate. The authors have provided several sets of thresholds for various impacts of sound based on published literature, including the conservative 120 dB re 1µPa for continual noise which is widely used as the threshold of behavioural changes in marine mammals. The authors have provided theoretical audiograms for several marine mammal species, have used these audiograms to weight the sound exposures received by marine mammals and have then used the weighted exposures to assess impacts. While the theoretical audiograms used in analysis are based on a thorough assessment of literature it must be cautioned that they are theoretical, as audiograms for these species have not been measured.

If the proposed mitigation measures are sufficient to adequately reduce impacts, and why the Primary Contributor considers it so.

The proponents have suggested many mitigation measures to reduce underwater noise outputs from vessels under their control including the reduction of vessel speeds to reduce the probability of vessel strike with marine fauna, and they have put considerable thought into this process. While some of the mitigation measures will reduce vessel noise outputs they will not remove all underwater noise and the proponents cannot control the noise outputs of other vessels operating in the CCAA. A tug working hard will cavitate and produce high noise levels no matter how efficient the propellers are at reducing noise when the vessel is steaming.

One aspect that the reviewer thought could have been emphasised more in underwater noise mitigation was training and real-time feedback for vessel masters employed on the Northern Gateway Project. This reviewer's experience is that a good vessel Master can significantly reduce the noise output of even a poorly designed (from an underwater noise perspective) vessel. Thus a live feedback hydrophone located near the berthing terminal streamed to the tug wheelhouse will enable vessel Masters to understand when their manoeuvres create significant noise outputs and so attempt to avoid or reduce these instances.

Other issues this reviewer felt important:

The reviewer felt a major shortcoming of the environmental assessment process was that existing underwater noise in the CCAA waterways had not been monitored over the long term. A series of short-term measurements were made over several hours at multiple locations but these do not allow noise statistics to be calculated nor do they allow the noise exposure from a wide range of vessel classes to be calculated. The current level of shipping and vessel traffic noise in the CCAA waterways could have easily been quantified by data from long-term autonomous sea noise recorders and careful correlation of the sea noise with AIS ship movement data. By doing this, future noise increases could be easily and more accurately predicted (since the measurements will account for variability in sound transmission phenomena and will span a wide range of vessel classes). Sub-sea autonomous sea noise recorders have been available for some time and several groups specialise in deploying them and quantifying the data outputs. This reviewer recommends that these instruments be deployed immediately to obtain actual measures of current shipping noise in the CCAA region and to use vessel noise statistics from this data to better predict the noise exposure regime produced by increaesd vessel traffic.

While the ESA document outlined monitoring programs for marine mammals, thiswas seriously compromised by the lack of a monitoring program for key prey species, the trophic links that support these and correlating vessel noise measurements. The proponents would be wise to factor in some prey species surveys into planned marine mammal surveys (perhaps using sonar systems) and to discuss this issue with DFO Canada, who have considerable experience at running such surveys.

Since completing the intial review a further document outling the proposed marine mammal monitoring plan was supplied for review. This document (*Framework for Marine Mammal Protection Plan, July 2012),* while curently a high level document, is comprehensive and a major undertaking on the proponents part in protecting marine mammals per se. But, it continues to ignore the viability of prey fields and their response to increaed vessle traffic. Marine mammal poulations in the study area will only be viable if the prey fields remain viable. This reviewer feels that this issue, *viability of marine mamal prey fields in response to increaesd vessel traffic*, needs to be explicitly expressed as an outcome of the marine mammal protection plan aims, included in the document section 4 and that methodolgy for long term monitoring of prey fields be incporated into the *Marine Mammal Protection Plan* sampling strategy.

Specific comments on individual reports are presented below. The late document received, (*Framework for Marine Mammal Protection Plan, July 2012)* has been summarised in Table 1 only.

Table 1: Summary of documents reviewed in relation to the environmental impacts of underwater noise generated by the Enbridge Northern Gateway Project. For details see the document specific notes below. The prefixes given to the titles are arbitrary and used in this table only.

Document	**Presents**	**Review / Notes**
A/ Technical Data Report Marine Acoustics (2006) Enbridge Northern Gateway Project JASCO, Version 10.0 2010	1) limited ambient noise measures 2) limited sound transmission measures 3) seven modelled sound fields for noise vessel source combinations inside inland waterways	Reviewed Approach technically reasonable Does not consider source directionality Presents data only No data synthesis A later document (F below) points out errors in scaling ranges off the modelled sound fields, by a factor of around 2
B/ Technical Data Report Marine Acoustics (2010) Enbridge Northern Gateway Project JASCO, 2010	1) modelled sound fields for four vessel configurations operating in open water and coastal regions	Reviewed Technically reasonable Does not consider source directionality Presents data only Little data synthesis
C/ Northern Gateway Pipeline Project: Vessel Transit Noise. Marine Acoustics Modelling study 2011. JASCO July 19, 2012, V2.0	1) Re-modelled sound fields as previously calculated in 2006 and 2010 for same and different vessel configuration scenarios, some using different vessel	Reviewed Technically reasonable Does not consider source directionality Presents data only

