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By email and/or on-line submission

## COVER LETTER

Experience shows that even when oil spill specialists and politicians think that an excellent prevention and response system and infrastructure are in place, even a modest spill can overwhelm their capabilities and cause extensive environmental damage.

The Nestucca oil spill of December 1988 is a vivid example. A comprehensive plan was in place that integrated the activities and assigned responsibilities among three main federal departments and provincial agencies. Primary responsibility is, of course, the spiller's, under the "polluter pays principle", which is enshrined in Canadian law. But this usually means the polluter pays the bills ex post facto. It falls to governments to investigate spills, identify the spiller and direct an emergency response.

Emergency response sections in the Canadian Coast Guard (CCG) and Environment Canada (EC) were well funded and permanently staffed with experts who had many years of experience responding to spills. The Department of Fisheries and Oceans' (DFO) Institute of Ocean Sciences in Sidney, on Vancouver Island, had a cadre of spill trajectory modelling experts running state-of-the-art computerized modelling programs. These experts were used to working with Environment Canada and the Canadian Coast Guard on marine oil spills, and could provide estimated trajectories within an hour or two at any time of the day or night. The DFO also had ocean ecologists, ocean chemists, ocean physicists and coastal geomorphologists conducting research who could be, and often were, called for advice during emergencies; and the DFO had a separate fisheries research institute at Nanaimo, B.C., with fisheries scientists who likewise were available to help on environmental emergencies. Both institutes had a variety of vessels, from small sampling boats to ocean-going research ships. A private company, funded by industry, had storehouses of booms, dispersants, absorbents and other materials, and it had boats tied to docks fueled and ready.

But the oil, flowing from a holed barge off Washington, did not behave as expected. Although it floated north with the currents, it was almost never visible on the surface, apparently over-washed with waves and much of it riding a little beneath the surface. Experts in reconnaissance aircraft never saw the oil visually, nor was it detected with infrared sensors, until it began washing up on the Vancouver Island beaches of Pacific Rim National Park. Some of the oil, becoming emulsified, waterlogged and laden with sediment, sank to the bottom before reaching the shore, but enough floated on or near the surface to kill tens of thousands of seabirds in Washington and British Columbia waters. Commercial and sport fisheries were closed for several months to avoid getting contaminated or tainted fish and shellfish into markets.

The CCG, DFO and EC had set up a command post in Ucluelet to direct the clean-up. The CCG was in command, with EC setting environmental priorities for shoreline protection with advice from DFO and provincial representatives. But these agencies cleaned up no oil themselves. Instead, a small army of “volunteers”—tourists visiting the National Park and locals who wanted to help—did the dirty work on the beaches around Tofino and Ucluelet, while First Nations mustered their members down to the beaches to clean up oil and protect their food resources outside of the National Park area. Mostly, they simply picked up blobs and “pancakes” of oil and dead seabirds from the sand and dumped them into plastic bags. Despite requests to the on-scene commander from the DFO and EC environmental members of the command team, no shoreline protection, such as booms, were ever deployed.

The CCG had no idea how to actually clean oil from rocky shorelines and cobble beaches. Against the advice of their environmental coordinator because of expected damage to intertidal organisms, they tried burning oiled wood and other debris on the beaches with napalm and propane torches, they built an experimental incinerator to burn oiled rocks of cobble beaches, and they considered steam-cleaning these high-energy environments, except that the needed equipment was unobtainable. All of these environmental damaging methods were unsuccessful. Eventually, the high-energy shorelines were left to “self-clean”.

Because of the ineffectiveness of the clean-up, federal and provincial enquiries resulted in vastly increased funds to the three federal departments to augment response capabilities and reorganize their environmental emergency sections. To these improvements was added about \$10 million in costs and environmental damages from the successful prosecution of the American barge company that spilled the oil. These funds paid for sensitive shoreline inventories and related research, which would be available to help guide future spills.

Other advancements in spill prevention and response have made today’s oil transportation safer than that of 27 years ago. Canadian implementation of an international convention mandates double-hulled tankers for offshore bulk oil transport, for example. But more recent Government of Canada decisions have greatly reduced government capability to respond to oil spills, particularly in the reductions of scientific and environmental emergencies technical staff and indeed whole sections responsible for environmental emergencies. Many lightstations have been closed or replaced with automated systems, eliminating an important source of local observation and assistance. In DFO, many scientific positions at the Institute of Ocean Sciences have been terminated, including all of those, as far as I know, with expertise in effects of oil on fish and marine ecosystems and related chemical analysis. The laws, such as the Fisheries Act, under which these scientists operated, have been gutted. As well, despite the amalgamation of CCG with DFO, they have fewer vessels capable of sampling. The closing of Environment Canada’s regional Environmental Emergencies sections was at least as egregious. There is no one based in the region with primary responsibility to respond to spills, let alone anyone with the requisite expertise and experience.

Kinder-Morgan has an Emergency Management Program. However, the plan for responding to spills in the marine environment is incomplete. The application merely refers to plans to review and expand its existing plans (<http://www.transmountain.com/emergency-response>):

*“The review of our existing plans will result in a program to address the requirements of the expanded facilities...Since the updated EMP depends upon the final detailed design of the Project, a process that will not be carried out unless the Project receives approval and until we have an opportunity to review the conditions of such approval, the updated EMP cannot be provided during the NEB’s regulatory review of the Project.”*

The Kinder-Morgan response plan for marine oil spills is incomplete and undefined. To the extent that it will rely on being able to clean spilled oil from water, it is sure to fail in all but the most quiescent waters near urban areas. Even then, some oil will sink and damage benthic biota. Indeed, it may be purposefully sunk with dispersants, which are toxic themselves and become more so when mixed with oil.

