SCIENCE RESPONSE TO INFORMATION REQUESTS SUBMITTED TO THE ENBRIDGE NORTHERN GATEWAY PROJECT ENVIRONMENTAL IMPACT ASSESSMENT HEARINGS RESPECTING BIOLOGICAL RISK ASSESSMENT AND MANAGEMENT OF SPILLS

Context

Fisheries and Oceans Canada's (DFO) Environmental Assessment and Major Projects Division (EAMP), Pacific Region, requested that DFO Science, Pacific Region, on May 15, 2012, provide information regarding specific Information Requests (IRs) submitted to the Enbridge Review Panel that DFO Science has the expertise to evaluate. As the IRs for which Science advice was requested cover a range of issues and scientific disciplines, separate Science Responses have been developed for each category of IRs, and in some cases specific IRs. In addition to science related questions, some IRs included elements that were questions pertaining to DFO policy, management or legal information.

This Science Response addresses the questions about the management of dilute bitumen and condensate spills and the biological risk assessment for the following species Prince Rupert District, Haida Gwaii and Central Coast Pacific Herring, Pacific Halibut, Harbour Seal, and Eulachon. Specifically with regard to expected severity and duration of impacts from a spill at the individual, population and habitat level as well as interactions with other stressors.

This Science Response report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Regional Science Special Response Process (SSRP) of May 29th, 2012 on the Science advice in response to information requests submitted by Intervenors to the Enbridge Northern Gateway pipeline project environmental assessment Panel Review Process. Additional publications from this process will be posted as they become available on the Fisheries and Oceans Canada Science Advisory Schedule at [www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.](http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm)

Background

The Enbridge Northern Gateway Project proposes to ship dilute bitumen from Kitimat, British Columbia to markets in China and California with tankers of the class Very Large Crude Carriers (VLCC) (Vol. 1, B1-2, Enbridge Northern Gateway Project Section 52 Application). The tanker route from Kitimat through confined waterways in British Columbia and then into open waters of Hecate Strait, Dixon Entrance and Queen Charlotte Sound in British Columbia are illustrated in Figure 1. For assessment purposes Enbridge Northern Gateway defines two areas, the Confined Channel Assessment Area (CCAA) (Figure 2) and the Open Water Assessment Area (OWA) which is BC waters to the territorial sea limit (Figure 1). Incoming ships will deliver cargoes of condensate. Enbridge Northern Gateway estimate 71 condensate and 149 oil tankers will call in at the Kitimat terminal for a total of 440 transits per year (Vol. 8C, B3-37, Enbridge Northern Gateway Project Section 52 Application). A marine terminal will be constructed near Kitimat with two tanker berths and one utility berth (Vol. 1, B1-2, Enbridge Northern Gateway Project Section 52 Application).

Two IR submissions were made to the Joint Review Panel (JRP) by DFO. Enbridge Northern Gateway provided responses to requests for information in the IRs. Since then Intervener review of the Environmental Assessment documents prepared by the proponent (Enbridge Northern Gateway) and of the IRs and the responses by the proponent has resulted in a series of further questions to DFO by Interveners. This document addresses the Intervener questions to DFO regarding biological risks associated with potential spills resulting from the proposed Enbridge Northern Gateway Project.

