DRAWING LINES IN THE ICE:

REGULATING MUSSEL MUD DIGGING IN THE SOUTHERN GULF OF ST. LAWRENCE

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Crossing the North River causeway into Charlottetown Royalty during the winter of 1901 would have revealed a landscape quite unlike the bucolic country scenes from the pages of Prince Edward Island's most famous novel, *Anne of Green Gables.* Instead, the sight would have included over a hundred "mussel mud" machines, a few hundred men on sleighs, perhaps twice as many horses, a bootlegger selling rum in plain daylight, and a man in uniform arresting one of these gentleman farmers for digging in a restricted conservation area. Lucy Maud Montgomery's Prince Edward Island never looked like this. This ocean of men and machines, and they were probably all men, were there for one purpose — to dig through the thick shield of ice and extract as much of the river's heavy, shell-encrusted mud as they could before spring freshets weakened the ice.[1]

Gazing around from the causeway would reveal clues as to why some men were doing this, and why others were trying to regulate or even stop it. On the land more than 80 per cent of the original forest had disappeared, along with most of its flora and fauna; in the water a thick carpet of eroded topsoil covered the river bottom, suffocating much of the estuary's original biodiversity. Social pressures were mounting from land and resource scarcities, and the recent collapse of shipbuilding and other industries had driven young and old to the Prairie harvests and the "Boston States." The primary sector was also under threat, on both land and sea. The cleared land had encroached on parcels that could not support agriculture, and even the best land was under immense pressure to feed the province's largest population to date (including the growing city of Charlottetown at the mouth of the river). It had been decades since anyone on the shores of this river had had cheap energy and other products from local forests, and most of the inhabitants of town and country here kept warm and fed on imported coal.[2] Oyster fishers in the province's second most important bivalve habitat were frustrated by declining yields despite years of federal intervention and scientific research; within two decades the entire industry would collapse from the Malpeque Oyster Disease.

Digging oyster and mussel mud was not traditional sustainable agriculture as some have argued, but rather an intrusive human modification of the natural landscape. Large-scale commercial and provincial digging outfits eventually exhausted certain estuaries, and as farmers encroached on protected areas all parties involved drew lines in the ice that became flashpoints for confrontation.

This chapter examines the harvesting of this marine fertilizer, and the ways in which primary industry and the state modified the nature of the estuaries. State officials encouraged sea manure use at first, although it was always harvested by privately operated businesses and innovators. Then, between 1893 and 1920, governments tried to moderate it through legislation and their own distribution network. Finally, scientists discouraged the use of sea manure and advised farmers to adopt the newly available synthetic fertilizers for lime and nutrient replacement. The state's approach to regulating and managing estuarine resources evolved as the federal government turned to scientific methods in the late 19th century, and then again as the estuaries were turned over to the provincial governments in 1912.

"Mussel mud" or shell mud used as a fertilizer is a cherished part of Prince Edward Island history. It receives special mention in most community memoirs — even those located far from estuaries.[3] It is also visible in most academic histories of the province's economic development and in practically every telling of Prince Edward Island agriculture. Historians have investigated the use of mussel mud in Prince Edward Island since 1876, when a historical society included questions on its use and origin in a questionnaire. Mud reappeared in historical texts, from Sir Andrew Macphail's *The Master's Wife* to myriad community histories published as centenary projects and other initiatives. It did not figure heavily in the single most extensive study of the island's agricultural history, *Three Centuries and the Island*, possibly because A.H. Clark thought of it as popular history and an unscientific method of soil treatment. He was writing in a context, after all, where synthetic fertilizers were accepted as the most predictable way to feed the rapidly expanding global population.[4] Horse manure and seaweed have never been glamorous subjects, but perhaps this was even more true in an age completely mesmerized by the potential of fossil fuel-powered agriculture.

A resurgence in folk history in the 1980s led David Weale to write an excellent oral history of mussel mud use for *Canadian Papers in*

Rural History. More recently, mud has surfaced in studies of sustainable agriculture and digital oral history projects.[5] Weale argued that soil exhaustion increased over the course of the 19th century and that necessity led to the invention of a highly efficient mussel mud digger. Wayne MacKinnon and Elinor Vass emphasized exogenous knowledge transferred through cultural folkways and the agricultural press as an explanation for the increased use of sea manures during the 19th century.[6] Oral histories have revealed a wealth of information, but by themselves these sources tend to suggest that mussel mud fertilizer use was a ubiquitous and evenly distributed resource for all coastal inhabitants. They present farmers as stewards of the land and guardians of traditional forms of sustainable agriculture.[7] They say little about the estuaries themselves, but implicit in the stories of sea manure use is the notion that these marine resources were naturally occurring, unlimited, and unaffected by human activity. Human activity in the salt marshes has been addressed by biologists such as Rosemary Curly and by environmental historians such as Matthew Hatvany and Rod Giblett, but the shell beds and intertidal flats are a different ecosystem again.[8] Even before the first mussel mud diggers went to work these were highly disturbed environments, and what farmers found on the bottom when they arrived was in large part their own creation. This chapter examines the effect of sea manure use on the quality of life and environmental history of rural communities, and using historical maps it explores what happened when state officials and other experts attempted to manage these resources.

The first attempts to map the region's estuaries from the bottom up took place in the mid-19th century. The historical maps created by surveyors such as Captain Henry W. Bayfield are a primary source for this study, but they were also part of the story. Claire Campbell has described the charts of Bayfield and others as "attempts to make sense of a place that did not always conform to their expectations of 'nature,' and to order that space as best they could."[9] Since mapping usually required major infrastructure and technology, it was usually the domain of the state, and the spatial documents available to historians reflect what was important to governments at the time. Maps in Prince Edward Island focused on coastal navigation and development, resource management, scientific aquaculture, property ownership, and land use. Detailed surveys of the estuaries and their resources were in great demand by the federal Department of Fisheries in the 1890s, but they were never actually begun in Prince Edward Island

until 1912-13. These plans were for the purpose of delineating aquaculture lease boundaries and "barren bottoms" more than the actual presence of shellfish or shellfish habitats. In the early 1970s, Environment Canada and the provincial Department of Fisheries together created an Estuarine Resource Inventory program, researching and mapping the physical and shellfish characteristics of most of the Island's rivers and estuaries.[10] The province has also created its own historical land use data in the form of forest inventories based on aerial photography, beginning in 1935.[11] Using geographic information systems, it is possible to overlay and combine data from these documents and databases with qualitative sources that offer a picture of the province's mussel mud usage and resulting areas of conflict. Together with diaries and account books, these spatial records are perspectives of place — road maps of the relationship between humans and their landscapes.