There may never be a spill of Kinder-Morgan's oil. Nevertheless, it is guaranteed that the increased shipping will result in more oil entering our marine environment. Most oil contamination of the marine environment is from small spills and "routine" discharges, such as bilge water and leakage from fittings. Oil contamination of benthic environments and shorelines increases with amount of oil transported in shipping lanes around the world and is a fact of life already, even on our "pristine" west coast, as shown by our chemical analyses of samples collected during the Nestucca incident.

Given the complementary nature of government and corporate responsibilities in preparing for and responding to a spill, the recent severe diminishment of federal capabilities, and the cold, high-energy environment of west coast shorelines, one cannot have confidence that spills will be prevented, that sensitive environmental resources will be protected, or that the oil will be effectively cleaned up when spills occur.

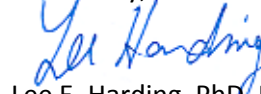
A decision on the Kinder-Morgan pipeline should be deferred until the federal government emergency response capabilities (including laws) have been restored at least to the level of the post-Nestucca enhancements. After this, the application should be considered in light of (1) realistic scenarios for containment and cleanup, having regard to conditions on the west coast marine environment, (2) the certainty that ambient anthropogenic oil contamination will increase as an inevitable consequence of increased marine oil transport, even if no major spills occur, and (3) that major spills are inevitable at some frequency, even if improbable (statistically speaking) in any given span of years.

The following notes explain the factual basis for the above comments.



*Photo 1. Tufted Puffin, a common nesting seabird along the coast of British Columbia.*

Yours truly,



Lee E. Harding, PhD, RPBio



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## Marine pollution

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### *Comments on Kinder-Morgan's application to expand its oil pipeline capacity to the West Coast*



*Photo 2. Oiled Western Grebe, West Coast of Vancouver Island, January, 1989 (CWS photo).*

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## INTRODUCTION

The oil spill resulting from the holing of the barge Nestucca in Grays Harbour Washington on December 23, 1988, is instructive because of what it demonstrates about how wrong government agencies and “experts” can be when they think they are prepared for a major spill.

The response has been called a “fiasco” (Hawkes and M'Gonigle 1992) and led to several federal and provincial reviews of what went wrong (Addison et al. 2004; Anderson 1989; Brander-Smith 1990; Canadian Coast Guard 1989; Davis 1989; Waldichuk 1990). This paper gives a perspective of practical problems encountered during the spill by one who was there (Harding and Englar 1989; Harding and Englar 1990; Harding and Langford 1989; Harding et al. 1991; Langford and Harding 1989; Snowden et al. 1992).

This spill resulted in > 56,000 dead seabirds (Burger 1991; Burger 1993; Duval et al. 1989; Rodway et al. 1989; Waldichuk 1990), contamination and tainting of fish and shellfish resulting in fisheries closures throughout the West Coast of Vancouver Island (Davis 1989; Wright 1994), and at least one dead sea otter (Davis 1989). A law suit for damages resulted in an out-of-court settlement of about \$10 million for cleanup costs and environmental damages.



*Photo 3. Common murrelets comprised most of the seabirds killed by Nestucca oil. About 10,000 nest in British Columbia, of a population of about 40,000 from Washington to Alaska.*

I will start with the Nestucca spill and then comment on spill prevention and clean-up technology, spill frequency, and government and industry preparedness.



## **NESTUCCA OIL SPILL, 1988**

### **Jurisdictional Setting**

When the barge Nestucca, carrying almost a million litres of oil, was holed in Grays Harbour, Washington, on December 23, 1988, the harbourmaster ordered it out to prevent damage to the sensitive estuary. It was towed offshore, across the Humboldt Current that goes straight to Canada. We at Environment Canada thought we were ready. We had no idea.

Environment Canada's spill response team was well experienced and worked within a jurisdictional framework. The Department of Fisheries and Oceans (DFO) took lead responsibility among federal agencies for mystery spills in the marine environment, while Environment Canada (EC) led on inland mystery spills. But for marine spills from a known source, such as a ship or shipping accident, the Canadian Coast Guard (CCG; then not a part of Fisheries and Oceans) took the federal lead, with DFO and EC advising, according to our respective areas of jurisdiction and expertise. EC had considerable expertise, with a spill response centre in Ottawa, a research unit in Burlington and environmental emergencies branches (EEB) in each region. These federal departments worked with provincial agencies where provincial interests were involved and had good communications with American agencies for cross-border incidents.

At the time, the EC environmental emergencies sections, staffed with mariners and environmental technologists, had both spill response and inspection/enforcement responsibilities (these were later separated as a result of the Brander-Smith Inquiry, discussed below).

As manager of the Marine Programs Division, I was not normally involved in oil spills or other emergencies. My staff and I assessed impacts of marine pollution at sites of permitted or regulated marine waste discharge, such as pulp mills, mines, and ocean disposal operations. But our marine biologists were called in when necessary to evaluate the impact of spills of oil or other pollutants. Another part of EC, the Canadian Wildlife Service, would also be called in if birds were threatened.

### **Initial Response**

Within hours of the spill, EC emergency staff were in contact with the US Coast Guard and monitored events through the night. Everyone knew that the longshore currents would carry anything floating from Washington to British Columbia waters.

