What risks does the Enbridge Northern Gateway project present to Cetaceans?

Oil tanker traffic associated with the proposed Enbridge Northern Gateway Project poses risk to marine mammals in at least four broad ways:

1. Elevating the risk of oil spill. A catastrophic oil spill could expose large fractions of marine mammal populations to contaminants. The sinking of a small diesel tug in Johnstone Strait in 2007 exposed 25% of the northern resident killer whale population to fuel (Williams et al. 2009[1]) demonstrating the vulnerability of killer whales at a population, not just individual, level.

   Chronic toxicological effects from oil spills are a serious concern for killer whales. Killer whales are long-lived and slow to reproduce, with females giving birth to typically only four to six calves throughout their lifetimes. Prince William Sound, Alaska is home to both resident and transient killer whales. Before the *Exxon Valdez* oil spill, the AT1 transient population was stable at 22 whales. Although nine whales disappeared immediately after the spill, it took years to confirm these missing whales had died. After the spill, 15 transient whales went missing from the AT1 group, a number of which were females. Although only five carcasses were ever found, these whales are almost certainly dead. Moreover, over the last 20 years no recruitment of calves into this population has been recorded. All evidence suggests this unique population of killer whales is going extinct. The timing and magnitude of missing individuals directly following the spill plus the known exposure of the AT1 pod to the oil suggests that oil was the cause. Scientists have hypothesized that these whales died from inhaling toxic oil vapours or from eating oiled harbour seals (Exxon Valdez Trustee Council 2010[2]).

   Similar to the transient killer whales, the link between the decline of the resident population and the oil spill was not immediately obvious. No carcasses of any resident whales were ever discovered. As with the transients, the resident whales

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[1] Williams, R. D. Lusseau, P.S. Hammond. 2009. The role of social aggregations and protected areas in killer whale conservation: the mixed blessing of critical habitat. *Biological Conservation* 142:709-719.
[2] Exxon Valdez Oil Spill Trustee Council http:// www.evostc.state.ak.us/Recovery/ status.cfm

were observed surfacing in oil slicks immediately following the spill and nearly all of the deaths occurred between then and over the following winter. The mortality rate was 19% in 1989 and 21% in 1990, roughly 10 times the natural rate. Fourteen of 36 whales died in the AB pod, many of which were young and reproductive females. Although calves have been born into this population, unexpected mortalities and the loss of these important females has meant an uphill battle for recovery. Mortality and impacts are likely due to petroleum or petroleum vapours inhaled by whales (Matkin et al. 2008[3]).

2. Elevating the risk of ship strike to whales. Growing shipping traffic is escalating the risk of vessel strikes on whales and other marine mammals. A spatial risk assessment was conducted in 2004 (Williams and O'Hara 2010[4]) to identify areas where fin, humpback, and killer whales encounter areas of high shipping intensity. The study found that relative risk was highest in confined areas (geographic bottlenecks). In addition to the threat from supertankers in and out of Kitimat, expansion of the Port of Prince Rupert and high levels of cruise ship traffic all increase the potential for ship strikes. By 2020, container traffic travelling to Asia from BC is expected to increase by 300 percent from 2007 levels (BC Crown Speech 2007[5]) further increasing the possibility of injury or mortality.

3. Increasing chronic ocean noise levels in important marine habitats. The proposed oil tanker route provides important habitats for several marine mammal species (Williams and Thomas, 2007[6]). Chronic exposure to boat traffic and noise can cause killer whales to reduce their time spent feeding (Williams et al. 2006[7]).

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[3] Matkin, C.O., E.L. Saulitis, G.M. Ellis, P. Olesiuk and S.D. Rice. 2008. Ongoing population-level impacts on killer whales Orcinus orca following the "Exxon Valdez" oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series 356:269-281.
[4] Williams R, O'Hara PJ. 2010. Modelling ship strike risk to fin, humpback and killer whales in British Columbia, Canada. *Journal of Cetacean Research and Management* 11:1-8.
[5] BC Crown speech 2007
[6] Williams, R. and L. Thomas. 2007. Distribution and abundance of marine mammals in the coastal waters of BC, Canada. *Journal of Cetacean Research and Management 9: 15-28.*
[7] Williams, R. D. Lusseau and P.S. Hammond. 2006. Estimating relative energetic costs of human disturbance to killer whales (*Orcinus orca*). *Biological Conservation* 133: 301-311.