This chapter is set in the places where agricultural land and sheltered estuaries intersect in the coastal zone of the southern Gulf of St. Lawrence. This interprovincial area consists of communities in New Brunswick and Nova Scotia along the Northumberland Strait and along most of the coastline of Prince Edward Island. The focus of the research is on Prince Edward Island, due to the availability of sources and the widespread significance of the mud-digging phenomenon in the province's popular memory and its environmental and economic histories. The region's estuaries, defined as partially enclosed bodies of water with constantly mixing sources of salt and fresh water, are home to large shellfish populations. Humans have influenced these estuaries in two ways: inputting materials into the water column and removing estuarine resources through dredging, pumping, digging, and fishing.[12] The lobster is the best-known shellfish in the region's fishery, but bivalves such as oysters, clams, quahogs, and mussels were actually the first to be extracted from the sea on a large scale. Many were harvested for direct consumption, but in Prince Edward Island most were dug up, either dead or alive, by farmers for use as a calcareous fertilizer.[13]

In Prince Edward Island this fertilizer was known colloquially as "mussel mud," but in reality most of the shells were from oysters as these had the highest concentration of what farmers needed — calcium carbonate.[14] Prince Edward Island soils are highly acidic and require calcium carbonate to lower their pH to a level suitable for agriculture. The region's shell mud contains 4.5 per cent calcium carbonate, although this

varied widely depending on the concentration of oyster shells in the mud. Dense concentrations of shell contained more calcium carbonate but even less plant food. "Do you know what it was?" whispered one demystified farmer, "It was just dead oysters, that's all it was."[15] The estuaries in the southern Gulf of St. Lawrence were ideal sites for extracting mussel mud for three reasons: they formed one of the world's best habitats for *Ostrea edulis,* the watersheds drained some of the region's best habitat for farmers, and the northern climate allowed one to reach the other through holes in the ice. This habitat, and the human and bivalve activity it encouraged, varied across the region. Some rivers were better hosts than others, and all of the habitats changed over time. What mattered most for oysters were depth, temperature, salinity, and strong tides to provide an adequate food supply.[16]

As early as the mid-19th century, Prince Edward Island officials pointed to resource scarcities in the rapidly developing province. The 1860 Land Commission identified a shortage in lime that affected the province's agriculture and quality of life. The province had no lime quarries, and transporting limestone to its kilns was expensive. Without limestone "it is found impossible to preserve land in this Island in a state of fertility, for any length of time," the commission claimed. Occasionally farmers burned oysters in kilns to make lime, but this practice was banned in Prince Edward Island in 1832.[17] With poor yields caused by declining soil nutrients, and the Island's high acidity, lime was essential. Then, during the 1860s, something changed, and farmers rather suddenly treated almost 49,000 acres of acidic soil. Between 1861 and 1871, the number of lime kilns more than doubled, and lime production increased more than 250 per cent. The 1871 census indicated that almost 16,000 acres of farmland had been treated, presumably not all in the previous year but over a longer period.[18] More than 33,000 acres of farmland were also covered in mussel mud by 1871. Farmers suddenly began importing expensive lime and gathering sea manure in a dangerous, cold, and time-sensitive environment. If there was a yield problem in the region's fertile crescent at mid-century, it was quickly addressed by an enormous investment of time and capital. The region was experiencing intense growth in the 1860s, and the lowly bivalve *Ostrea* was to be a central part of the new growth plan.

Coastal farmers have used seaweed, offal, and shell mud as fertilizers for millennia. However, even the most ambitious farmer would use sea manure on his land only if there was a shortage of fertilizers and fertile

land and a demand for food surpluses that justified investing the time, materials, and other expenses in procuring this soil treatment. Part of rising demand for mussel mud in the 1850s and 1860s arose from the realization by livestock farmers of the dramatic effect it had on their hay crops; some farmers later proclaimed that "without "mussel-mud we would starve on the farms — both man and beast. We could not grow hay enough to feed one horse."[19] In 1860 the Prince Edward Island Land Commissioners' Court stressed that mussel mud, "which but few can procure," would be an excellent substitute for the lime necessary to improve the hay crop.[20] The census of that year did not record the quantities, but the enumerators' notes mentioned certain areas that used it. For instance, Lot 32 farmers had been applying mud and seaweed as fertilizers for about five years prior to the census in 1860.[21] The rivers bordering these farms, the West (Eliot) River and North River, became the first extensive mud source.

When the first significant increase in lime and mussel mud began in the 1860s, it was markedly strongest in the West River and North River watersheds. The popular and academic literature have both suggested that mussel mud digging in Prince Edward Island was ubiquitous. A very different story emerges, however, from the 1871 *Census of Prince Edward Island* — a source generally unexplored by environmental historians. The census was taken separately from Canada's, and it posed questions — such as the quantity of mussel mud used — that would never have been part of a national census. This source demonstrates that only 11 of the 67 townships in Prince Edward Island had treated more than a thousand acres of land with mud by 1871. Even the heavily mined river bottoms were used differently by farmers: townships on one bank, such as Lot 18, were heavily mudded whereas farmers across the bay treated their land at sometimes a quarter of the rate (Lot 14). Farms to the immediate west of Charlottetown harbour treated more than 29 per cent of their cropland, whereas farms to the east treated only 4 per cent.

The West and North Rivers were the first estuaries to have significant amounts of mud extracted. Between about the mid-1850s and 1871, these rivers lost between 78,000 and 117,000 yards of shell beds and mud.[22] In estuaries such as Bedeque Bay and New London Bay, mud was being extracted at rates ranging from 3,500 to 7,500 yards per year. The census does not provide data on specific river use, but these amounts are deduced because they were the most likely source for the mud that appeared on these townships in 1871. Depending on how heavy the loads of mud and

shells were, these extractions cost the rivers between 3,500 and 10,000 tons of shell and mud per year. If farmers dug at an average depth of two yards, they would have disturbed up to three quarters of an acre per year.[23] In other estuaries farmers were much less active, and it is likely that most rivers in Kings County and several in Prince County were generally undisturbed until later in the 19th century.

Every yard of mud used on fields in the 1860s was dug and transported by human and horse power. Farmers worked alone or in partnerships to operate mud diggers made mostly of materials from their own woodlots. The farmers relied on their own knowledge of place to locate the best shell beds, and they hauled the mud home to their own fields and spread it over the winter snows with shovels and sleighs. Dig sites were recorded by lines of sight, and by marking the ice with bushes. Roderick Munn, a gentleman farmer in Marshfield, noted that the "Land mark for our digger site in 1888," was as follows: "McEachern's Chimney in a line with bush at McLeod's shore and bush in P Robertson's field in a line with East end of Sheep House."[24] Several diarists mentioned marking beds in December in preparation for the heavy ice, and scouting the estuaries with sounding rods or "mud-poles" was a common fall activity well into the 20th century.[25] These efforts to understand the nature and location of estuarine resources indicate that farmers had extensive knowledge of the river bottoms. An emphasis on the self-sufficiency of farmers also gave rise to a popular notion of the mud digger as a subsistence operator, working with tools derived through direct provisioning and following sustainable practices. In reality, mussel mud digging was also, or perhaps even primarily, a market activity, and people who went into the business of commercial mud digging were early adapters to new forms of energy and technology.

