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NATURAL RESOURCES DEFENSE COUNCIL

SUBMISSION OF THE NATURAL RESOURCES DEFENSE COUNCIL TO THE ENBRIDGE NORTHERN GATEWAY PROJECT JOINT REVIEW PANEL

Regarding Underwater Noise Impacts from Northern Gateway Tanker Traffic

December 22, 2011

The Natural Resources Defense Council ("NRDC") is an international non-profit environmental organization, headquartered in New York City, with more than 1.3 million members and online activists. Since its founding in 1970, NRDC has worked to protect the world's natural resources, public health, and the environment.[1]

For the past fifteen years, NRDC has helped lead the environmental community in advancing policy on the impacts of underwater noise on marine wildlife. We have published two general reports on the issue; have served on multiple expert working groups and stakeholder panels, including, currently, the Gulf of the Farallones/ Cordell Bank National Marine Sanctuaries Joint Working Group on Shipping Impacts on Marine Mammals; have presented papers on the subject at numerous scientific and legal conferences, including the Acoustical Society of America and the Society for Marine Mammalogy Biennial; have regularly submitted comments to U.S. government agencies on underwater noise and successfully litigated the matter before U.S. federal courts; and have progressed the issue in various intergovernmental fora, including the International Whaling Commission and the Convention on Migratory Species and its related agreements. We are currently working at the International Maritime Organization to develop guidelines for reducing underwater noise from commercial ships.

This submission concerns the acoustic impacts of the Northern Gateway project on marine mammals, particularly the northern resident killer whale and humpback whale, both of which are listed under the Species at Risk Act. NRDC is submitting this testimony because underwater noise generated by the project poses a significant risk to BC coastal wildlife; and because Enbridge's 2010 application fails to adequately assess these impacts.

[1] For further information on NRDC, please see our website at www.nrdc.org.

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I. Introduction to Underwater Noise

The ocean is an acoustic world. Unlike light, sound travels extremely efficiently in seawater, and marine mammals and many fish depend on sound for finding mates, foraging, avoiding predators, navigating, and communicating—in short, for virtually every vital life function. When we introduce loud sounds into the ocean, we degrade an essential component of ecosystem health. Some biologists have likened the increasing chronic levels of noise from human activities to a rising tide of "smog" that has urbanized and in some areas industrialized major portions of the marine environment off our coasts.[2] This "acoustic smog" is shrinking the sensory range of marine animals and disrupting important behaviors on population and species scales. A substantial and growing body of research now indicates that ocean noise pollution negatively affects at least 55 marine species, including several endangered species of whales and commercially valuable species of fish.[3]

Commercial shipping, including tanker and tugboat traffic, is by far the largest single contributor to man-made noise in the oceans. It dominates ambient noise in the low-frequency band below 250 Hz, which for many species, including humpback and grey whales, is a critical component of their habitat; and, being broadband, it can affect a wide diversity of wildlife, including virtually every species of marine mammal.[4] For this reason, the International Maritime Organization ("IMO") has identified underwater noise as a priority issue for its current biennium, and its Marine Environment Protection Committee has placed the development of vessel-quieting guidelines on the IMO's work agenda.[5] Impacts from shipping include habitat avoidance and abandonment, masking of biologically important signals, loss of foraging ability and opportunity, reduced reproductive success, and chronic stress.

Should the Gateway project go forward as proposed, tankers would run the hazardous northern or southern route from Kitimat through the Douglas Channel and Hecate Strait and out to open ocean, at an estimated rate of 380 to 500 transits per year, or more than

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[2] Bode, M., Clark, C.W., Cooke, J., Crowder, L.B., Deak, T., Green, J.E., Greig, L., Hildebrand, J., Kappel, C., Kroeker, K.J., Loseto, L.L., Mangel, M., Ramasco, J.J., Reeves, R.R., Suydam, R., Weilgart, L. (2009), Statement to President Barack Obama of Participants of the Workshop on Assessing the Cumulative Impacts of Underwater Noise with Other Anthropogenic Stressors on Marine Mammals.