4. Transportation of invasive species. Ballast water could transport invasive species, facilitate movement of pathogens, or increase the incidence of harmful algal blooms, which can kill marine mammals (Gulland and Hall 2007[8]).

5. These individual concerns also combine to create cumulative effects.

All of the above conclusions can be reached through a reasonable examination of peer-reviewed scientific literature.

We have quantified the risk (defined as probability of an oil spill multiplied by the consequence) to marine mammals by assigning the segments taken from Figure 3-1 of Volume 8C, (Enbridge 2010[9]) spill probability numbers from Table 8-2 of the Marine Shipping Quantitative Risk Analysis Technical Data Report (Enbridge 2010[10]). In ArcGIS, the segment probability was extended outwards from the intersection point between segments using a geo-referenced shipping line to create polygons assigned the probability value (Figure 2.1.8). This layer was joined to the 5-km^2 grid used in the density surface modelling. Probability of a spill was then multiplied by the consequence (predicted density or frequency) for marine mammals, for each grid square. Where an individual grid square was intersected by multiple segment polygons, the highest probability number was retained. Although we use Enbridge's probabilities in our assessment of risk, our usage is not an endorsement as explained elsewhere in our submission.

Figures 2.1.9 and 2.1.10 show the risk (probability x consequence) for Humpback, Fin, Minke and Killer whales only (Figure 2.1.9), and all marine mammals included in the density surface modelling (Figure 2.1.10). In comparing the left-hand maps with the right-hand maps, the higher probability of spill in some segments clearly increases the relative risk to marine mammals in those areas; notably the east end of Dixon Entrance, Browning Entrance, southern Principe Channel and the waters surrounding Campania Island and Caamaño Sound. Increased

[8] Gulland, F.M.D., and A.J. Hall. 2007. Is marine mammal health deteriorating? Trends in the global reporting of marine mammal disease. *Ecohealth* 4:135–50.
[9] Enbridge Northern Gateway Pipelines. 2010. Exhibit B3-37 to B3-42 – Vol 8C - Gateway Application – Risk Assessment and Management of Spills – Marine Transportation - pg.3-3.
[10] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23-34 - Gateway Application – TERMPOL TDR Marine Shipping QRA - pg.8-122.

risk to marine mammals in these areas demonstrates that project impacts cannot be quantified by using only questionable baseline conditions, as Enbridge has done.

Enbridge's most egregious error was that probabilities of spills were not related to ecological consequences. Given the serious inadequacies in Enbridge's marine mammal surveys, combined with their failure to appropriately assess spatially related synergistic factors, we can only conclude that their assessment of project impacts to marine mammals is substandard and unusable for decision-making. Our more rigorous assessment of risk is illustrative of what can be done using very limited resources.

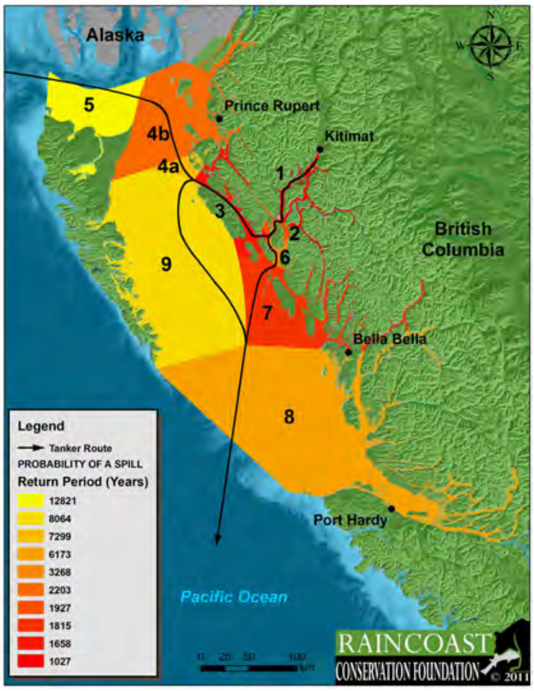

Figure 2.1.8: Probability of a spill from marine tanker traffic associated with the Enbridge Northern Gateway Project in north and central Pacific Canadian waters, by segment. Return period of a spill in years was calculated from mitigated probabilities using Table 8.2 of the Marine Shipping Quantitative Risk Analysis completed by DNV (Enbridge, 2010[11]).