The steady stream of sleighs hauling mud from the rivers had resulted in substantial disturbances in some river bottoms by 1871. However, as the newly built Prince Edward Island Railway began to operate in the early 1870s, the mussel mud landscape changed again, and the many thousands of tons of shell being extracted from rivers and transported by horse increased substantially in the late 19th century. The early productivity was made possible in part by the digger's mechanical designs, but in reality the railway shaped the way mussel mud was dug from very early in its history as a soil treatment on Prince Edward Island. In 1881, the Department of Fisheries presented a report on oysters to Parliament and noted that at least 200,000 sleigh loads of mud were being harvested annually. It warned that

"as it is now conveyed inland by railway the demand is vastly increasing. During the season of winter the cumbrous digging machines . . . cover the oyster creeks like a scattered encampment."[26] Bedeque Bay became the nexus for commercially harvested mud distributed on the railway, and several different attempts to build spur lines to the water's edge, and north to Malpeque Bay were discussed in the last two decades of the century. Newspapers in this period suggested that the railway moved from 1,000 to 2,500 car loads per year. The mud was usually hauled on flatcars, and by 1892, the *Guardian* noted that the diggers at Bedeque distributed most of their mud by rail, each machine producing enough to load eight to ten car loads per day.[27]

Perhaps the most obvious side-effect of digging mussel mud was the depletion and disturbance of the shell beds containing the rich calcium fertilizer. In the late 19th century, the area's oysters, especially the Malpeque and North River oysters, were an internationally renowned delicacy. The Mapleque oysters had acquired brand status, and the Department of Fisheries recognized the value of this asset.[28] A report on oyster culture in 1885 said that there were no restrictions in place and "live beds are cut up at random in all directions." "Oysters are protected by the Fisheries officers in the summer," it warned, "that they may be destroyed by the farmers in the winter."[29] The report recommended marking off some federal reserves to protect the live oyster beds from overfishing and mussel mud digging. In 1892 Charles Hibbert Tupper, Minister of Fisheries, hired the Kemp brothers, oyster experts from London, to survey the major oyster habitats on Prince Edward Island and assess what could be done to increase the oyster catch. After his initial survey of beds in the Malpeque area, Ernest Kemp recommended the complete elimination of off-season fishing, brood or "undersize" harvesting, and mussel mud digging. Immediately. The *Guardian* agreed that the first two suggestions made perfect sense. The third suggestion would be met "with disfavor" by the Island's farmers, to say the least. But Kemp supported his suggestion with evidence that mud digging destroyed oyster beds indefinitely, and he argued that eight or nine diggers were capable of destroying an acre of oyster land in one winter. Disturbing oyster habitat to procure mud for fields he claimed, was "planting gold and harvesting tin."[30]

In December 1893, the federal government passed an order-in-council to restrict any parties from digging mussel mud within 200 yards of live oyster shell beds. Liberal Fisheries Minister Sir Louis H. Davies

dealt with most of the conflict surrounding the this policy, and it was his responsibility to determine exactly where the lines should be drawn in the ice to prevent diggers from disturbing live oysters. The protests that followed split farmers and fishers, neighbours who might not otherwise have put themselves in disparate camps. Canadians debated the moral worth of mussel mud digging in terms of economic tradeoffs. A Department of Fisheries scientist asked the nation's top farm scientist to evaluate mussel mud in terms of its benefit to his constituents and neighbours, inquiring in a letter to William Saunders of the Dominion Experimental Farm in Ottawa: "Is the mussel mud of more value to the community than the oyster beds?"[31]

The earliest opposition came less than three months later, from farmers and commercial mud diggers near Bedeque Bay and Malpeque Bay. They argued that both bays should be exempted from the order-in-council, or at least until full surveys of the beds could be drawn to the satisfaction of both farmers and fishers. Fisheries officers, local enforcement agents or "guardians," and businessmen all wrote to the Deputy Minister William Smith, asking for clarification and possible exceptions. Most of the requests were passed on to Ernest Kemp, who was most familiar with the area. Kemp argued that enforcement should have been straightforward since the local federal guardians should be "well acquainted with the position of both live and dead beds." In reality, without detailed surveys of the beds, the local population was not so willing to accept the guardians' interpretation of the boundaries. One local businessman claimed that the "Guardian here says impossible to place any diggers in Richmond Bay at 200 yd proximity from live beds," and he strongly recommended excluding the entire Bay for the time being. Figure 1 uses the first surveys of the shellfish distribution in Malpeque Bay (mapped almost 20 years later) to indicate that in many ways he was right. Ultimately, so many residents, fisheries officers, and government officials wrote to the department that Kemp identified a place in the Upper Malpqeue Bay where "no live beds exist therin [sic] as they have already been destroyed by this process, and are totally unfit for oyster culture."[32] Thus began a series of exceptions to the 200-yard rule.

Farmers on the West and North rivers, the largest mussel mud-digging centre in the 1870s, were also the most actively opposed to the shell bed regulations. Most mud-digging conflicts were not addressed until February or March, when the ice was strong enough to support the

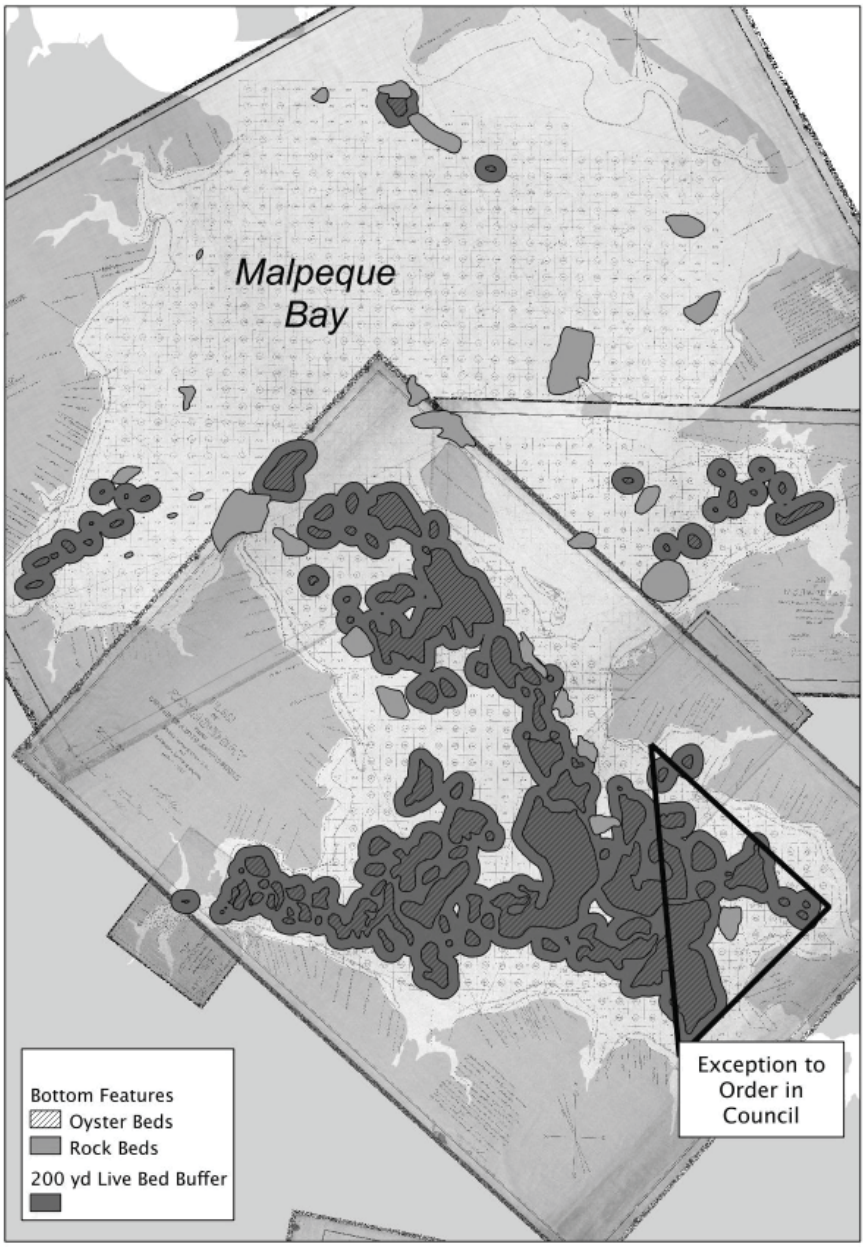

Figure 1. Malpeque Bay Oyster Beds. Map by J. MacFadyen. Source: H.H. Shaw, "Plan of Richmond Bay: Showing location of Oyster Beds and subdivisions for leasing purposes," [1912], Public Archives and Records office, Prince Edward Island.