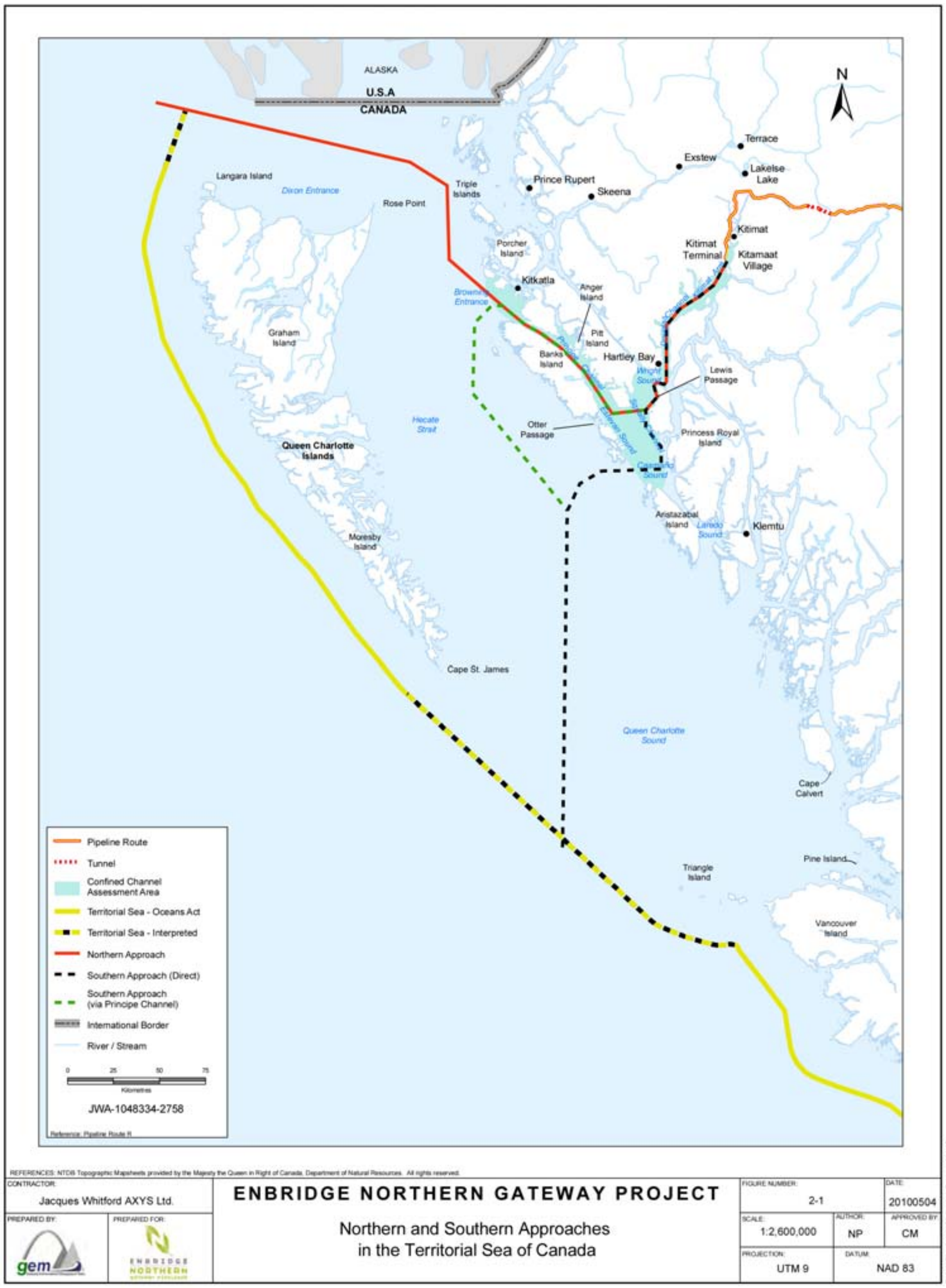

Figure 1. Map illustrating the proposed tanker routes through the Confined Channel and Open Water Assessment Areas (CCAA and OWA). The OWA extends to the territorial sea boundary (from Volume B9-42 Enbridge Northern Gateway Project).