[3] E.g., Hildebrand, J.A. (2005) Impacts of anthropogenic sound, in Reynolds, J.E., *et al.* (eds.), *Marine Mammal Research: Conservation beyond Crisis* (Baltimore: Johns Hopkins University Press); Weilgart, L. (2007), The impacts of anthropogenic ocean noise on cetaceans and implications for management, *Canadian Journal of Zoology* 85: 1091-1116.

[4] McDonald, M.A., Hildebrand, J.A., and Wiggins, S.M. (2006), Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California, *Journal of the Acoustical Society of America* 120: 711-718.; Wright, A.J. ed. (2008), *International workshop on shipping noise and marine mammals*, proceedings of workshop held by Okeanos-Foundation for the Sea, Hamburg, Germany, 21-24 April 2008.

[5] IMO Assembly (2010), Res. A.1012(26): High-level action plan of the organization and priorities for the 2010-2011 biennium; United States Government (2011), Provisions for the reduction of noise from commercial shipping and its adverse impacts on marine life, IMO doc. DE56/24/1.

one on average per day, in addition to their berthing and unberthing activities.[6] The Very Large Cruise Carriers required by Gateway carry 320,000 deadweight tons, which is more than 5 times the tonnage of the deep-sea vessels that presently call on the Port of Kitimat. (App. Vol. 8A at 4-8, Vol. 8B at 10-19, 10-57.) The other vessels that Enbridge anticipates using, Aframax and Suezmax tankers, also carry significantly more tonnage than ships that currently traverse the area (*id.*), and each would be escorted through Enbridge's Confined Channel Assessment Area by one or more tugboats, contributing additional noise. In general, large tankers produce more underwater noise than any other class of commercial vessel,[7] and here they would be used intensively in habitat that is particularly vulnerable to perturbation.

II. Behavioral Impacts

The impact analysis in Enbridge's 2010 application substantially underestimates the behavioral impacts that increased shipping noise would have on BC's coastal wildlife, and should not be used in the environmental assessment of the Northern Gateway project. Instead, NRDC believes that the Panel should use a more conservative metric in quantifying behavioral disruption in killer whales and other species, and should make conservative assumptions about the impacts of behavioral disruption (and masking) on whale energetics.

First, *the Panel should reject the "species-specific standard" for behavioral impacts that Enbridge has devised for northern resident killer whales (and, by implication, for other odontocete species).* This standard assumes that only sounds at least 55-65 dB above the killer whales' hearing threshold could affect them. (App. Vol. 8B at 10-39.) In its application, Enbridge models impacts using both its "species-specific" threshold and the species-independent 120 dB criterion employed by the U.S. National Marine Fisheries Service ("NMFS"). By comparison, the company's standard is patently non-conservative. Use of the Enbridge standard would radically alter the Gateway impact analysis, resulting in acoustic impact areas that are generally *one to two or more orders of magnitude smaller* than those calculated using NMFS' 120 dB criterion. (App. 10-51 Vol. 8B at 10-51.) For example, using its own standard, Enbridge determines that tugboats in various inland waters would behaviorally disrupt killer whale behavior only within a 0.3 km^2 area around each ship; using the 120 dB criterion, the impact area would cover 33 to 256 km^2 depending on location—a discrepancy of two to almost three orders of magnitude. (App. Vol. 8B at 10-46.) The company relies on this discrepancy (along with mitigation, see *infra*) to argue that the behavioral impacts stemming from its project would not affect the long-term viability of a population or pod. (App. Vol. 8B at 10-49.)

There is no direct evidence, however, to support Enbridge's standard. Indeed, the company's species-specific weighting system is inconsistent with the only data we have on killer whale responses to underwater noise, including the study on which its standard is expressly based (Williams et al. 2002). (*See* App. Vol. 8B at 10-39.) Williams et al.

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[6] Enbridge (2010), Northern Gateway Application ("App.") Vol. 1: Overview and General Information at 2-8.

[7] National Research Council (2003), *Ocean Noise and Marine Mammals*.