weight of dozens of diggers and hundreds of men and horses hauling the fertilizer to shore. Farmers from the upper West River complained that the government's policies on mud harvesting had effectively restricted the entire river upstream from the bridge (now St. Catherines bridge) from farmers. Forty-eight residents signed a petition in late February 1897 to this effect and asked Donald Farquharson, the local member of the Legislative Assembly, to send it to the federal minister of fisheries. "To say these people were excited," he explained to Minister Davies, "would be putting it mildly." Farquharson emphasized the urgency of the request by arguing that "stopping mud hauling for the sake of the few oysters it will destroy is a tremendous wrong." The petition arrived late in the season, and since there were only a couple of weeks left in the typical winter mud harvest they asked the minister to reply directly by telegraph. Farquharson would then call the small village of New Haven where the minister's decision could be relayed to the "mud men"; the farmers were waiting, in turn, by the shore ready to immediately dig through the ice before it melted. Time was working against the farmers, but, as William Cronon has argued, communications technologies had "annihilated space" by the end of the century. Now, even on the shores of the frozen West River in Prince Edward Island, farmers could receive critical information from the Minister of Fisheries in Ottawa in a matter of hours.[33]

It is peculiar that the opposition to the order-in-council was so great along the West River and North River in the 1890s, since that land had already been heavily treated with mud in the early years. This suggests that in this area the use of mussel mud was not about subsistence and sustainable agriculture but about maximizing the productivity of the land. Most early references to harvesting sea manure are at a strictly household level, but it is possible that even these families were buying and selling mud. The rapid expansion of mussel mud digging made it viable for some individuals to operate diggers full time and sell the fertilizer to farmers by the load. In the 1870s, a load cost about eight cents, but in the early 20th century the price was 10 to 24 cents per load.[34] Mud digging sites were chosen on a first-come, first-served basis, and Kemp noted that there was an unwritten rule among farmers against staking claims on the ice.[35] It was reported in the *Guardian* that some commercial mud diggers in Bedeque filled rail cars for shipping mussel mud to distant customers.[36]

The shores of the West and North Rivers were the location of a perfect storm: high-yield, intensive farming was practised on more than three-

quarters of the available land mass, the large surface area and a heavy demand for animal fodder meant sea manure could be applied liberally and consistently, and a biomass fuel shortage meant a surplus of time for harvesting mud in the winter months when other farmers were cutting wood. This gave farmers the time and incentive necessary to protest federal restrictions by forming associations, signing petitions, and entering expensive legal battles. These farmers knew the landscape below the water as well as they knew the shore; the estuaries were not foreign spaces but predictable forms of income and key resources in an industrial farm landscape. The perfect storm developed because the areas in the with the greatest demand for mussel mud — the North River, Wimot, and Dunk River watersheds — were next to the greatest concentration of oyster shell beds in the region — the North River, West River, and Bedeque and Malpeque Bays. The federal government had enacted rigid legislation to protect shellfish in these places, but they did not have the political will or local capacity to enforce the measures.[37] The most common complaint of all experts and scientists working on the oyster industry was that enforcement was not practised consistently.[38]

Farmers laid claim to estuarine resources, and they had the political will and the time to protest the measures. It is no surprise then that the North River became known as a site of conflict and lawlessness during the brief mud-digging seasons in the early 20th century. It was the site where "one enterprising businessman from Charlottetown . . . set up shop right on the ice where rum could be purchased."[39] Even more significant, it was the site where the first charges were laid against a farmer for encroaching on the 200-yard buffer zone around live beds. In the late 1890s, Archibald Warren was charged under the order-in-council passed under the Fisheries Act, but his trial became an issue of federal-provincial rights when the defence claimed that the estuaries were provincial domain under the British North America Act. The case went all the way to the Supreme Court, but Warren lost the case in 1902 and a precedent was set.[40]

The tension between the federal and provincial powers continued, but to provincial officials in Prince Edward Island improving the land and the agricultural economy was always paramount. The development of an oyster fishery was attractive, but it was seen as a federal project based on exogenous knowledge. Some Department of Fisheries scientists even noted the uncooperative nature of local governments when conducting federal research programs.[41] The order-in-council served the interests of a

small group of constituents, and economic growth in the shellfish industry had direct benefits to people in jurisdictions outside of the local riding and even outside of the province. Thus, as the Department of Fisheries described its dilemma in 1899, the "feud between the oyster fishers and the farmers continues, and as this is mainly an agricultural province the weight of public sentiment has preponderated for the latter."[42]

After protracted negotiations over jurisdiction and the property rights of aquaculturists, the province assumed the responsibility of oyster culture leasing and began to lease "barren bottoms" for cultivating oysters.[43] Almost immediately, the office of the Provincial Engineer plotted the long-awaited bottom survey maps. They were complete with cadastral information for coastline properties, extensive information about the physical characteristics of the river bottoms, and limited information about shellfish distribution. Along with the responsibility for administering aquaculture, the province became the de facto enforcement agency of mussel mud-digging regulations and drew a new series of lines in the ice between farmers and aquaculturists. Thus, when William Lyon Mackenzie King took up a rare issue of interest to Islanders generally, such as lowering the freight rates on mussel mud, he was winning over a group of Island farmers in ways that previous governments could not.[44]

Two years after winning the right to sell aquaculture leases, the province began work on a "Mud Scow," in St. Peter's Bay, on beds that the newspapers claimed had been recently discovered by local farmers. In 1915 the provincial Department of Public Works began to spend a small part of its budget on the mud scow. It sold this mud to Islanders, bringing in $200 in its first year, and this jumped up to an average of $6,100 per year over the next four years.[45] The scow operated out of St. Peter's Bay, with a 420-foot railway wharf in Midgell that allowed rail cars to sit level with the scow for faster loading (see Figure 2).[46] The province cancelled the scow program around 1924, and despite one or two attempts to do so, it was never revived. Public Works was not selected for its knowledge of shellfish habitats, but for its ability to distribute as much material as possible on an already congested rail network. The department was always in the business of maintaining shore roads, which farmers argued were "very much needed as there is a great amount of celp and seaweed comes on the shore."[47] Logistics were part of any mussel mud operation, and the Anderson farm in Seacow Head contained a seaweed road, a "mud road," and a "mussel mud road" — all of which required maintenance and even

