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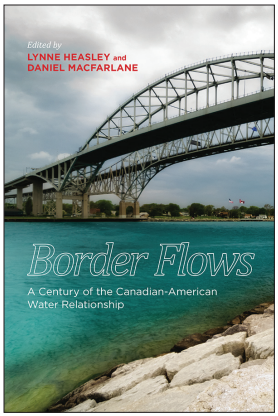

BORDER FLOWS: A Century of the Canadian-American Water Relationship
Edited by Lynne Heasley and Daniel Macfarlane

ISBN 978-1-55238-896-9

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Lines That Don't Divide: Telling Tales about Animals, Chemicals, and People in the Salish Sea

Joseph E. Taylor III

> Chucho. Bird flying south: you think he sees that line? Rattlesnake, javelin—whatever you got—halfway across that line they don't start thinking different. So why should a man?
>
> —*Lone Star* (1996)

We border our worlds to establish order—my side of the room, your side of the backseat, our province, your country—but boundary making is never a simple exercise. Among the many brilliant things about John Sayles's film *Lone Star* is its deft exposure of the psychic and material porosity of the lines we draw. Chucho's speech reminds us that nature has its own geographies, from the dust and mould that spread relentlessly from my bunkmate's side of the dorm to the exotic species that vex environmental managers around the world. Nature reveals the limits of our spatial projects. In fact, the more we try to keep each other at bay, the more nature draws us together. Conservative Montana farmers built fences to demarcate their private property, but rolling tumbleweeds forced them to establish

socialistic "weed districts" and coerce collective responses to keep their fields clean. Similarly, every nation subjects immigrants to health examinations to keep out the sick, but the mutability of pathogens also compels every nation to collaborate in a global disease-tracking system. We try to separate yours from mine to keep out that which is unwanted, but the only constant is transgression, from the 1832 cholera epidemic that swept the globe to the Fukushima-Daiichi-radiated bluefin tuna that arrived off California less than a year after the 2011 Tōhoku tsunami. Neither our national borders nor our cultural containers succeed very well at containing nature's dynamism.[1]

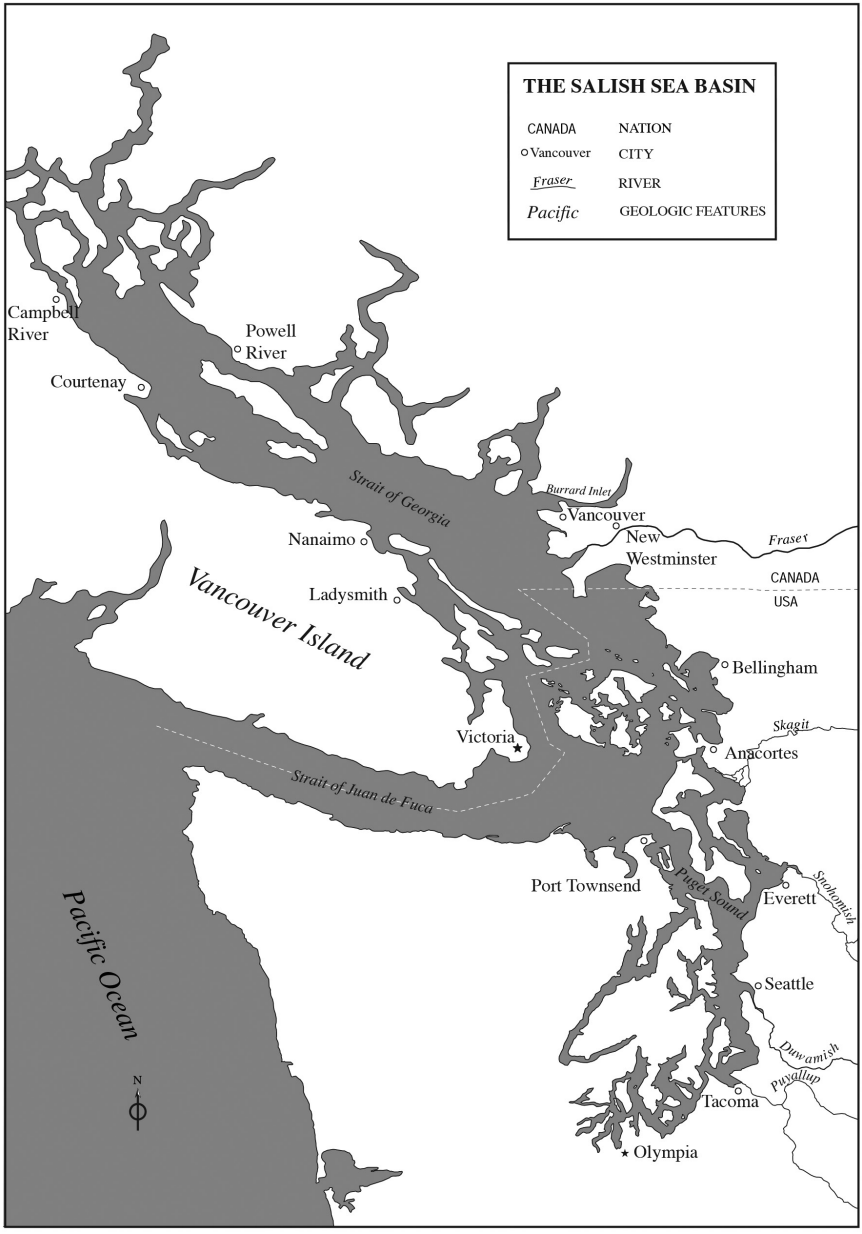
The globalized economy exposes daily the problematic nature of modern borders. Planes and ships carry cargo from every corner of the planet—everything from Afghani-raised poppies to Zimbabwean-mined platinum—to a world of eager consumers. Most of this is intended freight, but there are always stowaways ranging from migrant labourers to insects and pathogens, that are less welcome yet ubiquitous. Our insatiable appetites have so accelerated species transfers that North America now hosts a remarkably cosmopolitan ecology. The tales we tell about such invasions are telling. When we discuss starlings and kudzu, we tend to dwell on human agency, even if only to illustrate the limits of customs agents. Nature is a tag-along companion, the undocumented alien slipping in off-manifest in bilges, bodies, and holds. Just in 2012, Pacific Northwesterners learned about infectious salmon anemia spreading from farmed to wild salmon, whooping cough spreading from British Columbia to Washington and Oregon, and debris from tsunami-plagued Japan washing onto North American beaches from Alaska to California. Nature matters in these tales, but it resembles Dr. Frankenstein's monster: a horrifyingly unnatural beast unleashed by human caprice.[2]