	speeds and updated source level estimates from measurements	Little data synthesis No information on how the results of this document altered the findings of the 2006 and 2010 modelling results presented
D/ Volume 8B: Environmental and Socio-Economic Assessment (ESA) – Marine Transportation. Enbridge Northern Gateway Project. Sec 52 Application May 2010	1) Environmental assessment of potential impacts of Enbridge Northern Gateway Project 2) Major document detailing project, environment and environmental impacts 3) Attempts to synthesise sound modelling with literature for assessing environmental impacts on variety of marine fauna	Reviewed sections on invertebrates, fish marine mammals Uses JASCO 2006 modelling report and ranges for environmental assessment Superficial dealing with fish and invertebrate impacts from underwater noise Lacks a systematic ecological approach by not focusing on key prey species for higher-order predators, these are largely ignored Assesses impacts on marine mammals well but then largely dismisses the findings by considering BC wide populations Understandably, focuses primarily on impacts of vessel noise affiliated with Enbridge Northern Gateway Project but largely does not consider existing shipping nor how this project adds to that
E/ Northern Gateway Pipeline Project: Tanker and Escort Tug Source level Measurement Study. JASCO 2010. Attachment 15 to Northern Gateway Reply Evidence Part 1 of 2	1) Results of measurements of a tanker underway with attendant tugs to give source levels of tug and tanker. 2) Results used in revised modelling JASCO document (2012 V 2.0 above)	Reviewed Measurements good but inability to separate out different vessel sources Directionality of vessels not accounted for but use of closest point of approach suggests measures were abeam receiver at steep take-off angle Uses a scaling factor to account for different noise outputs of vessels at different speeds. A speed / noise relationship does not always hold for ships.
F/ Northern Gateway Pipeline Project: Audiogram-weighted behavioural thresholds for killer whales, JASCO July 2012, Attachment 15 to Northern Gateway Reply Evidence Part 2 of 2	1) Justification for how a 55 and 65 dB above Killer Whale audiogram behavioural response was derived 2) How the Killer whale weighting function was derived 3) Summary of the three JASCO modelling reports and how outputs of later reports impact environmental assessment 4) Series of sound field maps for killer whale weighted vessel movement /	Reviewed 1) Technique for deriving 55 and 65 dB threshold for behavioural response technically valid but approach is dubious as it uses a very limited data set and makes many assumptions 3) Largely a summary document of how changes made in the modelling process affect environmental assessment made using the first (2006) modelling report. This summary points out scaling error in JASCO 2006 report giving wrong ranges. 4) A series of maps with no summary information or tabulated

	location scenarios	ranges of impacts. Data not synthesised.
G/ Technical Data Report Framework for the Marine Mammal Protection Plan. Enbridge Northern Gateway Project. Stantec Consulting, July 2012	Outline of proposed startegy for monitoring of marine mamals in study area pre-and during operations of terminal. Presents high level outline with methodology defined but specific details to be detailed if and when project proceeds.	Reviewed An extensive, well thought out and major commitment for monitoring of marine mamaml populations in the study area. If the plan is followed this will provide a comprehensive assessment of impacts on marine mammal response to vessel traffic. Only criticism is that it largely neglects studies of prey fields, in that marine mammal poulations will only remain viable in the study area if the prey populations remain viable. The response of prey fields to vessel traffic and potential impacts on their viability should be bought forward as one of the key outcomes of the monitoring program and not be buried in isolated sections of the document.

2 Technical Data Report Marine Acoustics (2006) Enbridge Northern Gateway Project JASCO, Version 10.0 2010

2.1 General Comments

This document presents results of a limited set of ambient noise measurements made along the inland vessel transit route, measurements of transmission loss and modelling output predicting sound fields for six scenarios of vessel movements inside the inland waterways leading to Kitimat and one instance of dredging.

The work is of a high standard in presentation. There are some technical questions and limitations in the way the measurements of ambient noise, estimation of actual transmission loss and modelling were carried out although the methods used are robust.