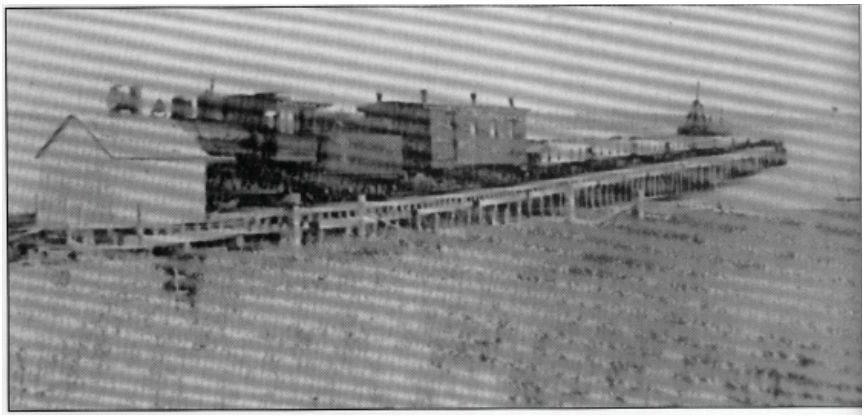

Figure 2. St. Peter's Bay Mud Wharf, Scow, and Train, 1915 (Prince Edward Island Department of Public Works, *Annual Report*, 1916).

a surveyor so they could be open for hauling manures home from multiple locations.[48]

The St. Peter's mud project has never been fully explored by historians, although one assumes from the literature that it was a massive system of centralized state soil treatments — a way for the province to "manage" the oyster industry and the needs of farmers all at once. In addition, the project would generate revenue from a product with guaranteed demand, create business for the railroad, and demonstrate to Ottawa that it could manage natural resources. In reality, the project was both a sacrificial landscape and an extensive engineering project (see Figure 3). Brian Black and others have referred to landscapes such as Petrolia as sacrificial, because they were destroyed so that others could be developed and sometimes preserved.[49] St. Peter's Bay was a dedicated mud territory, operating publicly in a manner similar to how Bedeque Bay operated privately in the 1880s and 1890s. The proximity to the railway was the defining feature for each location, and in 1917 the Department of Public Works explored the possibility of creating a second mud scow in Malpeque Bay. This ultimately proved unsuccessful, because the expense of building a spur to Malpeque was too high (even with the cost-sharing cooperation of the federally owned Prince Edward Island Railway). In Summerside, local residents had previously lobbied for the construction of a spur to Malpeque Bay to exploit the mud there and distribute it far beyond the borders of local farms.[50]

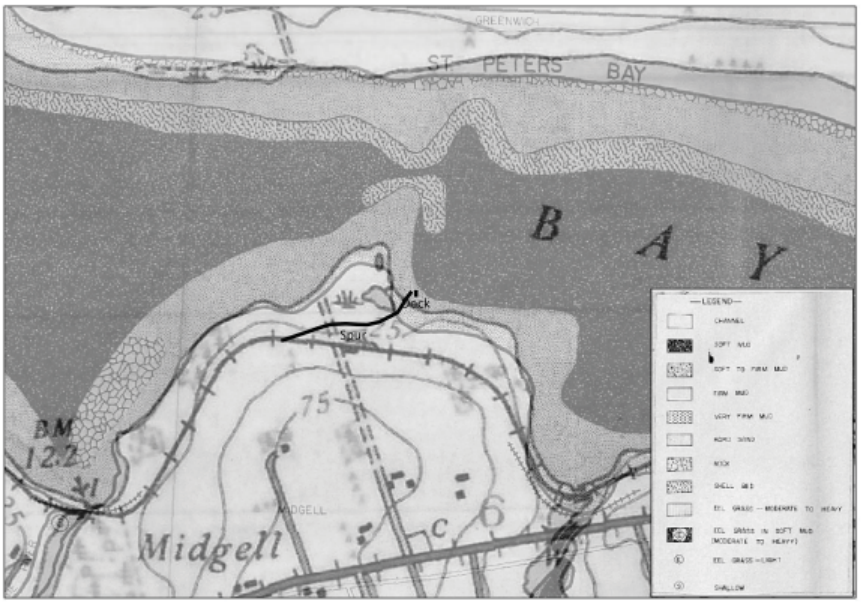

Figure 3. Location of Provincial Mud Scow Operation, St. Peter's Bay. Map by J. MacFadyen. Source: University of Toronto Map Library, "National Topographic Series, Canada, Sheet 11, L/7, Mount Stewart," Department of National Defence, Geographical Section, G3400 63 1929, 11 L7 [1944].

The St. Peter's Bay mud scow existed to save oyster beds for the Department of Fisheries, and it also helped to save face for Prince Edward Island. But rather than simply providing a larger version of the traditional mud-digging operation, the Midgell oyster bed was a way to open an enormous new shell reserve to farmers and professional diggers. According to the department's annual reports, the scow program suffered from financial difficulties and the inability to get enough rail cars for distribution. However, another reason for its disappearance in the mid-1920s was that it was no longer needed as farmers began to take over the digging once more. Local accounts of the St. Peter's area claim that the Midgell oyster bed extended completely across the bay and was visible at low tide. The shallow depth meant that it could not be harvested from the surface, because the ice never formed thick enough to support the mud diggers.[51] The site was not abandoned by the province in the 1920s; rather, it was handed back to farmers who continued to dig deep into the shell beds. Contemporary scientists noted that shell beds in Malpeque

Bay were dug at least 24 feet deep, and one farmer interviewed by David Weale claimed his father was using a 50-foot bucket in his final attempts to extract mud from St. Peter's Bay.[52] The province's solution had been to dig the mud from a barge in the summertime and load it onto scows for rail transport from Midgell. Once it had dug the shell bed to a sufficient depth, the ice would permit winter digging through the ice. As late as the 1970s, this estuary was one of the few sites where extensive damage to the river bottom from digging was still visible by fisheries researchers. In 1974 divers claimed "mussel mud digging was a common practice on P.E.I., at the turn of the century and the rough irregular channel bottom indicates that it occurred in this area."[53] Clearly, some beds were removed entirely and the seascape of the early 20th century was altered by a combined private and public effort to remove the shells. The famous estuarine scenery enjoyed by thousands of tourists and locals at St. Peter's every year was one formed by human hands.

Another reason the St. Peter's mud scow program was not repeated in Malpeque Bay hinged on more than just the cost. The collapse of the oyster industry due to the Malpeque Disease in 1915 and 1916 shocked the local population. It was caused by the scientifically sanctioned importation of oyster clutch, and it undoubtedly made the provincial government reconsider its plans for a mud-digging operation in an economy that had just been shattered by a disease no one understood.[54] The collapse of the Prince Edward Island oyster industry in this period was not the result of uncontrolled fishing or unregulated mussel mud digging. It occurred in spite of these regulations and other measures implemented by the state. During the first two decades of the 20th century, state scientists and other officials descended on Malpeque Bay from all angles. They came to settle disputes between diggers and fishers, they studied the physical and geological characteristics of the sea floor, they recorded the marine fauna of the region, and with an incredible vigour and some federal-provincial cooperation they attempted to create a place of predictable economic activity. The interest in Malpeque's oysters and shellfish habitat is a well-documented case of what Dean Bavington calls "managed annihilation."[55] The interest developed partly as a response to the region's declining oyster production and the accompanying rise in demand and prices. Oyster aquaculture presented an enormous opportunity for the local economy, and the declining production gave scientists a clearly defined problem to study.