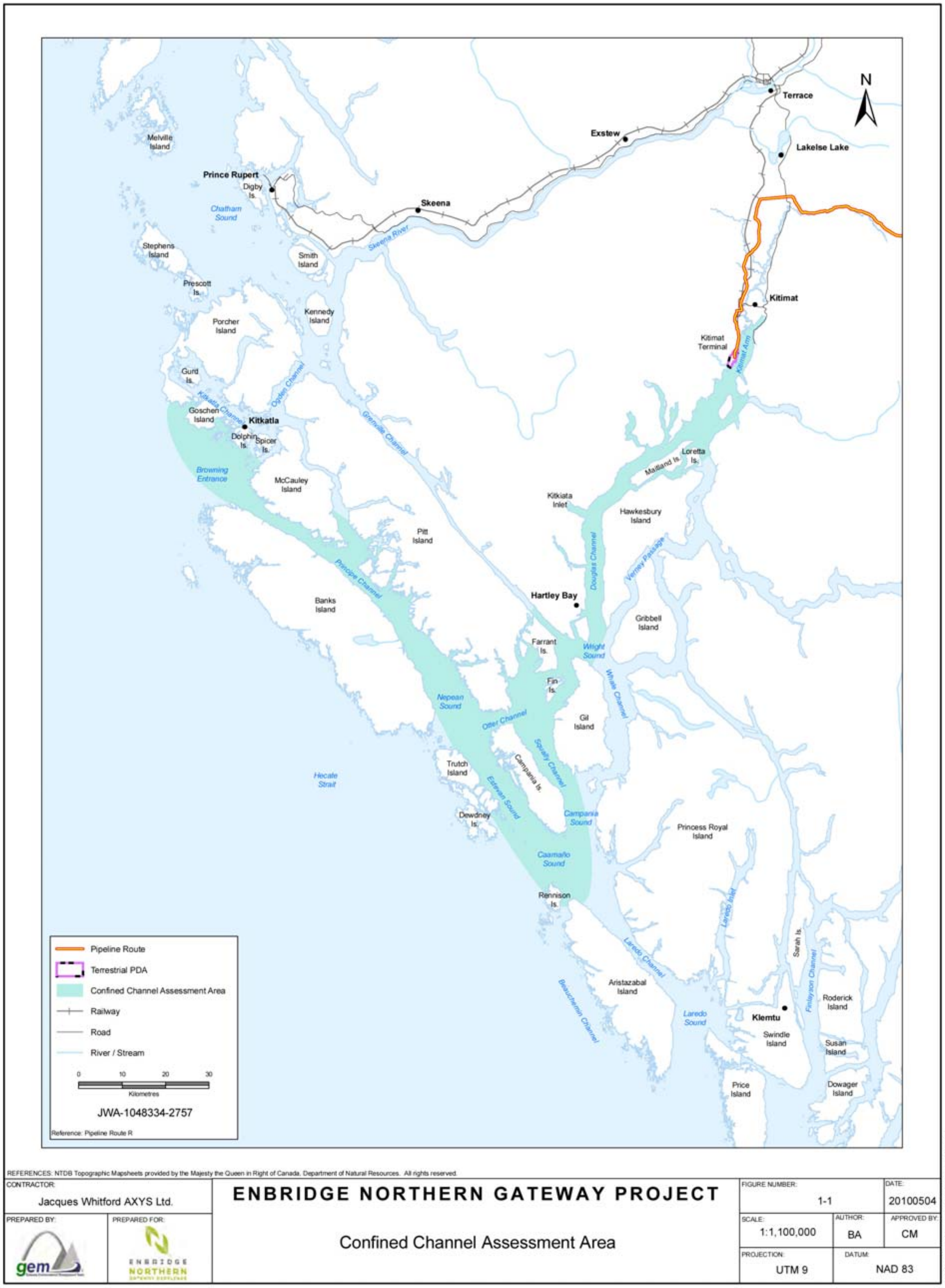

Figure 2. Map illustrating the location and extent of the Confined Channel Assessment Area (CCAA) (from Volume 8B Enbridge Northern Gateway Project Section 52 Application).

Analysis and Responses

Individual Intervenor questions posed to DFO Science are presented in the following bullets. In some cases, several questions could be grouped together to be addressed with one comprehensive answer. DFO Science analysis and response follows.