Although this plot can unnerve, it is familiar and reliable, even comfortable, because the moral of the story is always that somebody behaved badly. But how do we narrate when nature takes the lead, when humans are merely supporting players and the most disturbing monsters are largely a consequence of natural processes? Hollywood offers a few such tales. In the movie *Contagion*, for example, pathogenic mutations unleash a super-virulent influenza epidemic that rapidly outpaces humans to devastate the world. The camera dwells on individual experiences, but biological processes drive this viral plot. Life history, bioaccumulation, and migration

similarly frame movies such as *Andromeda Strain*, *Minamata*, and *World War Z*. Like the Frankensteinian narrative, these nature-propelled dramas illustrate the contingent significance of borders. Social spaces matter, but their meanings shift when nature crosses a line. In the case of *Contagion* and *World War Z*, human borders not only fail to keep citizens safe; they actually stymie the state's ability to comprehend natural threats. In such cases the only rational form of boundary making is individual quarantine. Characters literally wall themselves off from the rest of humanity, yet the underlying, almost too-subtle lesson is that isolation is impossible.[3]

This applies equally to the lines we draw between ourselves and nature. Although in the late nineteenth century the germ theory of disease led medical professionals to reimagine human bodies as separate ecosystems, the hermetic body never fully displaced the older view of bodily health as entwined with its environments. Twentieth-century researchers such as Macfarlane Burnet and Rene Dubos drew links between parasites, disease, and ecology, while environmental advocates such as Rachel Carson, Lois Gibbs, and Sandra Steingraber highlighted the linkages between chemicals, morbidity, and extinction. Clusters of rare cancers, birth defects, and chronic diseases kept epidemiologists focused on the role of place in human health. Horrors such as HIV and Ebola made most of the world more conscious of how zoonosis has shaped human history. Every major epidemic from Justinian's Plague to smallpox, measles, anthrax, yellow fever, the Spanish flu, and West Nile virus began when a pathogen jumped from an animal to us. The demarcations between humans, other species, and the environment seem less and less clear. One particularly instructive way to trace this blurred reality is via the ecology of chemicals along the northwestern edge of North America.[4]