All underwater sound modelling outputs of this nature should be treated as a guide only. While the techniques used throughout the modelling work are robust, natural variability in the source levels of vessels, inherent directionality of vessel noise (not accounted for in any modelling carried out here), a generally poorly spatially resolved and highly variable seabed type, and naturally fluctuating vertical sound speed profiles imply that the modelling of underwater sound fields only provides an estimation of likely sound levels. For the same class of vessel, source levels may vary depending on its loading state, the seaway it is operating in, its mechanical state, if the hull and propeller are clean, and the way it is operated. While surface geology can tell us the local seabed type, it does little to resolve spatial variation in layering thickness and variability of seabeds in space. These two factors can create significant variability in underwater sound levels produced by a vessel. Thus the modelling output gives averaged, representative noise levels only.

The document presents a great deal of model outputs, which are not synthesised from an environmental perspective nor quantified for range of various noise levels. The lack of model output summary data is a major shortcoming of this report.

Modelling was carried out for point sources at fixed locations in different scenarios, but has not included contributions of multiple ships passing (it has included various ship and tug combinations but not multiple ships), nor has it included time as a factor. Given the high density of ship traffic expected (1.2 transits a day for the proponent's vessels estimated in Volume 8, Environmental and Socio-Economic Assessment, May 2010, and more like 2-3 per day when factoring in all shipping movements) and that this rate will most likely increase, there will be instances of multiple ships transiting the narrow passages and in the open water to the west. If these ships are in close proximity then at some range their noise contributions will add, increasing the noise field produced and the time the noise field exceeds various thresholds.

The issue of time has not been considered. At selected locations, for how long will ambient noise levels be increased by a passing ship? For how long and how much will ambient noise levels be increased at selected locations across a year or a biologically pertinent time frame (for example a fish spawning period or humpback whale feeding season)?

2.2 Technical Issues

1.1.1 Ambient noise

The ambient noise measurements presented for Principe Sound are--as discussed in the document--biased high by various noise issues. There was little time over the ambient noise measurement deployment at Principe Sound where some form of noise, either man-made or a noise artefact, did not bias the measurements and raise ambient noise levels. Thus the values presented for Principe Sound must be considered high.

None of the ambient noise measurements presented were correlated with environmental data, especially wind speed. In these narrow waterways, wind will play a major role in setting ambient noise levels and may have been a key factor for different ambient noise regimes at the different locations. The environmental conditions over each measurement period need to be presented.

To be effective, ambient noise measurements should cover an extensive period, optimally a season, in order to span natural variability due to changing environmental conditions and so cover the extremely quiet and noisy conditions. These measurements did not do this, but can rather be considered a snapshot of ambient noise specific to the location and environmental conditions over the recording time frame, which need to be stated in the document. They should not be considered as indicative of the range of ambient noise levels likely to be encountered.

1.1.2 Transmission loss measurements

Transmission loss measurements made with a Lubell speaker will always be seriously compromised below 800 Hz as this speaker's output response drops rapidly below 800 Hz with the loss increasing as the frequency decreases (see manufacturers output response curves). Using the vessel as a noise source was a good idea, although the technique used, to throw the vessel into hard reverse to provide the low frequency energy, will be seriously compromised by variability in the source level output between runs, possibly some directionality in the noise (for frequencies above perhaps 100 Hz) and no accurate source level measurement. Thus the frequencies below those at which the Lubell speaker could be used to determine transmission loss will not have reliable transmission loss measurements. Simply running the vessel at a constant speed directly towards the receiver, perhaps with it towing some form of load (e.g. a few clean 44 gallon drums with the lids cut open) would have been more effective and would have allowed a clear view of multipath fluctuations and hence transmission phenomena for the area, by following vessel tones along the track.

Nevertheless, good, spot transmission loss measurements have been made at higher frequencies out to modest ranges.

1.1.3 Modelling

The document gives no details of the model type used for the sound transmission loss calculations. It refers to the JASCO proprietary MONM model and Reeves (2005) reviewing this model. The MONM model is not explained at all in this document (i.e. it is presented as a black box) and the Reeves (2005) document could not be downloaded. In a later document, the JASCO authors state that the MONM model uses the sound transmission model RAM; so presumably the MONM model used in this document acted as an interface to RAM allowing input of environmental variables and plotting or viewing functionality for model outputs. There are several groups with similar input / output routines for multiple sound transmission models, some of which are publicly available. The authors would do well to avoid future criticism to actually state which sound transmission model they have used, rather than a one-off in-house model name which is more a complex interface package carrying out the transmission loss calculations.

Assuming the MONM model used RAM, then this is a good sound transmission model for the scenarios explored here. RAM can deal with variable bathymetry, variable sound speed profiles and any combination of sea bed properties which do not involve losses via conversion of sound energy into shear wave energy in the substrate. The thick overlying sedimentary layers modelled in this document do not support significant shear waves, and therefore will be modelled well by RAM, assuming layering thicknesses and geo-acoustic properties can be well defined.