- Please provide information describing the pathways through which the various life-history stages of the above listed species and stocks would be, or are likely, or could be affected by a condensate or dilute bitumen spill (similar to 21 what is provided for select species in Application Volume 7C (Section 7.4 - 7.11) and Volume 8C (Section 8.4 - 8.11).
- Please provide detailed information about: i. The expected severity and duration of impact to the resources listed above at an individual level (i.e. how the health and survival of affected individuals are impacted); ii. The expected severity and duration of the impact to the resources listed above at the population level (i.e. how the distribution and abundance of each population would be affected given their current status and other stressors they are subjected to); iii. The expected severity and duration of impacts to important habitats of the five listed species (i.e. spawning, refuge, feeding grounds, dispersal rafts, etc.) could be affected, the duration of the impacts and the recovery likelihood and mechanisms.
- Please provide information on how impacts from a spill to the resources listed above could make them more vulnerable to other stressors including: i) climate change ii) oceanographic/climatic cycles such as El Nino and PDO iii) disease iv) fishing mortality v) habitat alteration vi) trophic relationships – competition and predation

The proponent’s mitigation plan for potential biological effects of dilute bitumen spills is to develop marine and terrestrial environmental effects monitoring programs that will include pre- and post-construction monitoring. Draft framework documents describing the Marine Environmental Effects Monitoring Program (“EEMP”) and the Pipeline EEMP have been provided to Environment Canada and DFO for comment (see Northern Gateway’s response to Federal Government IR 2.66). Once finalized, the framework documents will be provided to the JRP. In order to answer the types of questions raised above, and to be able to comment further on the proposed EEMP, it will be essential for DFO Science to have access to the raw data (i.e. the video, navigation data and resulting interpreted databases) from the proponents work.

The questions raised by the Intervenors are important ones, however, DFO Science is unable to provide quantitative responses regarding impacts to the specific biota and regions; more research and study would be required.

Biological effects of environmental contaminants, including the substances in question here, can be divided into two categories: Acute Toxicity, and Sub-lethal toxicity. Acute toxicity refers to lethal doses; sub-lethal effects can be cumulative and long-term. Any information on toxicity and biological effects is specific to the chemical in question. Therefore, in the absence of detailed studies on the particular dilute bitumen compounds, and the properties of condensate, exact answers are not possible.

There are many studies and references to work done on acute and sub-lethal effects on some of the species groups in question; these will help to inform DFO and other parties as to the priority areas for study (Waldichuck 1993; Nie et al. 2010; Incardona et al. 2011; Peterson et al. 2003).

Eulachon

Eulachon are anadromous so most spills would not impact incubating eggs in rivers. A qualification is that some live eggs may be advected into estuarine areas where some oil in the event of a spill (especially water-soluble components) could occur. Probably this risk would be greatest during March and April in the locations closest to the tanker routes with the Kitimat

River having the greatest risk, followed by other rivers draining into the Gardner Canal. Probably risks to eulachon eggs would be lower in most other areas (Hay and McCarter 2000).

During the months of April-June eulachon larvae are widely dispersed in surface waters (upper 10 m) of coastal inlets and adjacent areas. At that time of year, eulachon larvae in the waters of Douglas Channel and the Gardener Canal would be the most susceptible to a spill associated with a tanker incident. Similarly, eulachon larvae in the Skeena River estuary also could be at risk. Larvae from most other eulachon populations would likely be at lower risk unless oil were advected long distances away from the projected routes into inside waters such as the Dean Canal (which supports the Bella Coola River eulachon) or Johnstone Strait areas (McCarter and Hay, 1999).

Very little is known about the location of habitats of eulachon juveniles except that they are probably benthic. A special concern would be whether eulachon juveniles spend much of their early life in inside waters, such as in Douglas Channel and the Gardener Canal. If they do reside there, then they would be especially susceptible to spills occurring in that area (Hay and McCarter, 2000).

Adult eulachon occur in the shelf areas of Hecate Strait, and probably these fish originate from several different spawning rivers, including all known eulachon rivers in the central and northern coasts of BC. Although there is some suggestion of some diurnal movement (from recent studies off of Oregon) in general it is thought that adult eulachon remain in deeper waters (50-200m). In such locations, they would be vulnerable to any oil products that sank to bottom habitats (Hay and McCarter, 2000).