From December 24 through January 3, the American Coast Guard flew light aircraft over the probable spill path off Washington and into Juan de Fuca Strait, searching for oil. After waiting a few days for the oil to drift north, the Canadian Coast Guard with an EC observer began flying surveys on January 2, 1989. Except in the immediate vicinity of the barge, no oil was seen on the waters off Washington, nor in Canadian the waters. This is discussed more fully below.

Our staff were therefore surprised when oil began stranding on the beach sands of Pacific Rim National Park on Vancouver Island on January 4. By evening oil covered many beaches. It was obvious that we had a major spill on our hands.



Immediately, local residents and park visitors began cleaning up the oil. They became known as “volunteers” and were at first viewed by the CCG as interfering in the official business of cleaning up the oil. But, since it was many days before any effective cleanup response from government agencies was seen on the ground, the volunteers kept cleaning the oil as more and more landed on the Pacific Rim beaches. They were, in fact, responsible for most of the cleanup within the National Park, as First Nations people were in their communities up and down the coast (Photo 4). Eventually, the CCG arranged to pay these volunteers a small, daily stipend for their efforts.



*Photo 4. A cobble beach at Bajo Point was heavily oiled. Members of the Hesquiaht First Nation cleaned the surficial oil.*

A federal-provincial response team was assembled at on January 5, 1989, to establish clean-up priorities and direct clean-up operations. It was based at the CCG headquarters at Amphitrite Point in Ucluelet. Initially, this team, led by CCG, was composed of emergencies personnel, but its composition soon expanded.

I drove to Vancouver Island on January 6 and stayed through most of March. Since our HQ had approved essentially whatever funding I needed, I hired a helicopter from a local charter company. Other biologists from various departments and agencies began arriving soon after, and I was given the use of a garage on the CCG property for managing biological equipment and coordinating biological investigations. We used the “biology” helicopter to survey for wildlife concentrations and sensitive habitats and, later, to transport biologists and their equipment to remote camps for observation (e.g., marine mammalogists from the Vancouver Aquarium to observe the sea otter colony at Bajo Point). The CCG had three other helicopters based at Amphitrite.

## ***REET***

The Regional Emergency Response Team (REET) was set up every time there was a significant spill. It was a standard part of the National Environmental Emergencies Contingency Plan, which, however, no longer exists (or at least does not come on an Internet search; last updated in 1999 according to <http://www.publications.gc.ca/site/eng/86518/publication.html>). It was led by the head of the EEB and consisted of environmental agency representatives; its purpose was to advise the on-scene commander (the on-site head of CCG, in the case of the Nestucca spill) on environmental sensitivities and cleanup priorities. Operation of the REET during the Nestucca spill was described by Davis (1989) and Duval et al. (1989).

Besides the normal agencies, the REET for Nestucca included representatives of Nuuchahnulth Tribal Council and the Kwakiutl District Council, representatives of municipal and regional governments, and a representative of the volunteers who were cleaning the local beaches.

For the remainder of January and most of February, I convened a meeting of biologists representing EC (including CWS), DFO, the Vancouver Aquarium and others, each evening at 5:00 PM to receive and compile reports of oiled wildlife and threatened sensitive habitats. These were reported to the nightly REET meeting at 6:00 PM to guide protection and cleanup efforts.

## **Fate and Effects**

### ***Floating Oil Not Seen***

During the spill response in January 1989, the on-site REET made three specific requests to protect sensitive habitats with oil booms (Harding and Englar 1989:6-7). Harding and Englar (1989) note, p. 6: "No attempts at containment or recovery of oil at sea were possible, given the nature and location of the spill." Duval et al. (1989) made a similar comment. This is because (1) floating oil was almost never seen, and then only in such small amounts that containment would not have been feasible, and (2) the CCG deemed (probably correctly) that protection techniques such as booms and dispersants would have been ineffective in the cold, stormy, winter environment.

Of the hundreds of oil observations reported during the spill response, only a handful were of oil floating on the water (Harding and Englar 1989:16): "Most records are of stranded oil on shorelines; however, incoming slicks or pans of oil were observed on the water off Barkley Sound, within Barkley Sound as far as Mayne Bay, off Long Beach, near Estevan and Escalante Point, in Checkleset Bay south of the Brooks Peninsula, and on the incoming tide at Triangle Island. Many light sheens were also reported throughout the area both during the initial strandings and for several weeks thereafter."

This is despite the fact that we had aerial observers in fixed-winged aircraft daily from about Christmas Day through the New Year's Day and continuously thereafter searching the Strait of Juan de Fuca, as described by Davis (1989). The first oil reported in Canada (Harding and Englar 1989: page 2 of Appendix 3) was on December 31, 1988, when some tar balls and 2 dead birds were found on the beach at Carmanah Point.

Other records from Appendix 3: The CCG reported an unspecified amount of oil on 3 January; location not specified, but it may have been floating, since it was reported by Tofino Traffic. Observers also reported oil patches on Florencia Beach, and other beaches on January 3. On January 4 oil was seen on the water at the shoreline and on beaches in Barkley Sound.

After January 5 we had a several helicopters flying up and down the coast searching for oil (to direct containment crews, had it been feasible, but it was not; and to direct clean-up crews) and small flotilla of boats and ships (described by Davis 1989). I had charge of one of the helicopters, which I deployed searching farther, according to the spill trajectory modelling provided daily by the Institute of Ocean Sciences (IOS), as well as ferrying marine mammalogists and other specialists to remote locations. In addition, the Canadian Wildlife Service (CWS) deployed observers in a fixed-winged aircraft to identify bird concentrations and sensitive habitats, in case it had been possible to deploy booms to protect them.