The waterscape abutting southwestern British Columbia and northwestern Washington State was once known as the Puget Sound, Strait of Juan de Fuca, or Strait of Georgia (Figure 1). Now it is called the Salish Sea, a vast inland sea studded with rocky islands, complex currents, charismatic fauna, spectacular scenery, and very large cities. In most ways the Salish Sea is a seamless ecology teeming with life, yet as Emma S. Norman and Alice Cohen illustrate elsewhere in this volume, it has always lapped up against a complicated social geography. Native peoples dominated the region for millennia. Most groups spoke dialects of the Salish language, and all relied primarily on marine and riverine resources, especially the Pacific



7.1 Salish Sea basin. The "Salish Sea" is the official geographical term now applied to a waterscape whose individual components are also called the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound. Map by author.

salmon (*Oncorhynchus* spp.) and whales that plied these waters. Residents interacted both peacefully, via marriage and trade, and violently, through war and slave raiding, but sovereignty rarely reached beyond the village. Europeans overlaid but did not erase this fractured world. Even during the hegemony of the Hudson's Bay Company in the 1820s and 1830s, or after Great Britain and the United States formally divided the continent at the 49th parallel in 1846, Aboriginal seasonal movements continued to bare the porosity of corporate and state space. No single sovereign has ever ruled the Salish Sea, and British Columbia's ongoing land claims process with First Nations groups in the province reminds us that the modern state has not yet perfected its title to the region.[5]

This social dynamism depended heavily upon a setting of ecological continuity, but food chains became ever less reliable over the nineteenth and twentieth centuries. The Salish Sea had never been a pristine wilderness. Indigenous peoples harvested vast amounts of nature for millennia, but with little change to the sea's ecology or chemistry. Nineteenth-century farmers, fishers, loggers, and miners accelerated the rate of extraction, especially by denuding forests, silting spawning beds, and blocking streams. Lumber mills, tanneries, and coal mines dumped their wastes into rivers and bays in a giant circle from Port Townsend to Olympia, Seattle, New Westminster, Powell River, Campbell River, Courtenay, Ladysmith, and Victoria. Sawdust leachates altered water chemistry and, in large depositions, absorbed all the suspended oxygen, while tannins toxified the water. Still, resettlement's ecological impact on the sea was slight until the end of the century, when industrialization and urbanization transformed the Salish Sea ecosystem in ways similar to what Nancy Langston describes for Lake Superior in the next chapter. In the 1880s, railroads solidified the line between water and land by filling marshes, tidal flats, and river banks with rock and dirt. Towns expanded the hardscape with ports, levees, and pavement. Population growth and industrial development substantially deepened the ecological impact. Every urban centre poured raw sewage into the sea. Petroleum facilities on Burrard Inlet in 1908 and in Seattle in 1911 disposed wastes similarly, as did ships, shipyards, and steel mills. By 1930 the Salish Sea had suffered significant habitat loss and diminished oxygen content. The main contributors then intensified with World War II and the Cold War.[6]

The distinguishing ecological theme of the twentieth century was not simply the Salish Sea's increasingly polluted state but the changing nature of the things flushed into it. Petroleum- and electrical-based energy used an array of new chemicals that refineries routinely dumped into the sea, including benzene, toluene, and xylene. The widespread practice of burning domestic and industrial wastes released mercury into the air. Pulp and paper mills poured chlorine and heavy metals into the water. Electrical transformers leaked PCB-laden coolants in the Puyallup, Duwamish, Snohomish, and Fraser Rivers and Burrard Inlet. From the 1930s to the 1970s all these chemicals—plus PCDDs, PCDFs, PVCs, and an array of organochlorines such as DDT and 2,4-D—entered the ecosystem in ever increasing amounts. A key period in the watershed was the early 1970s, when federal, state, and provincial regulatory agencies began to rein in pollution. Halting the production and distribution of toxins was a critical turning point, but the chemicals were not easily erased. All would continue to seep into and remain in the sea for decades. The sediment became a kind of safety deposit box of horrors. Moreover, even as the production and release of some compounds abated, new flame-retardant PBDEs, introduced during the 1970s as part of consumer safety legislation, entered the sea in ever increasing amounts through the air and water. Researchers also discovered a much vaster category of unregulated "nonpoint source pollution" as chemicals washed into the sea from urban streets, suburban yards, and rural farms. Most chemicals had structures and modes of action similar to dioxin—a particularly awful carcinogen—and their resilience to decay led all to be dubbed "persistent organic pollutants."[7]