The comparison of measured vs. modelled transmission loss curves (Figure 7.1 to Figure 7.4) show a modest match. Few statistics on how well the modelled data matched the measured data are presented. Looking at the plots, discrepancies up to 20 dB are evident at some frequencies. These discrepancies may have a major bearing on sound transmission depending on the frequency content of the source. It is always difficult to match modelled sound transmission with measured data for various reasons. While the maths underlying the sound transmission modelling is well defined (for that model's capabilities), the environment is generally not known in sufficient detail and is naturally variable along any transmission path. Thus it is to be expected that there will be discrepancies between modelled and measured data, with modelling providing an indication of likely sound levels to be experienced. This reviewer would like to see a better quantification of the match of modelled vs. measured data and some form of carry-through of potential errors into modelled sound fields.

1.1.4 Acoustic source levels

A variety of source level estimates have been used. For the tanker underway the authors used measured data from a tanker travelling at 16 knots then subtracted 5 dB from this to account for the reduction in speed in the fjords, stating they have assumed the vessel will be operating at half power. They give no justification for the 5 dB drop. How was this derived? Assuming half power is a 3 dB drop for equal shaft power to radiated noise. A 3 dB decrease in source level compared with a 5 dB decrease will increase the modelled ranges for any particular sound level.

1.1.5 Measured sound fields

It is not clear in the document if the modelled sound fields presented do or do not include expected ambient noise levels. There are several images which appear to show sound energy from a source reaching behind Islands (i.e. Coste Figure 7-11). Was this due to the ambient noise contribution? Or due to diffraction of sound around the Island? Or was the Island bathymetry removed from the model run?

The document concludes with a large number of figures showing sound fields for the different scenarios modelled with a following section showing similar figures after applying frequency weightings to predict levels above an animal's hearing threshold. While the images are all good, there are no summary statistics, for example what are the along-channel ranges for a variety of received sound pressure levels? Such a table would allow comparison of the different sources operating in the different environments and would enable anyone to estimate the time of raised noise levels during vessel passages. The document has been considerably weakened by not summarising the modelled outputs in some tabular format.

2.3 Presentation Issues

The reviewer would prefer to see the spectrograms of figures 3.1 to 3.5 with calibration bars for the intensities displayed, although this is an option.

There is no explanation of how Figure 5-10 was derived. While it shows the surface duct described how did they model this and derive the figure?

2.4 Summary

The document provides a small snapshot of ambient noise measurements in the study area, some limited sound transmission data and estimated sound fields for multiple scenarios of vessel movements in the channels. Modelling underwater sound fields in any environment is an exercise fraught with problems, these primarily being: 1) natural variation in the source levels of vessels; and 2) naturally variable and usually unknown environmental factors which are critical in accurately modelling sound transmission. Aside from these two factors, the document presents a good estimate of the likely noise fields of various vessels operating in the channels approaching Kitimat, but these should be considered as estimates. The document fails to capitalise on the modelled outputs by quantifying the ranges along-channel for various received sound levels.

3 Technical Data Report Marine Acoustics (2010) Enbridge Northern Gateway Project JASCO, 2010

3.1 General Comments

This document follows the previous modelling document (2006) by presenting modelling of ships underway in the open water west of the coast. This document only presents four model outputs.

The major technical comment for this document is similar as for the previous 2006 modelling document in that the MONM package used for the underwater sound field modelling is presented as a black box model thus one cannot really ascertain if it used the most appropriate sound transmission loss model for the environments.

Assuming RAM was used for the sound transmission loss modelling, the environments used for modelling scenario 2, 3 and 4 are suitable for RAM as they have thick surficial layers which do not support shear waves. The environment for Scenario 1 at the Langara site may require a different model to be run which does support shear waves (RAM does not support shear waves in its calculations) as the bedrock is very close to the surface and will have a significant shear wave

sound speed which is likely to be close to the in-water sound speed and thus involve good coupling of sound energy into shear waves in the bedrock. If the proximity of the bedrock to the seabed does invoke losses of in-water sound energy into shear wave energy in the bedrock, then the existing model outputs at the Langara site will over-predict the sound fields (i.e. will predict longer ranges for a given SPL value), so they will be conservative in predicting environmental impacts.

This document has provided some summary data from the modelling output in the form of a table of equivalent radii, which encompass 95% of the area ensonified at 120 dB re 1μPa. This is an improvement over the previous document although this author would like to see along-channel ranges for a selection of SPL values at each modelled scenario.

No comparison between this report and the outputs of modelling report 1 listed above are presented.

No time series data and no instances of multiple vessels using the channels are presented.