(2002) reported the received sound levels of an experimental vessel whose movements affected important behaviors in killer whales. Even if one knew which frequencies emitted by the vessel played the greatest role in inducing the response, a simple comparison between available killer whale audiograms and the power spectral density analysis provided by Williams et al. indicate that the received levels in that study were substantially lower than 65 dB (and indeed 50 dB) above the whales' threshold throughout the analyzed spectrum.[8] Furthermore, the only study to consider killer whale responses to sounds of different frequencies, a major, multi-year behavioral study involving scientists from the U.S., U.K., and Norway, found that frequency (1-2 kHz versus 7-8 kHz) made no difference in the onset of significant behavioral response in killer whales, even though killer whale audiograms would otherwise suggest a 25 dB drop in acoustic sensitivity at the lower frequencies.[9]

Enbridge's "specific-specific standard" is non-precautionary and inconsistent with the available evidence, and the Joint Review Panel should not use it in assessing noise-related behavioral impacts on the Northern resident killer whale population.

Second, *the Panel should recognize that shipping noise can adversely affect killer whale behavior at received levels well below NMFS' 120 dB re 1 µPa criterion*, which is the other, more conservative standard referenced in Enbridge's 2010 application. These effects were demonstrated, for example, in the same controlled exposure experiments on killer whales cited by Enbridge (i.e., Williams et al. 2002a, b). In those studies, focal whales were tracked from shore in the absence of boats; then one boat was sent in to experimentally follow the animals using fast and erratic or slow and predictable movements.[10] The results showed significant behavioral responses to broadband (~0.1-24 kHz) noise from a 90 horsepower, 2-stroke outboard engine well below the 120 dB threshold. A slow, parallel approach (predicted to result in received levels of 108 dB) elicited "subtle" evasive tactics, whereas the fast-moving boat (predicted to result in received levels of 116 dB) elicited more striking evasive tactics that were apparent to casual observation.[11]

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[8] Williams, R., Bain, D.E., Ford, J.K.B., and Trites, A.W. (2002), Behavioural responses of male killer whales to a 'leapfrogging vessel,' *Journal of Cetacean Research and Management* 4: 305-310. Enbridge does not provide a weighting methodology in its 2010 application, so a fuller technical critique is not possible.

[9] Miller, P.J., Kvadsheim, P., Lam., F.-P.A., Tyack, P.L., Kuningas, S., Wensveen, P.J., Antunes, R.N., Alves, A.C., Kleivane, L., Ainslie, M.A., and Thomas, L. (2011), Developing dose-response relationships for the onset of avoidance of sonar by free-ranging killer whales (*Orcinus orca*), presentation given at the Society for Marine Mammalogy Biennial Conference, Tampa, Florida, Dec. 2, 2011; *see also* Miller, P., Antunes, R., Alves, A.C., Wensveen, P., Kvadsheim, P., Kleivane, L., Nordlund, N., Lam, F.-P., van IJsselmuide, S., Visser, F., and Tyack, P., The 3S experiments: studying the behavioural effects of navy sonar on killer whales (*Orcinus orca*), sperm whales (*Physeter macrocephalus*), and long-finned pilot whales (*Globicephala melas*) in Norwegian waters, Scottish Oceans Institute Tech. Rep. SOI-2011-001, available at soi.st-andrews.ac.uk.

[10] Williams, R., Trites, A.W. and Bain, D.E. (2002), Behavioural responses of killer whales to whale-watching traffic: Opportunistic observations and experimental approaches, *Journal of Zoology (London)* 256: 255-270; Williams et al., Behavioural responses of male killer whales.

[11] *Id.*; pers. comm. with Dr. R. Williams (Dec. 2011).

NMFS' criterion derives from behavioral response studies on gray whales in the 1980s, and represents the point at which 50% of the exposed whales were found to respond to a broadband sound source.[12] Given the best available science, it is not precautionary to use 120 dB re 1 µPa as the lowest received level expected to affect killer whale behavior. Use of that metric could substantially underestimate the area of the zone of disturbance: since decibels are calculated on a logarithmic scale, reducing the threshold by even 6 dB could enlarge the effect area by as much as a factor of four. The Panel should therefore remodel the behavioral impact area for killer whales using a more genuinely conservative threshold, recognizing that effects can occur at exposures of 108 dB and above.