To this point the narrative resembles the Frankenstein plot. In our heedless pursuit of progress, humans have unleashed new, sometimes frightening, forms of nature, fouling nests and wreaking unintended consequences. The plot is so familiar—especially because of those 1950s sci-fi flicks featuring ants and blobs—that we can ignore the details and still accurately predict the outcome: giant women, toxic avengers, Ninja Turtles, and the residents of Hinkley, California, whom Erin Brockovich rescued. We focus on the human victims, but some of the things that were flushed down the toilet—birth control pills, steroids, and other artificial hormones with endocrine-disrupting properties—mutated the sea itself. Biologists have begun to detect broad changes in water chemistry. During winter holidays the sea around sewer outfalls tastes more like vanilla and

cinnamon, and the entire Pacific is more caffeinated these days. Salmon farms transmit epizootics and heavy metals to wild fish. Similar to the effect that Langston describes for trifluoromethyl-4-nitrophenol on larval lampreys in Lake Superior, the endocrine-disrupting properties of PCBs and mercury may have changed reproductive rates and sex ratios in bottom fish in heavily industrialized areas such as the Duwamish River and Hylebos Waterway. Make no mistake: there be monsters here, but this narrative is more complex and devastating than *Godzilla* redux.[8]

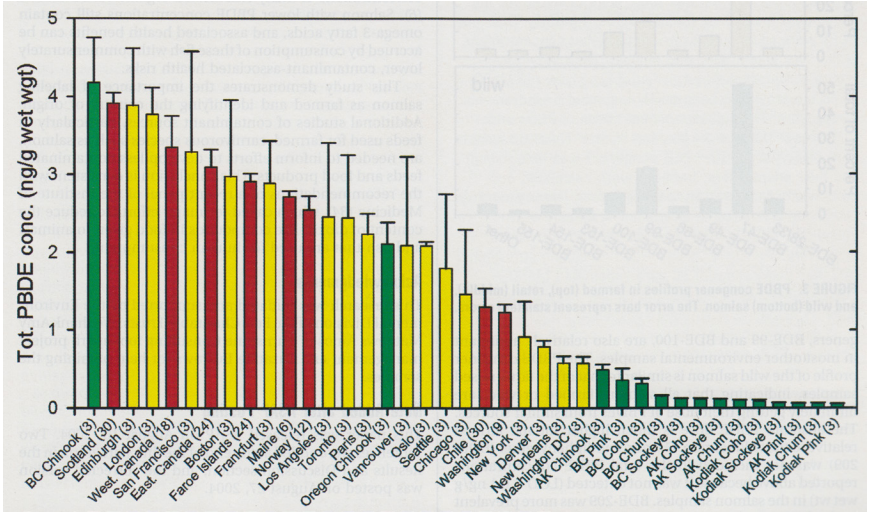
What makes the Salish Sea's chemical history so disturbing is that its environmental processes were utterly natural. Ecosystems are the sum of acts of production and consumption. Sunlight is the foundation of nutrient flows, and food chains are how they cycle. This is life, pure and simple, but the effect on the sea was anything but simple or pure. When chlorine, mercury, PCBs, and PBDEs settled into sediments, microphytes and algae broke down and absorbed these chemicals. This began many cycles of uptake. Anaerobic organisms in the sediment transformed mercury into methylmercury, a more toxic form of the element easier for other organisms to absorb. Those microorganisms were in turn consumed by plankton floating in the current, which were eaten by small fish and shellfish. At each step predators became prey. Smaller-bodied species fed larger, higher-trophic species such as bottom fish, maturing salmon, and marine mammals, while decomposers recycled nutrients and persistent organic pollutants at every level of the ecosystem. Most of the pollutants had anthropogenic origins, but their journey through the Salish Sea was utterly natural, as was the tendency for larger-bodied, longer-lived species to metabolize them—called "bioaccumulation" or "biomagnification"—in ever greater concentrations than smaller-bodied, shorter-lived species. The same process that coloured the flesh of salmon by consuming carotene-laden krill and shrimp, and made longer-lived, fattier chinooks (*O. tshawytscha*) and sockeyes (*O. nerka*) redder than shorter-lived, leaner pinks (*O. gorbuscha*) and chums (*O. keta*), also turned these high-trophic predators into toxic-waste sites.[9]