4 Northern Gateway Pipeline Project: Vessel Transit Noise. Marine Acoustics Modelling study 2011. JASCO July 19, 2012, V2.0

4.1 General Comments

This document presents modelled sound fields from seven scenarios of vessel movements in the entrance to and in the waterways leading to Kitimat. Several of the scenarios from the previous modelling reports (1 and 2 above) were re-modelled here using different source level estimates (incorporating new measurements and higher vessel speeds) and a wider frequency band (outputs of modelling over 20 Hz to 5 kHz were presented in reports 1 and 2 above, this document uses a modelling frequency bandwidth of 1/3 octave centre frequencies from 20 Hz to 20 kHz). The format presented in this document follows that of the previous two modelling reports with large numbers of figures and few tables summarising the figure outputs.

This document gives more detail of the MONM model and confirms that RAM was used below 5 kHz and Bellhop used over 5 kHz to calculate sound transmission loss. These sound transmission models are robust over the frequency ranges used, allow variable environmental parameters to be used, but do not support seabed types where coupling of sound energy into shear wave energy in the substrate may be substantial. The authors indicate that the RAM model can be altered to incorporate shear wave effects but do not state how this is done nor if it was done. The seabed type at Caamano Sound is most likely to invoke in-water sound energy coupling into shear wave energy due to the shallow bedrock, but as the table listing geoacoustic properties for this environment does not give any values for shear wave speed or attenuation through the substrate, we must assume that it was not included in the model calculations.

This document uses updated source level estimates based on measurements taken between this document and documents 1) and 2) above. But, as the document states, these source level estimates are somewhat compromised by the inability to separate out the individual contribution of multiple sources in the measured data. The document discussion elaborates the consequences of this and of altered source speeds used in this document compared with documents 1) and 2) above.

As per modelling report 2) above, for each modelled scenario, this document only presents the equivalent radii which encompass 95% of the area ensonified by SPL values of 120 dB re μPa or

above. The document does not give along-channel ranges for ensonification of various SPL values. The document does not give comparisons of the equivalent radii for 95% area of the 120 dB re μPa contour between this analysis and the previous analysis conducted in studies 1) and 2) above. Comparing the two summary tables in modelling reports 2) and 3), implies the radii given in this report are more than twice as large as given in report 2). If anything, this exemplifies the inherent variability in estimating underwater sound fields, which presumably was due to the altered source levels (and implied different vessel speeds) used between model runs, although this is not clearly discussed in this report.

Not easily to interpret, quantified comparison between this report and the outputs of modelling reports 1) and 2) listed above are presented. The effect of the altered source level measures for vessels operating at different speeds is not clearly discussed here. This document does imply that much greater ranges for a given sound level occur for the vessel travelling at higher speeds but does not compare the results modelled here to those modelled in report 1) above (2006) to indicate if speed or the different vessels measured will alter the 2006 sound field estimates. The estimates made in the 2006 modelling document are critical as they have been used to estimate environmental impacts.

No time series data and no instances of multiple vessels using the channels are presented in this report.

5 Volume 8B: Environmental and Socio-Economic Assessment (ESA) – Marine Transportation. Enbridge Northern Gateway Project. Sec 52 Application May 2010

5.1 General Comments

Sub sections with predicted underwater noise impacts for different faunal groups were reviewed as explained below. The underwater acoustic modelling report 1) above was used to estimate sound fields on which the environmental assessments were made.

There was no cumulative mapping which included time and multiple large ships for the sound fields of vessel movements associated with the Enbridge Northern Gateway Project, the noise impacts of other vessel traffic currently using the waterways was not considered, and the cumulative impact of Enbridge and other traffic combined in time and space was only considered superficially. There was no mathematical attempt made to move beyond a single scenario of vessel passage combination as was carried out in the modelling. There have been no long-term monitoring programs put in place to define the current ambient noise regime (i.e. the current level of ship traffic) using the waterways and none seem to be proposed to define the increased noise from the Enbridge Northern Gateway Project. While measurements of ships wake were made, there has been no discussion of the effect of ship propeller wash on eggs and larvae, which may be a prominent environmental impact for fish and invertebrate eggs.

The section on invertebrates dismisses any impacts from underwater sound based on little evidence being available for sound impacts on invertebrates, assuming that the dearth of experiments and appropriate observations implies no effects. That there have been few experiments conducted on the impact of chronic sound on marine invertebrates is in no way proof that impacts do not occur. Indeed there are experiments that show reduced fitness for invertebrates exposed to sound (e.g. Regnault and Lagardere 1983), that some invertebrates definitively respond adversely to intense sounds (squid, Fewtrell and McCauley 2012) and that some invertebrates may

suffer severe sensory damage from moderate sound exposures (squid, Andre et al. 2011). None of this literature is presented or discussed.