Third, the Panel should fully consider the literature on the effects of boat traffic on marine mammal energetics, particularly the studies conducted on killer whales. Remarkably, Enbridge devotes only a single brief paragraph in its application to the killer whale literature (App. Vol. 8B at 10-37), referencing only a few of the available studies, understating their findings, and failing to assess the implications of the impacts that these studies document.

For example, Enbridge implies that the science with respect to the energetic costs of repeated disturbance is less definitive than it actually is: "If such responses increase energy expenditure or reduce foraging efficiency, they may adversely affect killer whale health (Williams et al. 2006; Lusseau et al. 2009)." (App. Vol. 8B at 10-37.) In fact, the papers cited (Williams et al. 2006, Lusseau et al. 2009) show that repeated disturbance *does affect* the overall activity budgets of both northern and southern resident killer whales, respectively.[13] Boat-based disturbance carries much stronger impacts in terms of reduced prey acquisition than in terms of increased energetic expenditure.[14] Given the concern about food limitation in the current at-risk status of resident killer whales,[15] any activity that exacerbates this threat runs counter to prevailing management efforts under the Species at Risk Act to improve habitat quality for resident killer whales. *The Panel should conservatively assume that the substantial tanker traffic generated by the Gateway project will significantly impact the ability of northern resident killer whales to forage and compromise the whales' activity budget, affecting their reproduction and recovery.*

III. Masking Effects

[12] Malme, C.I., Miles, P.R., Clark, C.W., Tyack, P., and Bird, J.E. (1984), Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior, Phase II: January 1984 migration, report to U.S. Minerals Management Service, Anchorage, AK, NTIS doc. PB86-218377.

[13] Lusseau, D., Bain, D.E., Williams, R., and Smith, J.C. (2009), Vessel traffic disrupts the foraging behavior of southern resident killer whales *Orcinus orca*, *Endangered Species Research* 6: 211-221; Williams, R., Lusseau, D. and Hammond, P.S. (2006), Estimating relative energetic costs of human disturbance to killer whales (Orcinus orca), *Biological Conservation* 133: 301-311.

[14] Williams, R., Estimating relative energetic costs of human disturbance.

[15] Fisheries and Oceans Canada (2008), Recovery strategy for the northern and southern resident killer whales (*Orcinus orca*) in Canada.

It has long been recognized that human masking of biologically important sounds represents an extremely serious threat to marine mammals, especially (but not limited to) baleen whales.[16] While Enbridge acknowledges masking as a concern, it addresses the issue in only a single paragraph for each of the two cetacean species it assesses (App. Vol. 8B at 10-60, 10-83 to 10-84), and appears to conflate masking and behavioral effects in its general analysis (App. Vol. 8B at 10-74, 10-82). Perhaps because of this scant treatment, the company seems uncertain throughout the document about which impact threshold should apply, citing the NMFS' 120 dB criterion in its general discussion of humpback whale impacts (App. Vol. 8B at 10-73), referencing sound levels 35 to 40 dB above hearing threshold in its paragraph on humpback whale masking effects (App. Vol. 8B at 10-83), and mapping received levels out to 20 dB above the whales' hearing thresholds, which indicates large areas of ensonification from transits through the coastal area (App. Vol. 8B at 10-65 to 10-71). In fact, the potential for masking begins at the very threshold of audibility of sounds important to wildlife in the ocean – a much lower level of sound than Enbridge models in its application.