By the early 2000s, wildlife biologists had a fairly clear picture of what bioaccumulation was doing at the top of the Salish Sea food chains. It was not a pretty sight. Adult chinook bore significant loads of PCBs and PBDEs back to spawning grounds and hatcheries, and persistent organic pollutants accumulated in the blubber and hair of Steller sea lions and harbour

seals at even higher levels. Organochlorines were linked to cancer rates in California sea lions in British Columbia. Resident killer whales "exceeded the health-effects threshold for PCBs in blubber and, most notably, the four juvenile whales exceeded the threshold by factors of 2-3.6." The impact on juvenile orcas was particularly devastating. Lactating orcas were managing to lower their toxic levels by transferring pollutants to their calves through maternal milk. Although researchers focused on those apex species most likely to harbour pollutants in high concentrations, they knew this was a systemic problem that affected every link in the sea's many food chains. And just as the ecosystem did not stop at the 49th parallel, neither did it stop at the water's edge. Biologists traced additional chemical pathways to surf scoters grazing in the nearshore environs of the Salish Sea, to grizzly bears eating adult salmon and excreting the nutrients and pollutants across the forest, and to American dippers feeding on the spawned-out carcasses of salmon in the upper Fraser River basin.[10]

Humans were ultimately linked to both ends of these food chains. Salmon eaters were made aware of their connectedness to the sea through a pair of scientific studies in 2004 that documented high concentrations of PCBs and PBDEs in farmed salmon. As in other tales of bioaccumulation, this was about toxins naturally concentrating as they moved up the trophic ladder. The researchers noted that farmed salmon, because they were fed processed bottom fish, functionally ate at a higher trophic level than wild salmon, which preyed on smaller-bodied fish. From an ecological perspective, there was little surprise in finding that farmed-salmon flesh contained higher concentrations of PCBs and PBDEs than did that of wild salmon, but there *was* a surprise: the single highest PBDE score came from a wild salmon (Figure 2). The data point seemed anomalous until researchers learned that it came from a large-bodied, long-lived chinook whose subpopulation matures in the Salish Sea; unlike most wild salmon, which spend the ocean part of their lives far out in the Pacific, these chinooks remain locavores and pay a price.[11]

The research on PCBs and PBDEs also illustrates how humans inhabit the highest trophic level in the Salish Sea's persistent organic pollutant ecosystem. Every human bioaccumulates, but we do not all consume toxins equally. Although most Salish Sea residents eat salmon, they do not all eat the same species of salmon. Wealthy residents consume fresh sockeye and chinook shipped from the nonindustrialized, far less toxic Skeena,



7.2 PBDEs in salmon. In 2004, researchers published studies on the bioaccumulation rates of persistent organic pollutants in farmed and wild salmon. The above graph illustrates PBDE accumulation, with wild salmon (black bars) mostly scoring at the low end. The higher uptake values among wholesale- and supermarket-supplied farmed salmon (grey and white bars respectively) was unsurprising, but the two exceptions involving Pacific Northwest runs, especially the BC chinook at the far left-hand edge of the graph, underscored the polluted state of Northwest waters. Reproduced with permission of Ronald A. Hites and American Chemical Society.

Copper, and Bristol Bay watersheds. Middling Northwesterners tend to dine on coho and chinook caught by local trollers and anglers or on Atlantic and steelhead salmon farmed in Washington and British Columbia. The poor eat pink and chum canned in northern British Columbia and western Alaska or bottom fish and crab harvested from urban piers. Thus, the middle class and poor most often consume local nature, and the poor eat more local fish per capita than any other segment of society. This is not a good thing. Bioaccumulation operates the same way in humans as it does in birds, fish, pinnipeds, and cetaceans. Toxins accrete in adipose tissues, especially the buttocks and breasts, and females can pass concentrated doses of these chemicals to nursing infants. Mammalian babies, it turns out, are the apex consumers of the Salish Sea's toxic ecology. The biological

mechanisms that led nursing juvenile orcas to have above-average levels of toxins are the same ones that place poor kids in Seattle—whose mothers consume high amounts of locally caught fish—at a higher risk for toxic contamination and cognitive delays. In this respect, the Salish Sea differs little from other heavily industrialized environments such as Lake Superior, New York's East River, Baden-W**ü**rttemberg in Germany, and Zhejiang in China, but at this point even places like Arctic Canada suffer from persistent organic pollutants.[12]