The section on fish assesses impacts on fish using a threshold for physiological damage set for impulse signals. Vessel noise is not an impulse signal and the threshold used for impulse effects is not appropriate for assessing behavioural effects, masking or associated loss of fitness to fish from long-term noise exposure. The document has made no attempt to consider sub-lethal or behavioural effects from chronic longer-term noise exposure and has not considered any of this literature. The document then implies that no monitoring of noise impacts on fish is required, even though it has ignored sub-lethal and behavioural impacts on fish from vessel noise.

The environmental assessment document is considerably weakened as it has considered impacts on marine fauna on a case-by-case basis and has not made a serious attempt to link these in an ecological or trophic framework. Thus large-scale ecological features driven by the more common and ecologically important species in the waterways have not been adequately considered. For example, the document goes into considerable detail in defining how killer whales may sense the sound field of vessels using the area and their possible immediate responses. But it largely ignores the fact that killer whales will only exist in the region if there is a viable food supply. The document has not thoroughly considered impacts on the key killer whale or other marine mammal prey species, which inhabit the CCAA waterways (see sections on invertebrates and fish above).

1.1.6 Section 8.3 Effects on Marine Invertebrates

This section dismisses any impacts of the noise from vessels associated with the Enbridge Northern Gateway Project on marine invertebrates. It justifies this conclusion based on one experiment with snow crab and seismic survey signals and apparently healthy population of snow crab coexisting with high traffic areas in other parts of British Columbia. The document makes the statement:

The modelling predictions showed little overlap between elevated acoustic emissions and nearshore habitats. With the exception of the marine terminal, typical maximum acoustic levels reaching nearshore habitats on the opposite side of Kitimat Arm, directly across from the marine terminal, are between 125 and 130 dB re 1 µPa. At the marine terminal, noise levels might be up to 165 dB re 1 µPa.

The modelling results do not show this, they indicate moderate levels of vessel noise in the range 120-130 dB re 1 µPa will be reached along the shoreline of many of the inlets leading to Kitimat and in Kitimat.

There is not sufficient information on impacts of low to moderate continual shipping noise on invertebrate communities to be able to determine if this noise does have any chronic effects on these animals. On the one hand it is difficult to argue against the conclusion made in the document due to the lack of appropriate science-based observations or experiments, but on the other hand the lack of appropriate science-based observations or experiments cannot be used to claim there are no effects.

1.1.7 Section 9. Marine Fish

There is one incorrect statement in this section. Page 9-18 states that transmission loss increases below 20 m depth and implies rockfish will be exposed to less sound energy than modelled. This is simply not true, there may be instances where it is true but in general sound transmission loss has a complex vertical structure throughout the water column and is generally

lowest between midwater and the seabed, implying received sound levels are highest between midwater and the seabed. This statement is false.

The assessment of impacts on fish has wrongly used a sound threshold set for impulse noise impacts for physiological damage to fish. Vessel noise is not impulse noise and will deliver more energy to a fish ear over the time it takes a vessel to pass than exposure to a short burst of say pile driving or seismic survey noise, which is what the threshold used in the document was set for. It is well known in studies of hearing loss that for continuous noise exposure the time of exposure plays a role in the susceptibility of the human ear to damage. Thus the assessment made for all noise impacts on fish in this section does not consider the continual vessel noise, which the fish will be exposed to.

The cumulative impacts assessment section (9.6.3) blandly dismisses any cumulative impacts based on no evidence or attempt to define over what period of time fish may suffer a loss of fitness. There has been no mathematical description of cumulative noise exposure fishes may experience now or after the Enbridge Gateway project is in operation.

There has been no attempt to define how vessel noise may reduce the communication space of fish in the waterways. The document points out that rockfish have muscles attached to the anterior section of the swimbladder. This reviewer's experience is that these muscles are associated with sound production for spawning events, with different sounds used to advertise spawning events to other co-specifics, for individual mate attraction and for mediating gamete release. The potential impact of a reduction in spawning success due to animals not being able to hear each other resulting from increased vessel noise has not been considered. The document points out that herring are hearing specialists having specialised structures to improve their hearing. They are hearing specialists as a large number of other marine fauna try to eat them, and they have highly developed sensory systems in general to avoid predation. The document makes no attempt to investigate how the potential decreased ability of herring to hear in the presence of vessel noise may change their probability of being eaten.

The document states that no future monitoring is required for fish. Given that the document uses a threshold for physiological impact set for impulse signals rather than continual vessel noise and has not considered the possibility of adverse behavioural impacts, loss of fitness, increased predation risk, loss of communication space and the trophic, economic and cultural significance of fish in the CCAA, there is no justification for the conclusion made and every justification for setting in place plans for detailed monitoring of the fish stocks and acoustic soundscape in the waterways impacted.