Also, in an appendix on water column sampling, Waters (1989) notes, "In general no direct observations of oil were seen in water " except for some droplets that escaped from the sampling apparatus and a small sheen resulting from disturbance of subtidal oil during sampling.

These few observations of floating oil were vanishingly rare, considering that some 180+ km of shoreline were oiled, many of them repeatedly on successive days. Also, few slicks or sheens were seen, out of the hundreds of times beaches were re-oiled.

John Davis's report (Davis 1989) states the case more clearly (p. 10):

*"Throughout the event oil appeared difficult to spot by aerial observation using both visual and IR techniques and extensive surface slicks were never spotted which could have accounted for movement of the bulk of the oil contaminating the coast. Following storms re-oiling of beaches off the Tofino-Ucluelet coastline appeared to occur suggesting shoreward transport of floating or submerged oil had occurred."*

Dr. Davis was the Director of the Institute of Ocean Sciences at the time, and he joined us in the field for most of January.

Taken together, the reported observations show that fixed-wing aircraft-based observers, searching every day after the initial spill in Washington State, never saw any oil crossing the Strait of Juan de Fuca; and observers in fixed-winged aircraft, four helicopters, a flotilla of boats and a research ship almost never saw oil anywhere until it actually reached the shoreline.

Failure to see oil on the surface, or to see it both on the surface and at depth, even immediately following a spill of Bunker C, is not uncommon. For example, within hours of a spill of Bunker oil in Vancouver Harbour on April 9, 2015, the first observer on the scene, a sail boater, described a half kilometer section of flat water amid the windswept waves where the slick wasn't just on the surface, but deep beneath the water, consisting of "black globules from the size of a pea up to a fish" (Crawford et al. 2015).

## ***Oil Identification***

The discussion of the oil "fingerprinting", i.e., chemically matching beached oil to oil taken from the Nestucca barge by the US Coast Guard, begins on page 23 of Harding and Englar (1989). The US and Canadian Coast Guards cooperated in the sampling of the barge and sharing data on the matching. I arranged for the chemical analysis of the Canadian samples, both during the spill and during residual oil surveys that I conducted in 1990 and 1991 (Harding and Englar 1990; Harding et al. 1991). Gas chromatograms are illustrated on pages 25 and 26 and 28 (Harding and Englar 1989). Chemical results showed that almost all of the oil that stranded on the beaches and fouled the waterfowl was Nestucca Oil.

However, results also showed that one “tar ball” in 1989 and some other oils sampled subtidally in 1990 (Harding and Englar 1989; Harding and Englar 1990) were not Nestucca oil. Tar balls such as this, and oil deposited in subtidal sediments, are a feature of shipping lanes throughout the world: the busier the shipping lane, the more tar balls, fouling of boats and fishing gear and other amenities, and oil polluting the sea floor (GESAMP 2007). Most oil lost to the sea is not, in fact from the big spills that get a lot of press coverage; by far the greatest amount is from “routine” discharges (such as bilge pumping) and small spills that are not reported (GESAMP 2007). Therefore, even if there is never a big spill associated with oil from the Kinder Morgan pipeline, it is a virtual certainty that the increased shipping traffic will result in more pollution of our shorelines.

### ***Oil Sank to the Sea Floor***

Environment Canada contracted an environmental consultant to conduct SCUBA dives to check for oil on the sea floor: five dives in January and five in April (Duval et al. 1989; Harding and Englar 1989).

The following is verbatim from Harding and Englar (1989:16):

*“Subtidal oil was observed during two SCUBA dives in the Stubbs Island-Wickanninish Island area in January. Divers reported a few 2-5 cm spheres of oil on the sea bottom at depths less than 7.9 m, and neutrally buoyant oil in the water column at this depth. A neutrally buoyant sphere of oil was collected and confirmed by GC-FID to be Nestucca oil, and submitted for density analysis. In an on-site experiment, the sinking rate of oil spheres released at 4.5 m was 5 cm/s. At one of the two sites, oil was also seen stuck to a commercial crab trap and on eelgrass. Divers also noted that oil drops placed on vegetation stuck to eelgrass, but not to algae.”*

The consultants who performed the dives and oil experiments concluded that “the neutrally-buoyant oil found during the dives was rendered such by the incorporation of beach material. This material was coarse (1 to 3 mm) and angular. The oil adhesion is temporary and resurfacing of some oil material would occur. The remaining oil would sink.” (Fingas, 1989, cited in Duval et al. 1989).

When SCUBA dives were repeated in April, no subsurface oil was visible.

These observations are relevant to the transport of Alberta bitumen, which is to be diluted with gas condensate, a by-product of natural gas production. A recent analysis of previous experiments on whether tar sands oil would float or not, that were cited in Kinder-Morgan documents (citing reports by Belore, 2010, Ross, 2012 and others), showed that they failed to consider realistic field conditions, particularly ambient wind speeds and sea state, seawater temperature and salinity, as well as the probable thickness of slicks. Contrary to those reports, oil spilled in winter, and in inside waters such as the Strait of Georgia and central coast fjords, which are much less saline than open ocean seawater, will sink (Short 2015). Therefore, the likelihood of containment and cleanup is lower than represented in Kinder-Morgan’s application documents.