Most fishers and marine scientists agreed that mud digging was a destructive force, but they also knew that agriculture was Prince Edward Island's economic and social mainstay and that digging had become more or less an institution for farmers in many parts of the coastal zone. Officials were divided on the issue. The Geological Survey of Canada reported enthusiastically on the "limitless" supplies of marine-based fertilizers in the southern Gulf's estuaries while consultants employed by the Department of Fisheries promised that one season of digging would permanently destroy the oyster habitat below a digger.[56]

The language of management had come into play in the late 19th century. Since at least the 1860s, officials and farmers were fully aware that the mud industry was both a limited resource and a destructive activity for marine life. The question was not whether shell mud would disappear, but how farmers could create a system of soil management that obviated the need for extensive mud use.[57] Likewise, there was no question that mud digging disturbed oyster habitat; what mattered to officials, farmers, and fishers was how the two industries could coexist and build stable rural economies. During the 1890s, Donald Farquharson, the member of the Prince Edward Island assembly who later premier, arbitrated on behalf of local farmers and the much smaller population of oyster fishers. He described the problems to Minister of Fisheries Louis Davies, a fellow islander and former premier. He admitted that "stopping mud hauling for the sake of the few oysters" would be important, but "with prudence we can protect both." In another letter to the fisheries minister, Farquharson addressed his friendly missive to "Sir Louis" and claimed that "with proper management all can be satisfied."[58]

To oyster specialists such as Ernest Kemp, the proper response to declining oyster stocks was not pure scientific research but state intervention and resource management. He was not trained as a scientist, and he signed his name only as "Oyster Expert." His career in oyster consultation had kept him in the region permanently since he was first hired in 1892. Federal scientists later referred to him as "Captain" Kemp, and to his position as "practical oyster expert." Kemp's first decade as oyster expert was spent traveling between Ottawa and estuaries in the Northumberland Strait and southern Gulf of St. Lawrence. Local work was performed mostly on board the government steamer, *Ostrea*, with a small crew. He was spread very thin across the region and, in addition to advising on matters of fishing seasons and limits, he had to consult on the

extremely difficult issue of enforcing the department's Order in Council to prevent mud digging within 200 yards of live oyster beds.[59] Kemp's suggestions were always heeded by the enforcement branch of the federal department, and in places such as Malagash harbour, Nova Scotia, Kemp pointed to government intervention (under his expert guidance) as the reason behind that area's healthy oyster population. Fisheries agents consistently complained that they knew nothing about the location and status of oyster beds, and were thus unable to prevent their disruption by mud diggers.

After the federal Department of Fisheries established the marine science lab at St. Andrews, New Brunswick in 1899, it made the Atlantic oyster a major research initiative and began to send teams of scientists and their assistants from various points in Central Canada to this small rural area. To coastal residents, the Department of Fisheries' floating marine biological science station must have seemed like a fish out of water. The station was barged from the Fundy to the Gulf of St. Lawrence through the Canso and Northumberland Straits, almost sinking one night en route and ultimately having to double back to Charlottetown when it arrived in Malpeque with inadequate equipment.[60]

It was up to these scientists to document and understand problems facing the oyster in the southern Gulf region; this characterized their quest to convert Malpeque Bay into a predictable economic laboratory for farming shellfish. It was a formidable challenge, and A.D. Robertson of the department claimed that he could not accurately map the "nature of the bottom."[61] E.W. MacBride was probably the first federal scientist to work on the Malpeque oyster, and his initial observation of the bay is a useful summary of the ecological cycle mussel mud diggers had entered. MacBride offered a long description of soil erosion and the siltation of the bay that came about as a result of deforestation. "In very many places on these bays, where now no living oysters are obtained," he explained,

> deposits of "oyster-mud" are found, which are dredged up in the winter time . . . aggregating in some cases eighteen feet in thickness. As the soil of Prince Edward Island is very deficient in lime, this oyster mud is much sought after by the farmers for use as a fertilizer. Oyster mud deposits can only be interpreted as *old oyster beds, which have been suffocated* [emphasis added] by the too rapid deposition of silt and subsequently buried out of sight

> by its continued accumulation. The numerous localities in which oyster mud can be dredged point to a former extension of the oyster beds, far exceeding that which exists at the present day.[62]

Thus, when farmers arrived at the edge of a hole in the ice, they were there to extract the organic matter that had accumulated as a result of a few short generations of human activity on the shore.

If Newfoundland's nitrogen stores were swept out to sea by the glaciers and became the Grand Banks, then agriculture there has meant harvesting the earth's biomass from a boat instead of a horse or tractor. In Prince Edward Island the relationship between land and sea is even more visible in the estuaries, and the people who harvested resources from the surface are interconnected. Nitrogen stores have also been removed from the soil in Prince Edward Island and fed to shellfish in the rivers and estuaries, but instead of ice shields the actors here were snow banks and human hands. Intense deforestation for agriculture and shipbuilding led to increased runoff and erosion of the province's loose, sandy soils. Silt in rivers and estuaries changed marine ecosystems significantly, but another element introduced to the watershed was nitrogen from manure and other fertilizers. The agro-ecosystem on Prince Edward Island has had a direct effect on aquaculture. Both farmers and fishers knew a great deal about the river bottoms and their uses.

David Weale argued that the practice of mud digging on Prince Edward Island ended in the 1940s. His main explanation for the decline and disappearance of the activity is the same reason predominately given in most other literature — that is, that soil treated by the mud caused a scab to form on potatoes. The scab was harmless, but it influenced potato sales to such a degree that the practice of mud use fell out of favour in a province where commercial potato production was becoming a mainstay.[63] No serious historical research has been conducted on the potato industry and the reaction to this scab that would connect it to the demise of mussel mud, although it no doubt gave the soil treatment a worse reputation among most farmers. Another reason, however, could well have been the exhaustion of good shell beds and the increase in confrontations between farmers and the fishery as that sector recovered from the Malpeque Disease and expanded in the 1920s.

Even more important than the fisheries was the position of the Department of Agriculture's soil chemists and the timing of the decline,

which lined up perfectly with the rise of synthetic fertilizer consumption in Canada and the rest of North America. "The practice of 'muddin' is dying out," Shutt and Wright reported, because scientific agriculture has made it more economical to use "commercial fertilizers."[64] If the purpose of digging mussel mud was not to escape the market and increase farm self-sufficiency, then there is no reason to think farmers would not have gladly exchanged it for synthetic fertilizers that were lightweight, highly effective, predictable, and which may not have cost much more than mud in some places. Since the purpose of using sea manures was not (as some have nonetheless argued) to maintain a sustainable balance between land and sea, it would have been an easy decision to exchange sea manures for synthetic fertilizers. No one could have predicted that these would later become so unsustainable.

