Comments on the Aurora LNG Environmental Assessment Certificate Application

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Dr. Barb Faggetter is a Registered Professional Biologist with a B.Sc. in chemistry/biochemistry (UBC) and a Ph.D. in biological and chemical oceanography (UBC). Her research has included the isolation, chemical analyses, and ecology of marine biotoxins (e.g., paralytic shellfish poisoning), and she has carried out phytoplankton identification and monitoring for the detection of biotoxin blooms in the Northcoast region. Her work is highly multidisciplinary, ranging from plankton and macroinvertebrate sampling and identification, shoreline habitat assessments, benthic video surveys, and habitat modeling and mapping to sidescan and multibeam sonar research, and oceanographic modeling. She has been working as a scientist on the BC coast since 1994, and has been involved in a wide variety of projects, including habitat mapping, community resource monitoring, and environmental assessment.

1. Risks to Marine Life from Noise

The proponent correctly points out that:

> *"Potential behavioral responses of marine fish to underwater noise are qualitatively discussed because, at the present time, the nature and extent of behavioral effects on marine fish are not well understood (Popper et al. 2014). Popper et al. (2014) state that there are currently no established thresholds for behavioural disturbance for a number of reasons, including:*
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> - *Fish species and life stages vary in their physiology, morphology, and behaviour, which makes it inappropriate to apply a single threshold to all fishes*
> - *The majority of behavioural studies have been conducted in laboratory settings; therefore, observed responses may not be representative of responses in the marine environment."* (Section 4.9: Marine Fish and Fish Habitat, pg 62)

and

> *"While an approach to predict thresholds for fish avoidance response to underwater sounds was developed by Nedwell et al. (2007) using species-specific hearing thresholds, Nedwell et al. (2007) identify two drawbacks to consider when applying their findings:*
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> 1. *The study applies an extrapolation based on the behavioural responses of six fish species to a single sound source (a continuous noise source at a sound pressure level [SPL] of 170 dB between 20 and 600 Hz), which may not be appropriate to apply to other sound sources.*
> 2. *The study does not consider the effects of habituation to sounds over longer periods (i.e., where individuals become accustomed to moderate levels of underwater noise and cease to react to it).*
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> *Given these limitations, the approach developed by Nedwell et al. (2007) was not used for this assessment."* (Section 4.9: Marine Fish and Fish Habitat, pg 62)

Essentially, the proponent is saying that there isn't enough scientific information on the effects of sound on fish to carry out a quantitative assessment (e.g., one that can predict how much, how far, etc.). My previous research[1] in this area supports that conclusion. The proponent goes on to say:

> *"Given the lack of established thresholds for noise levels that are likely to result in behavioural effects on marine fish, a qualitative assessment using published studies on marine fish responses to underwater noise is the best available method"* (Section 4.9: Marine Fish and Fish Habitat, Table 4.9-3, pg 4.9-9)

I question the validity of this approach. Is a qualitative assessment sufficient to determine that no harm will occur, especially to juveniles, for which we have the least amount of published studies?

As a mitigation method, the proponent often states something to the effect:

> *"These include limiting … to the DFO least risk work window (November 30 – February 15), which will avoid overlap with sensitive species and life stages such as outmigrating juvenile salmon and larval/juvenile eulachon."* (for example, in Section 4.9: Marine Fish and Fish Habitat, pg. 87)

However, based on data from the Stantec's studies for the PNW LNG, we know "*Data collected by PNW LNG indicates that juvenile salmon rear in the area year-round so that least-risk timing windows are not an available mitigation measure for avoiding risks to juvenile salmon*"[2].

Finally, the proponent repeats (excessively) that "*There is a moderate likelihood of success with this mitigation measure, which is generally considered an industry standard*" (for example, in Section 4.9: Marine Fish and Fish Habitat, Table 4.9-11, pg. 4.9-37) and "*Following the implementation of mitigation measures, residual changes in the behaviour of marine fish from … activities are characterized as low in magnitude*" (for example, in Section 4.9: Marine Fish and Fish Habitat, pg. 70). These are qualitative statements for which we are given no definition. What does the proponent mean by a "moderate likelihood of success" and "low in magnitude"? Based on what? Qualitative statements such as these proved no guarantee that there will be little environmental impact.

I'm not comfortable with proponent's assumption that a qualitative assessment of the situation is sufficient. Essentially, the proponent is equating lack of knowledge with low risk, which definitely isn't a precautionary approach in my view.

2. Risks to Marine Life from Light

My concerns regarding the proponents' handling of light impacts on marine life are essentially the same as they are for noise, in that:

- there is little in the way of quantitative guidelines
- the current studies in this field show much variation depending on species, life stage, and light wavelength
- the proponent has chosen to use a qualitative assessment: "*Given the lack of established thresholds for changes in light levels that are likely to result in behavioural effects on marine fish, a qualitative assessment using published studies on marine fish responses to changes in light is the best available method*." (Section 4.9: Marine Fish and Fish Habitat, Table 4.9-3, pg, 4.9-9)

The proponents' results for their qualitative analysis on light impacts are similar to the ones which I quoted above for noise, and I feel the same questions need to be answered:

- Is this approach valid? Is a qualitative assessment sufficient to determine that no harm will occur, especially to juveniles, for which we have the least amount of published studies?
- What does the proponent mean by a "moderate likelihood of success" and "low in magnitude"? Based on what?