[11] Enbridge Northern Gateway Pipelines. 2010. Exhibit B23-34 - Gateway Application – TERMPOL TDR – Marine Shipping Quantitative Risk - pg. 8-122

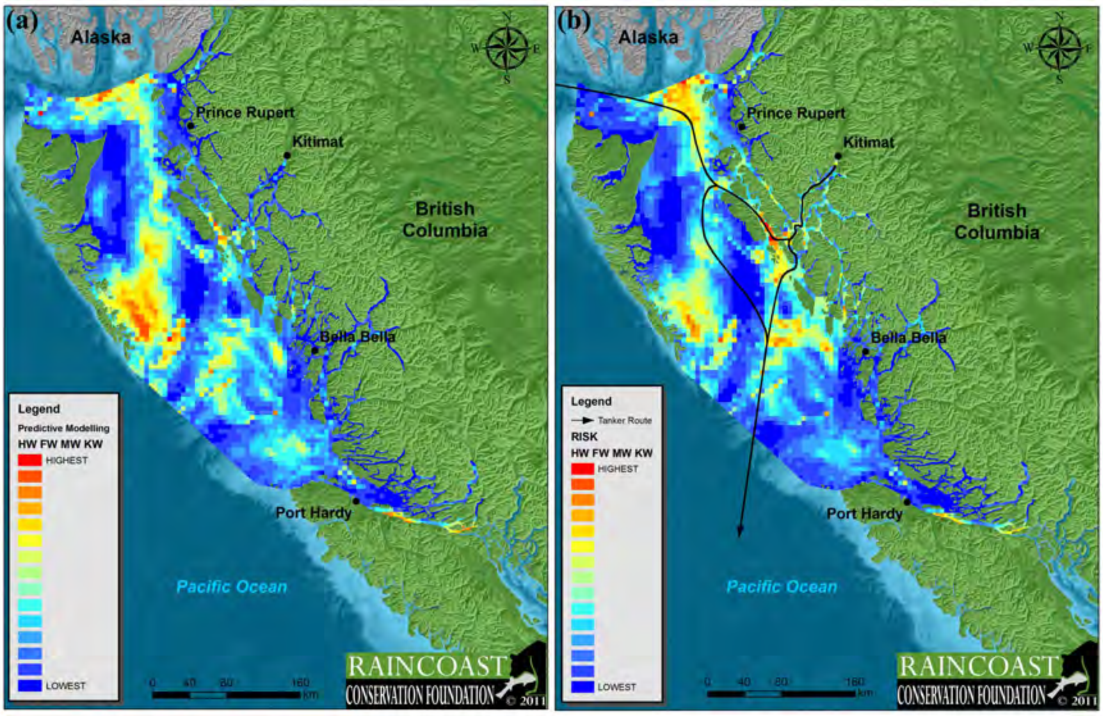

Figure 2.1.9: (a) Raincoast modelling (Best and Halpin 2009) compared with (b) the risk (predicted density multiplied by the probability of a spill) associated with marine transport for Humpback (HW), Fin (FW), Minke (MW) and Killer whales (KW) in Pacific Canadian waters.