Since 2009, substantial progress has been made to quantify masking effects from commercial shipping and other broadband noise sources. Researchers are now able to calculate the extent to which a particular sound source degrades the communication space of target species, *i.e.*, the area over which an individual whale can hear its conspecifics in the vicinity of a single activity, such a ship transit, or over time.[17] Indeed, using these metrics, and analyzing data from twelve hydrophones placed along the BC coast (including several in the inland waters around Kitimat), researchers from the University of St. Andrews and Cornell University have already quantified masking effects on some cetacean species from existing vessel traffic along the BC coast. They conclude that current levels of traffic are significantly degrading the communication space of North Pacific humpback whales and Northern resident killer whales, and may be having a similar effect on other cetacean species.[18] None of this is discussed in Enbridge's application, nor does Enbridge make any attempt at a quantitative analysis of masking. *The Panel should not conclude its environmental assessment without an independent evaluation of Gateway's masking effects on marine wildlife, preferably by the same university researchers involved in assessing present levels of BC coastal traffic, using the quantitative metrics that have recently become available.*

IV. Cumulative Impacts

As Enbridge acknowledges, the shipping traffic and activity anticipated by the project could have significant adverse cumulative impacts on marine wildlife, and has the

[16] *E.g.*, National Research Council (2003), *Ocean Noise and Marine Mammals*; Payne, R., and Webb, D. (1971), Orientation by means of long-range acoustic signaling in baleen whales, *Annals of the New York Academy of Sciences* 188: 110-142.

[17] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. Mar. Ecol. Prog. Ser. 395: 201-222.

[18] Williams, R., Ashe, E., Clark, C.W., Hammond, P.S., Lusseau, D., and Ponirakis, D. (2011), Inextricably linked: boats, noise, Chinook salmon and killer whale recovery in the northeast Pacific, presentation given at the Society for Marine Mammalogy Biennial Conference, Tampa, Florida, Nov. 29, 2011

potential to impede or prevent the recovery of some listed populations, particularly the northern resident killer whale. (App. Vol. 8B at 10-59.) Unfortunately, the company's application does not sufficiently describe the nature of the cumulative impact or risk. In particular, it fails to model or assess in any way the impacts of the proposed activity on marine mammal energy budgets, as discussed above; nor does it address other mechanisms of impact, including chronic stress, which has emerged as a major concern in the field of underwater noise.[19] Additionally, it improperly assumes that the northern resident population will tolerate noisy habitats, even though resident killer whales are among the few cetaceans demonstrated to have been displaced from important feeding habitats due to high-amplitude sound.[20] *The Panel should acknowledge the full range of potential cumulative effects on coastal species, including chronic stress and habitat abandonment.*

The Panel is further limited in its impact assessment by the inadequacy of marine mammal survey data. The biological surveys described in Enbridge's marine mammal Technical Data Report contradict the basic assumptions about coverage probability that underlie distance sampling. Relying on opportunistic sightings databases (e.g., the BC Cetacean Sightings Network), which do not account for observer effort, is inadequate for inferring relative importance of habitat, especially for at-risk species. Coarse, coast-wide survey data can be used to interpret marine mammal density in the Confined Channel Assessment Area within a wider context. The only systematic effort to determine abundance for six cetacean species and the distribution of many others in BC continental shelf waters (summer 2004 and 2005) is reported in Williams & Thomas (2007).[21] An additional year of data is included in a paper that reports density surface model predictions of distribution for 11 marine mammal species in Williams, Ashe & O'Hara (2011).[22] Taken together, these maps show, *inter alia*, that humpback whale density in the Confined Channel Assessment Area is among the highest reported anywhere in BC. As a result, the proposed tanker route represents one of the highest-risk areas for humpback whales, from both cumulative noise exposures and ship strikes, anywhere in BC.[23] *The Panel should use these data in evaluating relative habitat value.*

V. Mitigation and Its Limits

Enbridge relies heavily on mitigation in concluding that behavioral impacts are "not expected to affect the long-term viability of a pod of NR killer whales or their entire population." (App. Vol. 8B at 10-49.) It should be said that, given the project's long life,

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[19] Wright, A.J., and Highfill, L. eds. (2007), Considerations of the effects of noise on marine mammals and other animals, *International Journal of Comparative Psychology* 20: 89-316.

[20] Morton, A.B., and Symonds, H.K. (2001), Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, *ICES Journal of Marine Sciences* 59: 71-80.

[21] Williams, R. and Thomas, L. (2007), Distribution and abundance of marine mammals in the coastal waters of BC, Canada, *Journal of Cetacean Research and Management* 9(1): 15-28.