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[1] Faggetter, B.A. 2016. Comments on the Pacific NorthWest LNG Draft Environmental Assessment Report.
[2] Skeena Fisheries Commission to CEAA, 2016.

As with the proponents' studies on noise, I'm not comfortable with their assumption that a qualitative assessment of the situation is sufficient. Again, the proponent is equating lack of knowledge with low risk, which is not a precautionary approach.

3. Risks to Marine Life from Biocides

I found an isolated reference to the used of biocides by the proponent:

> *"Hydrostatic testing will comply with the Canadian Association of Petroleum Producers Hydrostatic Test Water Management Guideline (CAPP 1996), and discharged water will meet CCME Water Quality Guidelines for the Protection of Aquatic Life. If biocides are used, the test water will be neutralized prior to discharge. Mitigation Mechanism: Avoidance or neutralization of biocides removes the potential for toxicity effects on marine biota."* (Section 4.5: Water Quality, Table 4.5-26, pg. 4.5-66)

What was particularly disturbing was that I was unable to find any further references to biocides in the proponents' application. What types of biocides are being used, and for what specific purpose are they being used? How much and when? If the proponent has not provided these details, then they should. Impacts on marine life will be dependent on the type, amount, and timing of usage of biocides.

4. Importance of Herring Schools and Herring Spawning

It should be noted that the importance of concerns regarding herring schools and herring spawning should be increased in the project's list of "valued components" given that there are now more data on herring spawning on Flora Bank:

"We captured mature adult herring and surf smelt throughout the 2015 sampling period, including spawning aggregations of surf smelt which were captured off Kitson Island in the middle of June, at the same location in both 2013 and 2014, suggesting that the nearby intertidal area is an important spawning beach for these animals. We captured a spawning aggregation of herring on Flora Bank in the middle of June, and observed herring eggs deposited on eelgrass on Flora Bank two weeks later. This may represent a unique spawning population of herring, based on the timing of egg deposition, which is more than two months later than other North Coast herring populations."[3]

My comments on noise and light issues (see above) would also apply to herring schools. The proponent has looked at some studies on herring in their "qualitative assessment"; however, the question still stands - is a qualitative assessment sufficient to determine that no harm will occur?

5. Effects of Ocean Acidification Not Evaluated or Mitigated

Marine impacts of acid deposition on all of the proposed LNG projects have not been adequately assessed. In my comments regarding the same issue in the Pacific NorthWest LNG Draft Environmental Assessment Report[4], I stated:

> "*Ocean "acidification" occurs when chemical compounds such as carbon dioxide, sulfur, or nitrogen mix with seawater, a process which lowers the pH and reduces the storage of carbon. Ocean acidification decreases the ability of marine organisms - such as sea urchins, starfish, brittle stars, shellfish, corals, fish, and certain types of plankton - to use calcium carbonate for making hard outer shells or "exoskeletons", or for maintaining their internal body chemistry. These organisms provide essential food and habitat to other species, so decreases in their populations could affect entire ocean ecosystems (WHOI 2014).*

[3] Salmon science as related to proposed development in the Skeena River estuary, 2015.
[4] Faggetter, B.A. 2016. Comments on the Pacific NorthWest LNG Draft Environmental Assessment Report.

While increased atmospheric CO_2 has generally been considered the culprit behind the current increase in ocean acidification, acid deposition also has the capacity to affect the ocean. This effect is most pronounced near the coasts, which are already some of the most heavily affected and vulnerable parts of the ocean due to pollution, over-fishing, and climate change. In addition to acidification, excess nitrogen inputs from the atmosphere promote increased growth of phytoplankton and other marine plants which, in turn, may cause more frequent harmful algal blooms and eutrophication (excess algal growth which can create oxygen-depleted "dead zones") in some parts of the ocean (Doney et al. 2007, WHOI 2014).

… Unfortunately, studies on the impact of a coastal LNG facility on ocean acidification have not yet been done, thus the magnitude of the impact that acid deposition from the proponent's facility could have on the marine environment is not known. However, given the serious concerns that the BC shellfish industry has regarding ocean acidification and its relationship to the recent die-offs of oysters and scallops, coastal areas in BC may already be at risk. Increased ocean acidification can impact juvenile salmon by causing declines in the organisms on which they feed. For example small ocean snails called pteropods, which may make up more than 50% of the juvenile pink salmon diet, are already being affected by the acidification of the ocean."

In order to evaluate the impact of acid deposition from the proponents' facility on ocean acidification, we need to have air contaminant concentration forecasts that are trustworthy. All recent forecasts of NOx and SO_2 concentrations for the Prince Rupert area have been carried out using the CALPUFF modelling system. However, the results have been highly variable, the model assumptions have changed frequently, potentially without sufficient justification, and the input data has not been made available for independent confirmation of the model results.