1.1.8 Marine Mammals

The sections on potential impacts of underwater sound on marine mammals themselves are reasonably thorough and robust although all are lacking in assessing potential loss of habitat and subsequent reduction of fitness to the species concerned, this partly due to a lack of baseline data. The major failings of this section are that it glosses over impacts on marine mammal prey and largely ignores the potential loss of the communication space used by marine mammals due to masking by vessel noise. Most of the marine mammal species which utilise the inland or coastal waterways are critically dependant on viable prey populations remaining in the area. While the issue of healthy prey populations is mentioned in places in this section, it has not been considered as a key item of concern and in places is dismissed based on the sections on fish and invertebrates, which do not correctly or adequately assess the risk to prey fields. The listing of section *10.2.1 Key Marine Transportation issues for Marine Mammals* ignores potential impacts on prey species.

For northern resident killer whales, the conclusion is that underwater sound may present a significant risk to killer whales using the inland CCAA waterways but the current state of knowledge on impacts and how the animals use the waterways precludes a definitive answer on how severe this risk is. The document does propose methods to monitor the Killer Whale populations. These are reasonable conclusions and the authors have tried to make suggestions on appropriate mitigation techniques for reducing the project underwater noise and understanding the impact of the project on killer whales.

The section on humpback whales concludes that cumulative vessel noise in the CCAA and approaches will be a significant risk and detriment to the population using the CCAA. But the document then states that this potential localised loss of habitat or reduction of fitness will not impair recovery of the western north Pacific humpback population due to its size, but fails to quantify this or present the importance of the impacted waterways and coastal approaches at the humpback whale population level.

The section on Steller sea lions is brief but indicates that parts of the CCAA are critical to the British Columbia population, there being one of three primary rookeries present in the CCAA. This section concludes that underwater noise impacts on Steller sea lion individuals will be limited based on limited knowledge of their hearing ability and behavioural response to underwater noise. But again, the analysis presented completely ignores the fact that a viable rookery of Steller sea lions is critically dependant on a viable prey population. This is most critical over the breeding season when sea lions generally have a limited foraging range from their rookery, here listed as 17 km. Any vessel noise induced reduction in prey density or changes in prey behaviour which alter their availability to Steller sea lions will represent a significant risk to the population viability.

This section concludes with a summary of each key indicator marine mammal group claiming that ‘residual’ environmental impacts on northern resident killer whales, humpback whales and Steller sea lions in the CCAA is low. This does not agree with the conclusions made in each respective section, does not take into account the full range of vessels using the CCAA area (it focuses on project specific vessels only), does not take into account potential impacts on prey fields and ignores human users of the CCAA who value viable marine mammal and fish populations in the CCAA.

6 References

Michel André, Marta Solé, Marc Lenoir, Mercè Durfort, Carme Quero, Alex Mas, Antoni Lombarte, Mike van der Schaar, Manel López-Bejar, Maria Morell, Serge Zaugg, and Ludwig Houégnigan (2011) Low-frequency sounds induce acoustic trauma in cephalopods. Front Ecol Environ 2011; doi:10.1890/100124

Fewtrell J.L., McCauley R.D. (2012) Impact of air gun noise on the behaviour of marine fish and squid. Marine Pollution Bulletin 64 (2012) 984–993

Regnault, M. and J.P. Lagardere.(1983). Effects of ambient noise on the metabolic level of *Crangon crangon*. Marine Ecology Progress Series 11:71-78.

WWF-Canada
World Wildlife Fund Canada

1588 – 409 Granville Street
Vancouver, British Columbia
Canada V6C 1T2

Tel: 604-678-5152
Fax: 604-678-5155

pacificregion@wwfcanada.org
wwf.ca

for a living planet®

Corrections for, *"WWF-CANADA SUBMISSION TO ENBRIDGE NORTHERN GATEWAY JOINT REVIEW PANEL" Submitted August 29th 2012.*

Corrections dated: Thursday, September 06, 2012

Pg 21, Under Marine Mammals, para 1, line 1, remove "not". The corrected sentence should read;

> *The masking effects of noise on marine mammals are entirely neglected within the project submissions and there is no quantification of the amount of 'communication space' lost from increases of underwater noise from the project.*

Note: the work and metrics contained in WWF-Canada's submission from preliminary work done by Erbe et al (55) have undergone an iteration of revisions since the submission was made. In that light, the following update is issued to the numbers related to the noise metrics contained in our submission.

pg 22, in paragraph 4, under Cumulative Noise Levels, the previous range for the modeled increases in cumulative noise exposure level that would result from shipping traffic attributed to the Enbridge project were reported as 0 to 22.9 dB re 1 µPa2s. These should be updated and reported as 0 to 29.6 dB. The units are dB not dB re 1 µPa2s. Paragraph 4 on Pg 22 should be replaced and read as follows.