More recently, EC, DFO and Natural Resources Canada (NRC) studied behaviour of diluted bitumen in a laboratory setting and concluded that (Government of Canada 2013: quoted from the Executive Summary):

- Like conventional crude oil, both diluted bitumen products floated on [simulated] saltwater (free of sediment), even after evaporation and exposure to light and mixing with water;
- When fine sediments were suspended in the saltwater, high-energy wave action mixed the sediments with the diluted bitumen, causing the mixture to sink or be dispersed as floating tarballs;

- Under conditions simulating breaking waves, where chemical dispersants have proven effective with conventional crude oils, a commercial chemical dispersant (Corexit 9500) had quite limited effectiveness in dispersing dilbit;
- Application of fine sediments to floating diluted bitumen was not effective in helping to disperse the products;
- The two diluted bitumen products display some of the same behaviours as conventional petroleum products (i.e. fuel oils and conventional crude oils), but also significant differences, notably for the rate and extent of evaporation.

Current research by the Department of Fisheries and Oceans (CBC news report of Withers 2015) is strengthening the above conclusions:

- Diluted bitumen weathers quickly, meaning it gets heavy.
- Chemical dispersants have been found to be less effective on diluted bitumen than conventional oil.
- The dilutant - light oil used to make it fluid - evaporates leaving behind tar balls that sink.

When considering the results of these and other studies, it seems clear that Alberta tar sands oil transported via pipeline to the west coast would, if it were spilled into the marine environment, behave at least as poorly (as regards cleanup potential) as the bunker C from the Nestucca.

### ***Oil on Shorelines***

The west coast of Vancouver Island is a high-energy environment with high tides and Pacific Ocean storms pounding mostly rocky shorelines, ranging from bed rock to sand, cobble and gravel beaches, eel grass beds and high intertidal sedge meadows. About 180 km of shoreline was oiled, of which only a few km were considered heavily oiled (the terms “light oiling”, “heavy oiling”, “slick”, “sheen” etc. were quantitative terms defined in the reports) (Davis 1989; Duval et al. 1989; Harding and Englar 1989; Harding and Langford 1989; Langford and Harding 1989).

One of the problems we encountered early on was that the CCG observers were not experienced in spotting oil. One of their responsibilities was to survey the shorelines by helicopter or fixed-wing aircraft and locate oil for the cleanup crews. Meanwhile, biologists from EC (including CWS), DFO and the Vancouver Aquarium were flying the same routes to identify sensitive habitats and concentrations of wildlife to be protected. These more experienced observers frequently saw oil on beaches that the CCG had previously declared to be clean. This led to a credibility issue and conflict within the REET nightly meetings.

The problem of which beaches were contaminated and which were not also had a physical/geomorphology dimension. As waves lashed beaches and the tides rose and fell, oil was dragged off the beaches, mixed with sand, and deposited on the sea bottom as described above. Or it remained on the rocks and beaches, but was covered with sand and debris, making it difficult to spot from the air. As tidal pumping drew oil into beach sand, it remained in significant amounts, but was not visible to observers even walking on the beach. One DFO official happened to walk across an apparently clean beach wearing white rubber boots, which quickly became black with oil. Her “white boot test” became the standard method to determine whether beaches were contaminated when oil was not visible.

These problems of observing oil on beaches illustrate how important it is to have emergency responders who are experienced in actual oil spills (Canadian Coast Guard 1989; Davis 1989; Duval et al. 1989; Harding and Englar 1989; Langford and Harding 1989; Waldichuk 1990).

### ***Dispersants not used***

Dispersants are toxic themselves (although less so than when I first became involved in oil spill planning as a government biologist in the Arctic in 1976) and become more so when mixed with oil. Industry oil spill specialists like them because they offer a chance of preventing oil from reaching sensitive shorelines or amenities, such as marinas. Biologists hate them because they damage benthic biota and represent a trade-off of one kind of damage for another. Dispersants were available, but not deployed, for the same reasons that other potential protection measures were not deployed: (1) oil was almost never seen on the water, and (2) in any case, discussions in the REET meetings on its potential use centred on the likelihood of it being ineffective in the roily Pacific Ocean winter environment.

### ***Cleanup***

Besides picking up the oil and oily debris by hand or with shovels and rakes, cleanup crews used Petromesh, an absorbent material, and absorbent pom-poms to scrape oil from rocks. Government clean-up crews also tried (against Environment Canada's recommendations at the REET meetings because of anticipated damage to intertidal organisms):

- Burning oiled rocks using a gasoline gel (Napalm) for ignition. Samples of residue were submitted to an Environment Canada laboratory for chemical analysis. On the basis of high contaminant levels, including PAH (polynuclear aromatic hydrocarbons, which are toxic and carcinogenic), and the ineffectiveness, this was discontinued after a short trial.
- Propane "tiger" torches were used for ignition of oil on rocks. On the basis of ineffectiveness and mobilization of oil into gravel and as slicks on the water, this was discontinued after a short trial.
- Heavily oiled logs were burned at several locations, despite the observation that oil ran down into the gravel and cobbles.
- At several of the log-burning locations, bags of oiled debris were thrown onto the fires, although this was not an "officially approved waste disposal procedure" (Harding and Englar 1989).
- At select locations near Tofino, crews cut and removed eel-grass to prevent migrating brant from consuming it.
- At Bajo Point, a heavily oiled cobble beach near a colony of sea otters and an Indian Reserve, where First Nations expressed concern and had worked intensively to clean up the oil by hand, the CCG built a reciprocating kiln to burn the oil from the rocks. A front end loader was air-lifted to the site to dig up the cobbles and dump them into the incinerator. However, it was inefficient and the experiment was abandoned (Harding and Englar 1989).