Regarding, pre-spawning eulachon, Eulachon are known to congregate in marine areas adjacent to spawning rivers. Probably there are pre-spawning eulachon concentrations in the Douglas Channel adjacent to the Kitimat River, and in other rivers in Douglas Channel and Gardener Canal. Also, pre-spawning eulachon congregate in the Skeena estuary. These pre-spawning eulachon concentrations could be susceptible to an oil spills. Even though eulachon do not feed at this time, (they are semelparous) there is evidence (from Fraser River toxicological studies) that they may incorporate water-borne toxic substances in body tissues such as the liver. The explanation for this may be related to their requirement to adjust to changing salinities and therefore they ingest copious quantities of water to retain their osmoregulatory capacity in freshwater (Hay and McCarter, 2000).

Regarding individual eulachon eggs, contact with oil is unlikely. (Rogers and Birtwell 1990). The severity of impact on individual eulachon larvae would be variable depending on exposure, but it is likely that intense exposure (e.g. 30 day duration) would be lethal (Rogers and Birtwell 1990). The response of individual eulachon juveniles and adults is uncertain and warrants further research, especially to evaluate the potential for oil exposure to render eulachon susceptible to disease (as occurs in herring) (Rogers and Birtwell 1990).

As little is known about eulachon marine habitats, any suggested impacts are speculative. However, the greatest concern may be the impact of a spill in inside marine waters used as staging areas by pre-spawning eulachon, especially in Douglas Channel, as they prepare to enter rivers. Eulachon may utilize such locations for several months. Such a spill, occurring in late winter months in this location, could put a substantial part of the eulachon populations in this area at risk. (Rogers and Birtwell 1990).

Herring

Extensive research in Prince William Sound demonstrates there were short-term consequences from the Exxon Valdes Oil Spill (EVOS) which were detrimental to Pacific herring eggs, embryos, larvae, and adults (Carls et al., 2002). There were also long-term detrimental effects to fish eggs as a result of chronic exposure to sequestered oil that can persist for years after a spill (Peterson et al. 2003).

There are potential direct impacts on incubating herring eggs in spawning locations. The major locations are generally well known so the risks could be evaluated for each major location relative to (i) the time of year that a spill occurred; (ii) the volume of a spill; (iii) the location of a spill relative to spawning locations and prevailing currents and tidal conditions. In general, direct contact between herring eggs and oil (including the water-soluble fraction) would be lethal (Hay 1986a; Hay and McCarter 1991, 1997).

Herring larvae are ubiquitous throughout the northern coastal region for 8-10 weeks each year. In general, larvae occur in surface waters (upper 20 m) and may undergo diurnal migrations, so in the event of a spill many could be directly exposed to surface waters and oil slicks. It is plausible that there could be exposure through the ingestion of oil-contaminated zooplankton ingested as food (mainly invertebrate eggs and nauplii of copepods) (Hay 1986a,b; Hay and McCarter 1991, 1997; Peterson et al. 2003).

Juvenile herring tend to reside in nearshore waters for the first year of life and especially during their first summer and fall (mainly June-to October). In the event of a spill, juveniles could be exposed to oil occurring in shallow surface or bottom waters, especially in water depths of 50 m or less. In many areas, juveniles tend to inhabit seaweed and kelp beds so contamination of these habitats could lead to prolonged exposure (Haegele 1997; Haegele et al., 2005; Thompson and Therriault, 2006, 2007; Thompson and Hrabok, 2007; Thompson and Schweigert, 2007).