The state played a variety of roles in the estuary. In the 1860s, land commissioners used the proximity to estuaries and shell beds as a value indicator for Island farms in the land purchase process. In the 1890s, the federal Department of Fisheries followed the advice of a single expert to mediate between oyster fishers, who were concerned about decreasing catches and farmers who wanted to continue extracting shell mud as a fertilizer. In the early 20th century the federal government stepped up its enforcement of the digging restrictions, hired more marine scientists, and attempted to create a predictable site for scientific aquaculture in Malpeque Bay. They eventually turned over control of the issue to the province, which mapped the most important barren bottoms for sale as oyster leases and established a central mud processing and rail distribution system based in St. Peter's Bay. The provincial soil treatment project was short-lived — probably because the shell beds of Prince Edward Island were more profitably harvested through the ice by private individuals than from a mud scow owned by the province. By the 1930s, the role of the state appears to have been to discourage farmers from using mussel mud altogether. Persuading farmers to abandon mud was not difficult — the work was hard, hay was declining in value, and replacement fertilizers were suddenly becoming more affordable.[65]

Since the publication of Weale's first essay on mussel mud, the river bottoms have been visited once again, this time through a private venture led by Ron Sampson, an employee of the Department of Agriculture in Charlottetown.[66] Sampson's company dug about 15,000 tons of mud from the Mill River in the 1980s, marketed it to gardeners as processed

compost and sold it to farmers by the truckload. This initiative, however, was unsuccessful and probably unsustainable, and it also demonstrated that there is "little political/legislative or financial incentive for farmers to spread compost in view of the lower handling costs of commercial fertiliser."[67] Farmers did not have the proper equipment to spread the second wave of "mussel mud" fertilizers, and the stronger market for organic fertilizer consumption, small-scale organic farms and home producers, was not as large as it has become since. In Japan there is still a demand for oyster-based lime fertilizer, but if there is a future for sea manure in the Atlantic region's agriculture it will likely be as a regulated and possibly processed form of organic soil treatment that can compete with synthetic fertilizers and satisfy a market for local and organic food chains.[68]

80. GN 5/1, Vol. 3, 243, Will of Martin Williams, 10 July 1871.
81. GN 5/1, Vol. 3 (1871), 243.
82. For examples of Martin Williams's extensive business transactions throughout this period see Registry of Deeds, Vol. 2 (1851), 351, 353; Vol. 15 (1858), 566. For details of the disposition of Williams's estate among his heirs see, GN 5/1, Vol. 3 (1871), 243. For further evidence of ownership of property by those fishing families who petitioned in favour of cod seines, see Registry of Deeds, Vol. 23 (1876), 358.
83. Arthur McEvoy argues that these three fundamental processes are dynamic historical forces that are interdependent parts of an entire system. Following McEvoy, I agree that the "ecological character" of the human experience must not be neglected in the historical analysis of human industry. See Arthur McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980* (Cambridge, UK: Cambridge University Press, 1986), 14.
84. Karl Jacoby explores the importance of this dynamic in his examination of "Working-Class Wilderness" in the Adirondacks. See Jacoby, *Crimes Against Nature*, 48-81.
85. *The Express*, 14 April 1863.
86. *Journal of the House of Assembly* (1863): 86-87.
87. *Journal of the House of Assembly* (1863): 86-89.
88. *Journal of the House of Assembly* (1863): 88.
89. *Journal of the House of Assembly* (1863): 86-9.
90. For an analysis of the witnesses' responses, see Cadigan, "Failed Proposals," 159.
91. Cadigan has documented this historical dynamic in his examination of the capitalization of the 19th-century inshore fisheries and the erosion of the moral economy. See Cadigan, "Failed Proposals," 147-69, as well as Cadigan, "Moral Economy," 9-42.
92. *Journal of the House of Assembly* (1863): 89.
93. *The Express*, 14, 16 April 1863
94. Cadigan, "Failed Proposals," 158-61.
95. Hardin, "Tragedy of the Commons," 1244.
96. Richard Apostle, Bonnie McCay, and Knut Mikalsen, *Enclosing the Commons: Individual Transferable Quotas in the Nova Scotia Fishery* (St. John's: ISER, 2002), 12.
97. Bavington, *Managed Annihilation*, 9-10.
98. Apostle, McCay, and Mikalsen, *Enclosing the Commons*, 12-13; Bavington, *Managed Annihilation*, 9-10.
99. Bavington, *Managed Annihilation*, 9-10; Brian Crowley, ed., *Taking Ownership: Property Rights and Management on the Atlantic Coast* (Halifax: Atlantic Institute for Market Studies, 1996).
100. Apostle, McCay, and Mikalsen, *Enclosing the Commons*, 13.

MacFadyen, Drawing Lines in the Ice

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2. Douglas Sobey, *Early Descriptions of the Forests of Prince Edward Island*: *Vol. II, Part A*, (Charlottetown: Prince Edward Island Department of Environment, Energy, and Forestry, 2006), 77.
3. One prominent example of this is the memoir of the community of Breadalbane. See "Our History~Breadalbane," http://www.peicaps.org/breadalbane/.
4. See, for example, Belmont Women's Institute, *The History of Belmont* (1973), 16; Andrew Macphail, *The Master's Wife* (Montreal: Jeffrey Macphail and Dorothy Lindsay, 1939); Andrew Hill Clark, *Three Centuries and the Island: A Historical Geography of Settlement and Agriculture in Prince Edward Island, Canada* (Toronto: University of Toronto Press: 1959), 63, 78.
5. David Weale, "The Shell-Mud Diggers of Prince Edward Island," *Canadian Papers in Rural History* 2 (1980): 41-57; Weale, "The Mud Diggers," *Island Magazine* 12 (Fall 1978): 22-30; Wayne MacKinnon and Elinor Vass, *The Best of the Past: Traditional Sustainable Agriculture in Prince Edward Island* (Charlottetown: Institute of Island Studies, University of Prince Edward Island, 1989). Memories of mussel mud use were a common subject in interviews with elderly residents in Reg "Dutch" Thompson's *Island Voices*, http://www.islandvoices.ca/.
6. MacKinnon and Vass, *Best of the Past,* 8-9, 49.
7. These interpretations come across clearly in other readings of mussel mud digging, such as Godfrey Baldacchino and David Milne, eds., *Lessons from the Political Economy of Small Islands: The Resourcefulness of Jurisdiction* (London: Palgrave Macmillan, 2000), 165, and Deirdre Kessler and Martin Caird, *Green Gables: Lucy Maud Montgomery's Favourite Places* (Halifax: Formac Publishing, 2001), 54.
8. Rosemary Curly, "The Essential Salt Marsh," *Island Magazine* 41 (Spring 1997): 20-8; Matthew Hatvany, "'Wedded to the Marshes': Salt Marshes and Socio-Economic Differentiation in Early Prince Edward Island," *Acadiensis* XXX, no. 2 (Spring 2001): 40-55; Rod Giblett, *Postmodern Wetlands: Culture, History, Ecology* (Edinburgh: Edinburgh University Press, 1996).
9. Claire Elizabeth Campbell, *Shaped by the West Wind: Nature and History in Georgian Bay* (Vancouver: UBC Press, 2005), 36-8, 24; James W. MacNutt, *The Historical Atlas of Prince Edward Island: The Ways we Saw Ourselves* (Halifax: Formac Publishing, 2009).
10. See, for example, Kennie MacWilliams and W. Irwin Judson, *Estuarine Resource Inventory: East (Hillsborough) River, P.E.I.* (Charlottetown: Prince Edward Island Department of Fisheries, 1973); Clyde L. MacKenzie, *Harvesting Oysters from Channel and Stocking Them on Shallow Grounds in East (Hillsborough) River, Prince Edward Island* (Charlottetown: PEI Department of Fisheries, 1972). The inventories were a direct effect of the province's Comprehensive Development Plan in 1969, but appear to have been discontinued in 1974 (perhaps as a result of Premier Alex Campbell's shift to a "'small is beautiful' philosophy"). See Alan MacEachern, *The Institute of Man and Resources: An Environmental Fable* (Charlottetown: Island Studies Press, 2003).
11. Joshua D. MacFadyen and William M. Glen, "Top-down history: Delimiting

forests, farms, and the agricultural census on Prince Edward Island using aerial photography, c.1900-2000," in *Historical GIS in Canada*, ed. Jennifer Bonnell and Marcel Fortin (Calgary: University of Calgary Press, 2013 [forthcoming]); Douglas Sobey and William M. Glen, "A Mapping of the Present and Past Forest-Types of Prince Edward Island," *The Canadian Field-Naturalist* 118, no. 4 (2004): 504-20.