The cleanup's results were (Harding and Englar 1989:16):

*"Approximately 450 tonnes of oil and oily debris were recovered in B.C. (Rod Nelson, CCG, pers. comm. 21 May 1989) of which approximately 10% would have been oil (Ed Owens, pers. comm., Jan. 1989). More than 500 short tons, or 454 tonnes, were collected in Washington (Wash. Dep. of Ecology). If 10% of the total amount of oil and oily debris was oil, this would amount to about*

*11% of the approximately 850 tonnes spilled. Roughly 89%, or 757 tonnes, would therefore have been lost to the environment. If one assumes that most, or at least half of the oil that came ashore was collected (the cleanup policy was to be as thorough as possible), then a rough estimate of the amount of oil that arrived on Canada's shorelines would have been 50 to 100 tonnes."*

The oil and oily debris were eventually destroyed by burning in municipal incinerators.

Experience on major spills, especially in Cook Inlet, Alaska in 1989 (Exxon-Valdez) and the Gulf of Mexico in 2010 (Deepwater Horizon) has shown which cleanup methods work, and which cause more damage to marine organisms than the perceived benefit of removing the oil from view (e.g., Inkley 2014). However, given the paucity of federal scientific expertise remaining among federal departments (Soomai et al. 2013; Wells 2013) and closing of Environment Canada's environmental emergencies sections (see below), there is scant hope that future spills will benefit from this experience.

### ***Persistence After Cleanup***

The cleanup was essentially finished by the middle of February, 1989, although oil-contaminated crabs and seabirds were still appearing through March. Environment Canada conducted surveys of the more heavily-contaminated shorelines in March, June and September, 1989, with follow-up inspections in 1990 and 1991 (Harding and Englar 1990; Harding et al. 1991; Snowden et al. 1992).

Throughout March–September, 1989, oil was plainly visible on cobbles (Photo 5), wood debris (Photo 6, Photo 7) and in the crevices of bedrock; oil sheens (Photo 8) were frequently seen emanating from these areas (Harding and Englar 1990; Langford and Harding 1989).





*Photo 5. After the cleanup was considered complete, oil was still visible and a dry crust on rocks and cobbles (Bajo Point, March 1989).*



*Photo 6. Oiled debris was still relatively common at the Brooks Peninsula on March 18, 1989.*



*Photo 7. Oil remained on logs and rocks at Brooks Peninsula, March 18, 1989.*





*Photo 8. Besides surficial oil, tidal pumping forced oil into intertidal sediments (Bajo Point, March 1989), from which sheens were ubiquitous in heavily oiled areas for months after the cleanup was considered complete.*

A year after the spill, the oil was more solid/less viscous, indicating loss of the more volatile components. In 1990, oil was harder to see, but still visible as pavement-like deposits under cobbles and in crevices; and it was detectable in a few subtidal sediment samples (Harding et al. 1991). Even in intertidal sedge marshes, heavy oil persisted. For example, a thick, 3 m<sup>2</sup> patch of oil that stranded in an intertidal sedge marsh at Perez Rocks (near Estevan Point) in January 1989 was still plainly visible in 1990 (Photo 9).





*Photo 9. A patch of oil at Perez Rocks in June, 1989 (above) and March, 1990 (below). In 1990, the oil patch was almost the same size and thickness, but had sedges growing through it around the edges, indicated reduced toxicity.*

By 1991, Nestucca oil was rarely visible at these locations, but was occasionally identifiable by GC/MS analysis in intertidal sediment samples (Snowdon et al. 1992). At the Books Peninsula, oil was still visible as splatters on logs (Photo 10) and in pavement-like deposits in crevices and under cobbles (Photo 11).





*Photo 10. Oil-spattered logs in March 1991, Brooks Peninsula.*



*Photo 11. Thick deposits of pavement-like oil were still common at heavily-oiled locations such as Brooks Peninsula in 1991.*

## Federal and Provincial Reviews

In the media, the Coast Guard was castigated for its ineffectiveness in responding to the spill, and it initiated its own internal review shortly after the clean up was completed. As well, “the palpable anger of the citizens of British Columbia demanded a political response” (Hawkes and M’Gonigle 1992). The logistical and practical problems encountered in the response to the Nestucca spill resulted in one provincial and two federal reviews.

### ***Provincial Review***

In the spring of 1989, Premier Bill Vander Zalm appointed Canada's most respected critic of shipping pollution, the former Vancouver Island MP David Anderson, to report on the issue as it affected the West Coast. Anderson had been a major participant in the 1978 oil tanker enquiry at Kitimat (c.f. Thompson 1978). Anderson's report and recommendations were submitted to the newly formed “Washington/British Columbia Oil Spill Task Force” late in the year (Anderson 1989).

### ***Federal Review of Tanker Safety***

The Canadian Coast Guard began an internal review even before cleanup was completed, and finished it in July, 1989 (Anonymous 1989). The review was led by Environment Canada with participation of the CCG and the Department of Fisheries and Oceans (DFO). This was an “internal” review and has never been released to the public. However, the Coast Guard made a copy of the entire review, including reports submitted by individual departments, available to Hawkes and M’Gonigle (1992) for their analysis.

In 1989, in response to public concern after the Nestucca and Exxon Valdez accidents, the Prime Minister of Canada appointed a Public Review Panel chaired by a noted Canadian maritime lawyer, David Brander-Smith. His Public Review Panel Report on Tanker Safety and Marine Spills Response Capability was released in 1990 (Brander-Smith 1990).