Most herring in BC waters are migratory, spending summer and fall months feeing along areas of the continental shelf. They undergo diurnal migrations between surface waters (night) and bottom areas (day). Consequently, spills occurring in offshore areas occupied by adult herring could result in exposure to oil either at the surface or at bottom habitats with the high-density components of the spill (as in EVOS). In general, herring are more widely dispersed during summer months so the potential impacts of small spills at this time would probably pose less risk to herring than spills in winter (location dependent) when herring might be concentrated in a relatively smaller number of over-wintering locations. For instance, a spill in winter that impacted the lower east coast of Haida Gwaii (especially Juan Perez Inlet) could impact the whole Haida Gwaii herring stock. Similarly, spills in the Browning Entrance Area, or North Porcher Island, could impact much (or all) of the PRD herring stock (Hay, 1986b; McCarter et al, 1987; Keiser et al., 1987; McCarter et al., 1988).

It is not clear if herring detect and avoid oil-contaminated water. However, during the Nestucca spill (1989) there was clear evidence that herring changed spawning locations from the usual locations on the northwest shores of Barkley Sound to novel locations in the Broken Group (Hay and Kronlund, 1987; Hay and McCarter, 1999, 2006; Hay et al., 2009).

Halibut

To our knowledge, there are no peer-reviewed reports on the effects of oil spills on Pacific halibut. However, experiments for other flatfish species have shown that pelagic egg and larval stages can be susceptible to both acute mortality and longer-term developmental effects from exposure to hydrocarbons. For example, previous experiments on the effects of Benzo(a)pyrene (a polycyclic aromatic hydrocarbon) on the development of three other species of flatfish showed negative impacts on egg and larval development for two of the three species (Landolt et al., 1981). Benzo(a)pyrene is found in crude oils and many other oil products and the concentrations used in the experiments were comparable to those found in polluted harbours. In a second example, the effects of a 828,000 gallons (U.S.) spill of diesel and home heating oils on the embryos of another flatfish species, winter flounder, were studied (Hughes, 1999). The cumulative impact on winter flounder embryos of oil exposure was an estimated 51% reduction in the number of embryos surviving to the larval stage.

It is not clear to what extent halibut pelagic eggs and larvae would be exposed or susceptible to potential spills resulting from the proposed Enbridge Northern Gateway Project. The winter spawning grounds of Pacific halibut include areas off the southern and northwest tips of Haida Gwaii; however, spawning and larval dispersal is not known to occur within Hecate Strait or the mainland inlets of northern British Columbia (Valero and Webster, 2012). Halibut are caught in all these areas by the commercial fishery.

Harbour seals

Harbour seals are widely distributed in the CCAA and OWA and could be impacted by an oil spill. For example, Frost et al. (1994) found a significant decline in seal numbers at oiled versus non-oiled sites in Prince William Sound following the EVOS, and estimated that about 300 seals had died in the spill although it is possible seals may have been displaced from the oiled sites by disturbances related to spill clean-up operations (Hoover-Miller et al. 2001). However, pup production in the following year was 26% lower than normal, and tissue samples from animals collected in heavily oiled areas contained elevated concentrations of petroleum-related hydrocarbons.

Conclusions

Short term and long term effects to some biota from exposure to poly aromatic hydrocarbons from environmental petroleum contamination have been documented in the scientific literature. Stressor impacts can change the sensitivity of individuals, populations, communities, and ecosystems to climate variability (Perry et al. 2009). At the ecosystem level, a “loss of biodiversity, including extirpating genetically distinct population sub-units, losing the spatial patterns of these subunits” can cause ecosystems to respond more quickly to climate variability (Perry et al., 2009).

Impacts of a petroleum spill on marine fisheries resources from an incident involving a tanker in the CCAA or the OWA would depend on many variables, including the magnitude or volume of the spill, and the temporal and spatial extent of the spill and the season in which it occurred, all of which would have a bearing on the magnitude of the impact to species and sensitive life stages. Recovery of the ecosystem would depend on factors such as the fecundity, age at maturity, life stage, reproductive strategy and population connectivity of ecosystem components effected (Samhouri and Levin 2012).

DFO Science can not at this time quantify the magnitude and duration of impacts to individuals, populations, and habitats for all of these marine resources in the CCAA and OWA in the event of a spill.

A Marine Environmental Effects Monitoring Plan has not yet been developed and, therefore, can not be assessed at this time.

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