Because toxic ecologies exist pretty much everywhere, so do their environmental and social consequences. The intellectual and geopolitical borders that run through the Salish Sea offer a rare opportunity to consider the physical and cultural obstacles that thwart our ability to think ecologically. The sea that captures modern imaginations is decidedly not the world that Aboriginal peoples inhabited two centuries ago, yet its timeless beauty and bounty are why people continue to invoke regional identities that ignore the 49th parallel. Although the imperialistic ambitions of the Hudson's Bay Company and American jingoists lost favour, environmentalists and entrepreneurs suggested transnational spaces that were, each in its own way, as imperialistic and blinkered. In 1975, Ernest Callenbach's *Ecotopia* included the Salish Sea in an imagined nation that would encompass the entire northern Pacific coast. Underlying his fantasy, and repeated even more expansively in Joel Garreau's *The Nine Nations of North America* (1981) and Colin Woodard's *American Nations* (2011), is a belief that local nature nurtures unique environmental sensitivity. The Salish Sea's history of persistent organic pollutants complicates such claims, but it has not stopped Washington and British Columbia entrepreneurs from asserting their own kindredness with nature and each other in the "Cascadia" campaign that claims the Pacific Northwest is a natural bioregion and economy that is artificially divided by two nation states. In the words of a Canadian booster, Cascadia "is a spectacular array of natural and built environments, with wilderness coexisting in relative harmony with sophisticated urban centres."[13]

The coinage of "Salish Sea" is thus the latest in a long genealogy of regionalisms. First proposed in the late 1980s by Bert Webber, a Canadian-born marine biologist who spent his professional career at Western Washington University, "Salish Sea" slowly grew more popular among activists, artists, bureaucrats, and scientists. By early 2010, state, provincial,

and federal geographical naming boards had approved the term. Like previous ideas, "Salish Sea" conflates nature and culture too tidily. In honouring the Salishan-speaking people who had long resided around the edges of the sea, Webber memorialized the dominant language but homogenized the region's fractured political and linguistic geography, which included many independent groups, ten distinct dialects, and three Wakashan-speaking peoples (Kwakwaka'wakw, Nuu-chah-nulth, and Makah) who were effectively defined out of the modern "Salish Sea." Webber hoped his neologism might even erase memory of the old Georgia Strait, Puget Sound, and Strait of Juan de Fuca. His aim was "to restore the damaged waters by raising awareness that this is one shared ecosystem spanning the border between Canada and the United States." This was probably the most radical element of Webber's agenda, and a marked departure from previous coinages, both because it lacked an entrepreneurial edge and because it gained official sanction. Nevertheless, some reactions to the new name revealed that the most formidable obstacles to ecosystemic management are not the geopolitical lines on maps but the boundaries inside people's heads. One Canadian academic readily lumped "Salish Sea" together with "Cascadia" as another act of American "cultural imperialism," ignoring both Webber's Canadian nativity and the BC business community's support of the Cascadia campaign. The critic bristled, "It's just another one of the American efforts to erase the border. . . . It's a silly idea. We have beautiful [geographical] names." One is tempted to add, "and really ugly sediment chemistry," but as historian Carl Abbott observes, the international border has indeed grown less porous over the course of the twentieth century.[14]

The "Salish Sea" is thus less a resurrection of ancient geography than a thoroughly modern construct, yet the sea's environmental past is the single most important reason for embracing the new label, provided, of course, that the messiness of the past informs residents' understanding of the present ecosystem. This is not a given. Environmentalists who care about this waterscape, for example, like to wax poetic about the beauty of the sea and its magnificent breaching whales and salmon runs. These are charismatic environmental emblems, mythic both in their place in regional culture and in their historical emptiness. They capture the imagination, but they are rather timeless in a bad way. Only by moving past the superficiality of this imagery can residents grasp the ecosystemic implications. They must drill down to the blubber and fat, linger on the ickiness of their chemical