## Institutional Changes

Hawkes and M’Gonigle (1992), describing the “Nestucca Fiasco”, stated that:

*“The spill highlighted fundamental legal difficulties. Response to the spill was confounded by such logistical problems as lack of preparedness, equipment, and trained personnel and a reluctance of authorities and clean-up contractors to co-operate effectively with local volunteers. It also spotlighted the ambiguous legal obligation of the Minister of Transport. Despite having the authority to intervene in the event of such spills, neither the polluter nor the Minister were obligated to take preventive or mitigative action, and neither did for several days.”*

Hawkes and M’Gonigle (1992) went on to describe other legal problems that affected preparedness and response, such as vague or ambiguous assignment of liability for spills under Canadian law.

As a result of federal and provincial reviews, commentary in the news media and academic papers, the government of Canada revamped its oil spill preparedness in several ways. All involved federal departments received new funding for emergency response. Environment Canada, for example, received person-year funding for several new staff and a capital allocation for a custom-built “mobile command centre” based on a reinforced recreational vehicle with state-of-the-art communications capability and a weather station, and two new four-wheel-drive trucks each with top-of-the-line radio and telephone communications equipment. As well, for this and other reasons, the EEB section was split into two sections: one to deal with spills and other pollution events, and the other to conduct enforcement (i.e., collect evidence for possible prosecution of polluters and present information at trial).

Canada sued the owners of the barge *Nestucca* and won an out-of-court settlement for about \$10 million, roughly 1/3 of which was for cleanup costs and 2/3 for environmental damages. The latter amount was paid into a fund set up to restore seabirds and other environmental values that were damaged by the spill, as well as to improve preparedness for future spills (Province of British Columbia 1992). A portion of this supported shoreline environmental sensitivity inventories.

## Improvements in Spill Preparedness

Besides the improvements directly resulting from the *Nestucca* spill noted above, there has been progress in international pollution control from ships and improved prevention and preparedness.

According to Transport Canada (<http://www.tc.gc.ca/eng/marinesafety/>), the *Canada Shipping Act* requires tankers built after July 6, 1993, to be double hulled to operate in Canadian waters. Large crude oil tankers were phased out in 2010 and smaller tankers were to be phased out at the end of 2014, although some types were not. The International Convention for the Prevention of Pollution from Ships (MARPOL), to which Canada is signatory, requires that phase-in of double-hulled tankers worldwide will be fully implemented in 2015.

Canada also established a voluntary Tanker Exclusion Zone that “applies to loaded oil tankers servicing the Trans-Alaska Pipeline System between Valdez, Alaska, and Puget Sound, Washington” (<http://www.tc.gc.ca/eng/marinesafety/menu-4100.htm>).

## Improvements Reversed—Gains Lost

Fast-forward to 2015. The *Amphitrite* lightstation and 28 other formerly staffed stations along the B.C. coast have been closed. The regional EC Environmental Emergencies Branches have been disbanded. The environmental emergency group at HQ in Ottawa has been reorganized nearly out of existence. EC and DFO libraries have been closed, and in at least one case, the precious results of years of research thrown into dumpsters (Contenta 2014). Oil spill experts and scientists in DFO and EC have been let go and their positions terminated *en masse*. The laws, such as the Fisheries Act, under which these scientists operated, have been gutted. One of the DFO research ships that we used to use, the CCGS *Parizeau*, has been decommissioned. The submarine, *PICES IV*, that we used to use to examine the sea bottom has been sold, and the contract for its mother ship, the *MV Pandora*, cancelled. There is no longer an emergencies contingency fund at headquarters.



## Frequency of Spills

Industry-sponsored and industry-favourable commentary in the news media during the past year, in reference to marine transport of tar sands oil, have mentioned the infrequency of oil spills on our coast, or denied that any had happened at all. This is not true. As well, some technical reports are available (e.g., Genivar 2013). The following are a few that I saved notes on from a 1999 report for DFO:

Significant spills and near-spills in Juan de Fuca Strait:

1. In 1964, Rosario Strait (in the San Juan Islands) was the scene of the state's deadliest tanker accident when two explosions ripped apart the 504-foot tanker Bunker Hill, killing five of 43 crew. The unloaded ship, its tanks destroyed by exploding fumes, sank to the bottom and remains there today.
2. In 1983, the 811-foot tanker Sohio Intrepid lost power and ended up within 200 feet of the beach on Sinclair Island, in the San Juan Islands. Unloaded and riding high, the tanker loomed like an eight-story building. Tugs arrived minutes before it reached the rocks. Even unloaded, it contained oily ballast water and thousands of gallons of engine bunker fuel. No oil was spilled (or was reported) but it was a close call.
3. In 1985, the Arco Anchorage spilled 239,000 gallons into the harbor at Port Angeles in the Strait of Juan de Fuca.
4. In 1991, off the entrance to the Juan de Fuca Strait, the Japanese fishing vessel Tenyo Maru and a Chinese freighter Tuo Hai collided. The Tenyo Maru sank, releasing 365 tonnes of bunker fuel. The slick travelled southwest to the State of Washington's Cape Flattery.