> *From preliminary work completed (54) cumulative noise exposures and the duration of time for noise exposure can be determined for the project activities: the noise from projected vessel traffic that will result from the project will increase cumulative Sound Exposure Levels in a summer month between by an additional 0 to 29.6 dB. A preliminary map of where these increases are expected to occur are provided in Figure 2 which illustrates the increased sound levels with areas identified as potential or candidate critical habitat for Northern Resident Killer Whales and Humpback Whales.*

Figure 2, on pg 23 should be replaced by what is provided below.

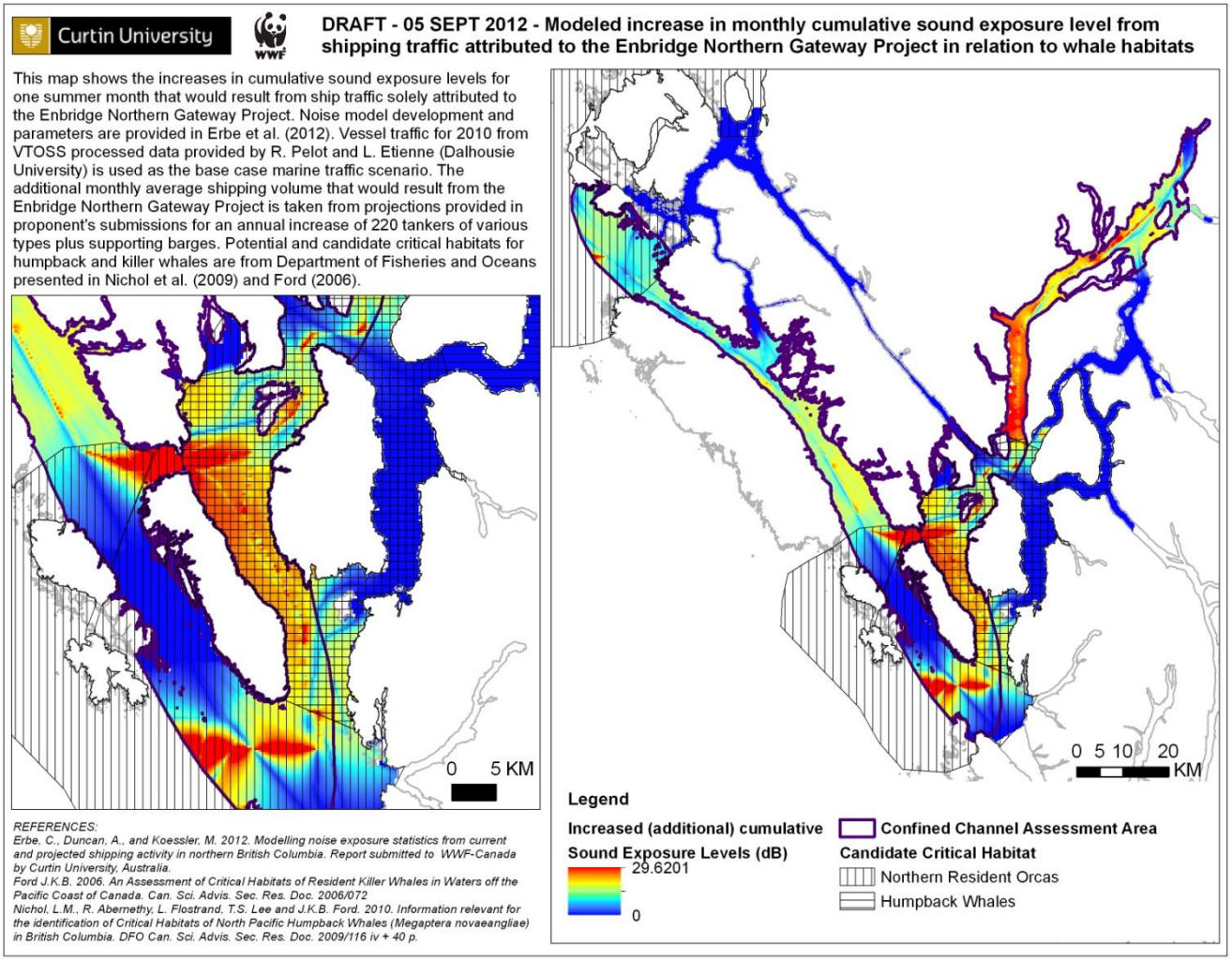


Figure 2: Modeled increase in monthly cumulative sound exposure level

(54). Erbe, C, Duncan, A and Koessler, M. Modelling noise exposure statistics from current and projected shipping activity in northern British Columbia. Report Submitted to WWF Canada by Curtin University, Australia. 2012.