compositions, to see how biology and chemistry link sea to land and fish to mammals and birds in historically contingent ways. Only then will residents develop the sort of holistic vision of humans *and* nature necessary to comprehend the true extent of the Salish Sea's persistent organic pollutant ecoystem. Historically grounded perspectives of the Salish Sea are imperative. Some local environmentalists promote locavorism—the ideal of eating locally to minimize the carbon footprint of consumption—but they seem unaware that the urban poor have long consumed local nature, and that this has not been good for them. Persistent organic pollutants no longer affect just the poor, however. Toxic fish are actually a remarkably democratic problem. Research has detected growing amounts of heavy metals in salmon that spawn in remote Alaska lakes. Thus, even well-educated consumers who avoid toxins by frequenting upscale stores and restaurants unwittingly eat tainted fish. DNA testing has also revealed that many vendors mislabel fish products, and the environmental labelling programs of the Marine Stewardship Council, Blue Ocean Institute, and Monterey Bay Aquarium are less than fully reliable.[15]

Such shortcomings may be a good thing. If fewer Salish Sea residents regard upscale consumption as an ecological refuge, perhaps more of them will work to make the sea an ecology that they, or at least their children and grandchildren, can consume without fear. Right now the sea is studded with signs along urban shores warning residents *not* to consume locally (see Figure 3). The signs offer several key lessons. First, usually written in multiple languages to inform the sea's many immigrants, the signs underscore the socioeconomy of locavorism. It is ultimately the poor and marginalized who most regularly consume the sea. Second, the signs remind us of the devastating effects of locavorism. Dangers range from immediate poisoning to delayed cancers to inherited birth defects. The poor and marginalized run a higher risk of suffering these fates, but society as a whole pays in the form of higher costs for medical, educational, and social services. Third, the signs reveal an uneven geography of concern. Even though the Georgia Strait's history of persistent organic pollutants mirrors that of the Puget Sound, and even though poor immigrant and First Nations fishers rely heavily on those polluted waters, the British Columbia government has been slower to erect warning signs. Finally, the signs reveal the limits of conceptualizing environmental and social problems. The public and media lean on predictable metaphors. They liken environmental monsters

7.3 Warning sign, 2015. The chemical legacy of 150 years of industrialization emerges in signs alerting residents not to eat fish from the Salish Sea. The above warning, posted at a popular park on the lower Duwamish River, is given in nine languages: English, Spanish, Korean, Chinese, Vietnamese, Russian, Laotian, Cambodian, and Somali. There is a marked difference between the United States and Canada in the frequency of these warnings. Photo by Matthew W. Klingle.

to Frankenstein, and victims to H.G. Wells's Morlocks, but the biological and ecological processes that cycle persistent organic pollutants through the Salish Sea and back to us are more subtle and complex than the monster and mutant tales can convey.[16]

The Salish Sea's toxic ecosystem reveals how easily and thoroughly nature transgresses governmental and cultural borders. Geopolitically, an increasing number of governments claim the sea as if it can be parsed into American, Canadian, and tribal space, while corporations and environmental groups regularly cross international boundaries to shape environmental policies. Norman and Cohen argue in chapter 2 that this fragmentation opens possibilities for a broader array of voices to shape environmental management, but those voices are not all equal. Moreover, adding more will not necessarily make management more responsive. The sea is a transnational space. Its sovereignty, though, is still exercised through territoriality—and governments, all governments, jealously guard their powers. The Salish Sea is thus, as always, a seamless ecology deeply fractured by an ever growing array of social and political geographies that might actually make regulatory coordination more difficult. The nature of this place also poses challenges to its intellectual boundaries. Environmental scientists, even when they seek "an integrated analysis of the marine social-ecological system," still speak of "natural and human drivers" as though these can be teased apart. The persistent organic pollutant ecology of salmon, seals, and people plays havoc with such distinctions. The United States and Canada, Nature and Culture; the Salish Sea merges our comfortable antonyms in a world of hybrids that cannot and ought not be segregated. Heavy metals and chemicals course through orca and human bodies via the same natural processes. To separate the natural from the cultural in apex predators, or any other species, does violence to the tangle of social and ecological systems that link species and countries. This is a messy world, one requiring messy explanations. Its human residents, and indeed all humans, will do better by nature and themselves to acknowledge the limits of the lines they draw. Intellectual and political borders get in the way of understanding. As Chucho says in *Lone Star*, no other animal thinks differently when it crosses our lines. Neither do persistent organic pollutants. Why should we?[17]

Notes

1 I would like to thank Mark Fiege, Lynne Heasley, Matt Klingle, Nancy Langston, Dan Macfarlane, and Louis Pubols for their advice and encouragement with this chapter.

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