[22] Williams, R., Ashe, E. and O'Hara, P.D. (2011), Marine mammals and debris in coastal waters of British Columbia, Canada, *Marine Pollution Bulletin* 62: 1303-1316.

[23] Williams, R. and O'Hara, P.D. (2010), Modeling ship strike risk to fin, humpback and killer whales in British Columbia, Canada, *Journal of Cetacean Research and Management* 11: 1-8.

the complexity and importance of the habitat it would affect, the wide-ranging impacts that vessel noise has on marine wildlife, and the uncertainties recognized in Enbridge's application, no mitigation measure can eliminate the serious environmental risk that Gateway poses from underwater noise alone. But the mitigation Enbridge has proposed in its application—though containing some indispensible elements such as speed limits, ship-quieting technologies, and propeller maintenance—is too indefinite, being merely the outline of a "Marine Mammal Protection Plan" that the company promises to release at a later date; and also lacks a number of important elements used on other projects. (App. Vol. 8B at 10-11.) For example:

(1) Any mitigation plan should include an actively monitored Automatic Identification System ("AIS") for purposes of enforcement of vessel speed limits, as has been used in the U.S. pursuant to the North Atlantic right whale ship-strike rule.[24]

(2) Similarly, the plan should also require placement of fixed hydrophones throughout the coastal area, as required of the Neptune LNG project off Massachusetts,[25] which would aid in the dynamic mitigation of both vessel noise and ship-strikes.

(3) Given that the best available science identifies 10 knots as an appropriate speed limit, at least to reduce the incidence and severity of ship strikes of baleen whales,[26] vessels should not be allowed to operate above 10 knots within the coastal area or its approaches, unless necessary for navigational safety.

(4) For any new construction, engineers should be required to consider and model a wide range of identified noise-quieting techniques, including not only the commercially available propulsion systems named in Enbridge's application, but those described by the Underwater Noise Correspondence Group of the International Maritime Organization's Marine Environment Protection Committee, which is developing guidelines for reducing noise from commercial ships.[27]

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[24] 73 Federal Register 60173-60191 (Oct. 10, 2008); *see also*, *e.g.*, Lagueux, K.M., Zani, V.A., Knowlton, A.R., and Kraus, S.D. (2011), Response by vessel operators to protection measures for right whales *Eubalaena glacialis* in the southeast U.S. calving ground, *Endangered Species Research* 14: 69-77.

[25] 72 Federal Register 27077-27091 (May 14, 2007); *see also* Hatch, L., Clark, C., Merrick, R., Van Parijs, S., Ponirakis, D., Schwehr, K., Thompson, M., and Wiley, D. (2008), Characterizing the relative contributions of large vessels to total ocean noise fields: A case study using the Gerry E. Studds Stellwagen Bank National Marine Sanctuary, *Environmental Management* 42: 735-752.

[26] 73 Federal Register 60173-60191 (Oct. 10, 2008).

[27] United States Government (2010), Noise from commercial shipping and its adverse impacts on marine life: Report from the Correspondence Group, IMO doc. MEPC 61/19; United States Government (2010), Noise from commercial shipping and its adverse impacts on marine life: Report from the Correspondence Group, IMO doc. MEPC 60/18; United States Government (2009), Noise from commercial shipping and its adverse impacts on marine life: Report from the Correspondence Group, IMO doc. MEPC 59/19; *see also* Renilson Marine Consulting Pty (2009), Reducing underwater noise pollution from large commercial vessels, submitted to the IMO Marine Environment Protection Committee Correspondence Group on Underwater Noise.

(5) The mitigation plan should require Enbridge or the federal government to set acoustic standards for tankers calling at Kitimat, or to provide incentives to tankers that meet those standards.

The Panel should defer completion of the environmental assessment until the company has submitted and the public has had an opportunity to review the more detailed "Marine Mammal Protection Plan."

We urge this Panel to undertake a more conservative, more scientifically grounded assessment of underwater noise impacts than Enbridge offers in its 2010 application. Thank you for considering this submission.

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