Others up and down the coast:

5. Exxon Valdez, 1989: A US-flagged tanker *en route* to Long Beach California wrecked on Bligh Reef in Prince William Sound, Alaska due to Captain-error. Eight of the eleven tanks were damaged, releasing 41,000 tonnes of Alaska North Slope Crude Oil. It contaminated 1,900 kilometres of coast
6. Kuroshima, 1997: A 368 foot seafood freighter broke away from its anchorage during a severe storm and ran aground spilling 145 tonnes of Bunker C oil. It contaminated approximately 10 kilometres of shoreline of Summer Bay on the Aleutian Island of Unalaska.
7. New Carissa, 1999: A Japanese-owned, but Panamanian-flagged bulk carrier on its way to Coos Bay, Oregon (US) lost anchor during storm conditions and grounded outside of Coos Harbour. It held 1,490 tonnes of bunker fuel, spilling 268 tonnes when it broke in half.

There have been others. In 2006, the B.C. ferry *Queen of the North* sank with 240 tonnes of oil on board.

Despite improvements in marine oil transport regulations and vessels, accidents happen.

## CONCLUSIONS

1. Despite a rather good (by comparison with today) intergovernmental environmental emergency response system in 1988–1989, federal agencies were unprepared for even a modest oil spill off the west coast of Canada in terms of spill management, communication internally and with the public, knowledge of cleanup techniques. They lacked even so basic a level of expertise of knowing when a beach was contaminated.

2. Since then, some aspects have improved, e.g., certain domestic and international laws, for example, those that mandate double-hulled oil tankers and availability of coastal sensitive ecosystem inventories.
3. The gains that were made in federal government emergency response capability following the Nestucca spill have recently (in the last eight years or so) been reversed.
4. Areas of infrastructure that formerly assisted in management of oil spill responses, such as research ships, institute funding and manned lightstations, have been reduced (or closed, in the case of the lightstations).
5. Federal scientists who formerly were available to advise on sensitive habitats to protect and effective protection and cleanup methods, have been terminated, leaving a huge knowledge and experience vacuum. The scope and application of laws that provided their mandate and gave them authority, such as the Fisheries Act, have been diminished to the point of ineffectiveness.
6. Diluted bitumen will behave at least as poorly as the Nestucca's bunker C in terms of it's being amenable to cleanup. Effective containment can not be anticipated in all but the most quiescent environments that are close to urban areas.
7. The knowledge in efficacy and effectiveness of various oil cleanup techniques that was gained following the Valdez and Deepwater Horizon incidents will not likely be brought to bear on any future Canadian oil spills, since so few cleanup experts and scientists are left and the environmental emergencies sections have been eliminated.

The above points make it unlikely that an oil spill on the west coast can be effectively contained and cleaned up.

Effective oil spill prevention and response to spills when they do happen is a collaboration between government and industry within the context of evolving environmental regulations following international laws and conventions. The actions and responsibilities of each are tightly integrated. The federal government and oil pipeline proponents including Kinder Morgan talk about a "world class" oil spill response system, asserting that it is either in place, or will be when the pipelines are built. The British Columbia government has made it a condition of pipeline approval. However, it is not in place now, and cannot be in place until federal government capabilities are restored at least to the level of post-Nestucca improvements. Those advocating increased oil tanker traffic on the west coast to support trans-provincial pipelines will learn that it is easier to tear apart an oil spill response system than to build one.

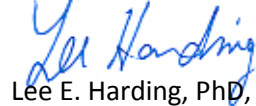
A decision on the Kinder-Morgan pipeline should be deferred until the federal government emergency response capabilities have been restored. After this, the application should be considered in light of (1) realistic scenarios for containment and cleanup, having regard to conditions on the west coast marine environment, (2) the certainty that ambient anthropogenic oil contamination will increase as an inevitable consequence of increased marine oil transport, even if no major spills occur, and (3) that major spills are inevitable and some frequency, even if improbable (statistically speaking) in any given span of years.

## ABOUT THE AUTHOR

Dr. Harding has a B.Sc. in Wildlife Management and a Ph.D. in Wildlife Toxicology. In 1972 Dr. Harding began, as a consultant, studying on impact on wildlife of the Mackenzie Valley Gas Pipeline, the Alaska

Highway Gas Pipeline, a natural gas pipeline system in the Mackenzie Delta and seismic exploration in the High Arctic. His reports were presented with environmental impact statements to both the Mackenzie Valley Pipeline Inquiry and the Alaska Highway gas pipeline environmental assessment panel. In 1975 he reviewed, indexed and cross-referenced all environmental issues discussed by the Mackenzie Valley Pipeline Inquiry for Environment Canada. In 1976 as an Environment Canada senior biologist in Edmonton, he compiled and published environmental Codes of Practice for the Mackenzie Valley and Alaska Highway gas pipelines (see Publications below). He inspected oil and gas pipelines in Alberta and Yukon for compliance with environmental regulations. He participated as an Environment Canada expert in both the Mackenzie Valley Pipeline Inquiry in Yellowknife, NWT and the Environmental Assessment and Review Panel public hearings about the Alaska Highway gas pipeline in Whitehorse, Yukon and surveyed by air all alternate routes from the Beaufort Sea coast to the British Columbia border. From 1977 to 1980, as the Manager of Environmental Assessment for the NWT (Yellowknife office), he sat on several committees that administered the *Arctic Waters Pollution Prevention Act*, which issued permits for offshore drilling, and the *Ocean Dumping Control Act*, which regulated the construction of artificial islands for offshore drilling and related oil and gas activities. His section studied impacts of oil and gas drilling in the field, on land and offshore. During 1980-1991 he managed Environment Canada's marine biological programs on the west coast of Canada. In this position he led the intergovernmental impact assessment of the Nestucca oil spill. He also participated as an expert and material witness in Canada's first successful court case to recover costs of environmental damages.

Respectfully,



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