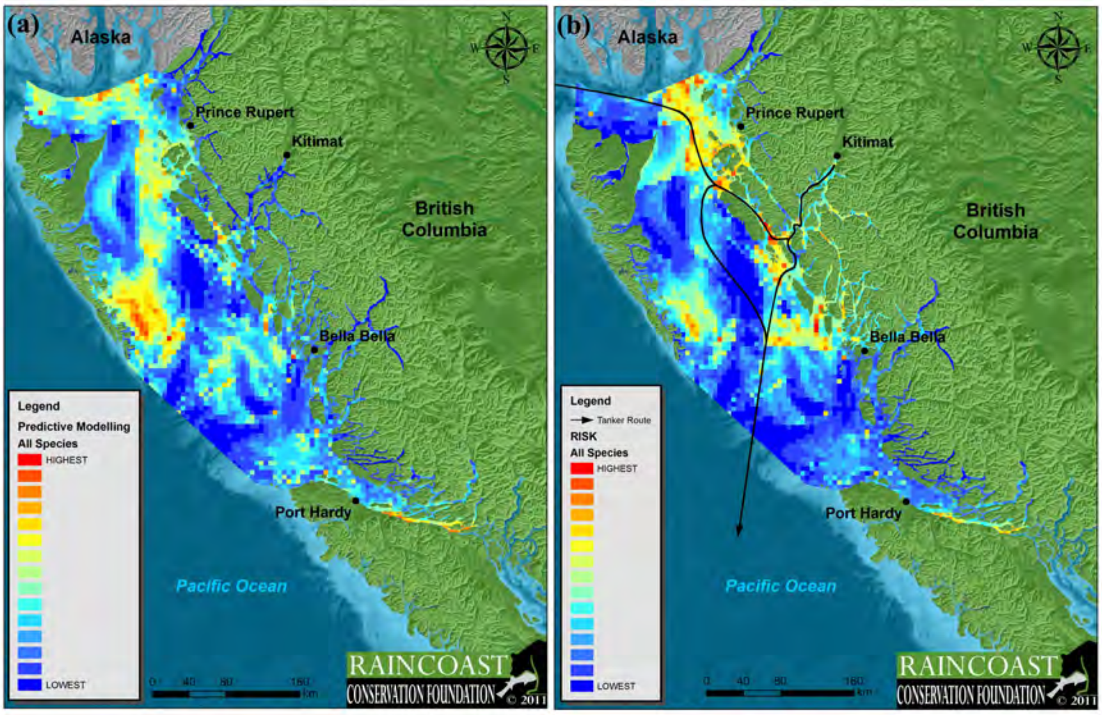

Figure 2.1.10: (a) Raincoast predictive modelling (Best and Halpin 2009) compared with (b) the risk (predicted density multiplied by the probability of a spill) associated with marine transport from the proposed Enbridge Northern Gateway project, for all species observed (cetaceans and pinnipeds) in north and central Pacific Canadian waters.

How do cumulative impacts, including climate change, affect these cetaceans and is the overall impact significant?

Concerns for cumulative impacts come from the incremental and combined effects of human activities. Many of the threats to marine mammals are shared across species: low populations from historical hunting, incidental catch from fishing gear, depletion of prey from overfishing, chemical pollution, vessel strikes, and ship noise (Rice 1998[12]). The removal of marine species that support habitat structure and food supply, destruction of the seabed, persistent addition of airborne and aquatic pollution, introduced species and diseases, and increased inputs of carbon dioxide to the atmosphere and ocean have all created multiple

[12] Rice, D. W. 1998. Marine mammals of the world: Systematics and distribution. Society for Marine Mammalogy.

lines of interacting threats. Acting synergistically, their effect is to compromise ecological processes such as primary production and species interactions, which results in an altered coastal environment.

For example, the absorption of carbon dioxide by the ocean could create noisier oceans (Hester et al. 2008[13]). When greenhouse gas reacts in the ocean, it lowers pH, creating more acidic waters. The more acidic the water, the less that sound waves are absorbed. Keith Hester, a researcher with the Monterey Bay Aquarium Research Institute, predicts sounds will travel 70% further by 2050 because of increased carbon dioxide acidifying our oceans. A louder ocean will negatively affect cetaceans that rely on sound to navigate, communicate, find food, and avoid predators.

The importance of regional scale connections for cetaceans and other pelagic marine predators was underscored by a recent study in Nature (Block et al. 2011[14]). A Census of Marine Life field program placed 4,306 tags on 23 different species in the North Pacific Ocean to provide tracking data of unprecedented scale. The results indicate that the California Current large marine ecosystem and the North Pacific transition zone attract and retain a diverse assemblage of marine vertebrates. The report identifies critical habitats across multinational boundaries showing that top predators exploit their environment in predictable ways, further highlighting the need for spatial management of large marine ecosystems.

[13] Hester, K. C., E. T. Peltzer, W. J. Kirkwood, and P. G. Brewer. 2008. Unanticipated consequences of ocean acidification: A noisier ocean at lower pH. Geophysical Research Letters 35:31.

[14] Block, B. A., I. D. Jonsen, S. J. Jorgensen, A. J. Winship, S. A. Shaffer, S. J. Bograd, E. L. Hazen, D. G. Foley, G. A. Breed, A.,L. Harrison, J. E. Ganong, A. Swithenbank, M. Castleton, H. Dewar, B. R. Mate, G. L. Shillinger, K. M. Schaefer, S. R. Benson, M. J. Weise, R. W. Henry & D. P. Costa. 2011. Tracking apex marine predator movements in a dynamic ocean. *Nature* 475, 86–90