12. Donald S. McLusky and Michael Elliott, *The Estuarine Ecosystem: Ecology, Threats and Management*, 3rd ed. (Oxford: Oxford University Press, 2004), 92.
13. Leo Farrell remembered his mother's family shoveling the Island's plentiful lobsters into wagons and spreading them live on the fields for fertilizer. See Reg Thompson, interview of Leo Farrell, *Island Voices*, 19 January 1999, http://www.islandvoices.ca.
14. Weale, "The Mud Diggers"; F. T. Shutt and L. E. Wright, *Peat, Muck, and Mud Deposits — Their Nature and Composition and Agricultural Uses* (Charlottetown: Department of Agriculture, 1933).
15. J. Arthur Hudson and S. Jean Meggison, *Preserving the Past: A History of Cascumpec-Fortune Cove, 1779-1979* (Cascumpec-Fortune Cove Heritage Society, 1979); Reg Thompson, interview of Vernon McCarvill, *Island Voices*, 17 December 2003, *http://www.islandvoices.ca*.
16. Ernest Kemp, *Oyster Fisheries of Canada: A Survey and Practical Guide on Oyster Culture* (Ottawa: Government Printer, 1899).
17. Colin MacIntyre, "The Environmental Pre-History of Prince Edward Island 1769-1970: A Reconnaissance in Force" (MA thesis, University of Prince Edward Island, 2010); W.H. Holmes, "Aboriginal Shell-Heaps of the Middle Atlantic Tidewater Region," *American Anthropologist*, new ser. 9, no. 1 (January-March, 1907): 113-28.
18. The "Land Fertilized with Lime" variable is problematic because although it was an attempt to get at the degree to which land had been "improved," it was not specified if the question was regarding land that had ever been treated with lime, land that had been recently treated, or land that had been treated in the previous 12 months only. Because the question was also asked of mussel-mud, which was widely known to last for a decade or more on the land, I have taken the figure to mean land that was ever treated with these calcareous fertilizers.
19. Prince Edward Island, Commission Under the Land Purchase Act, *Report of Proceedings Before the Commissioners Appointed under the "Land Purchase Act of 1875* (Charlottetown: P.R. Bowers, Printer, 1877).
20. Prince Edward Island, Land Commissioners' Court – 1862, *Abstract of the Proceedings Before the Land Commissioners' Court, Held During the Summer of 1860, to Inquire into the Differences Relative to the Rights of Landowners and Tenants in Prince Edward Island* (Charlottetown: "The Protestant" Office, 1862), 121.
21. "Report of the Superintendant of Census Returns, Charlottetown, August 23, 1871," Lot 32, Public Archives and Records Office (PARO), Charlottetown.
22. Ibid.
23. Reade Advanced Materials, an online industrial manual, suggests that ground oyster shells weigh 53 pounds per square foot, and that fluid mud weighs 108 pounds per square foot, so this calculation is based on a weight of between 75 and 100 pounds per square foot, depending on shell content. See http://www.reade.com/resources/reference-charts-particle-property-briefings/. Later, oyster experts complained that

an acre of shell bed could be destroyed by only ten diggers in one year, so it is possible that much higher rates of disturbance were occurring.

24. Ledger of Roderick Munn, Acc4325, PARO.
25. "Diary of Annie, Maggie, and Lottie Anderson, January 1, 1877-June 30, 1881," transcribed by Winifred Wake (April 1999)[in author's possession]; "Transcript of the Journal of Robert Houston Horne of Bloomfield, 1879-1892" [in author's possession]; Weale, "The Mud Diggers."
26. Canada, *Sessional Papers, 1880-81* (vol. 6): no. 11, 239.
27. Allan Graham, *A Photo History of the Prince Edward Island Railway* (Summerside, PE: Author, 2000), 53-4; *Summerside Journal*, 19 March 1885; *Daily Examiner*, 22 February 1902; Elmsdale and Area Historical Society, *Goin' to the Corner: A History of Elmsdale, Elmsdale West, and Brockton,* (Summerside: Cresecent Isle Publishers, 2006), 105; "Summerside News," *Guardian*, 7 March 1892.
28. Kennedy Wells, *The Fishery of Prince Edward Island* (Charlottetown: Ragweed Press, 1986), 158.
29. Canada, *Sessional Papers, 1885* (vol. 5): no. 7, 179.
30. "Our Oyster Fishery," *Guardian*, 30 August 1892.
31. E. Prince to Wm. Saunders, Dept of Agriculture, 9 February 1897, RG 23, Canada Fisheries, vol.-145-146, roll T-2833, file 388, pt. 1, 00069, Library and Archives Canada (LAC).
32. R. Hunt to Charles H. Tupper, 28 February, 1894, RG 23, Canada Fisheries, vol.145-146, roll T-2833, file 388 pt. 1, 00011, LAC; E. Kemp, Memo, 28 February, 1894, RG 23, Canada Fisheries, vol. 145-146, roll T-2833, file 388 pt. 1, 00012, LAC.
33. Forty-five farmers signed another petition with a very similar request and sent it to Davies in 1898. See D. Farquaharson to L.C. Davies, Department of Fisheries, RG 23, Canada Fisheries, vol. 145-146, roll T-2833, file 388 pt. 1, 00082, LAC. See also William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W.W. Norton, 1991).
34. *Goin' to the corner,* 104-5.
35. Ernest Kemp, "Report on Oyster Culture by the Department's Excerpt for the Season of 1906, in Department of Fisheries *Annual Report,* 1906, 269.
36. *Guardian*, 18 February 1892.
37. Enforcement of late-19th-century fisheries regulations occurred in many forms. One was the publication of regulation notices in local papers. See, for example, "Oyster Fishery," *Alberton Pioneer* , 22 July 1876..
38. See, for example, A.D. Robertson, "First Report on the 'Barren Oyster Bottoms' Investigation, Richmond Bay, P.E.I.," in *Contributions to Canadian Biology: Being Studies from the Biological Stations of Canada, 1911-1914* (Ottawa: J. de L. Tache, 1915), 55.
39. Weale, "The Mud Diggers," 29.
40. "Court Decides that Diggers Cannot Work Within 200 Yds of Live Oyster Bed," *Daily Patriot* (Charlottetown), 11 February 1902.
41. E.W. MacBride, "Oyster Culture and Clam Fishing, Prince Edward Island," *Contributions to Canadian Biology: Being Studies from the Biological Stations of Canada, 1906-1910* (Ottawa: C.H. Parmelee, 1912), 217-20.
42. "Annual Report of the Department of Marine and Fisheries, 1898," in Canada, *Sessional Papers, 1899* (vol. 9), Appendix 11A, 31.

43. Edward MacDonald, *If You're Stronghearted: Prince Edward Island in the Twentieth Century* (Charlottetown: Prince Edward Island Museum and Heritage Foundation, 2000), 71.
44. Ernest R. Forbes, *The Maritime Rights Movement, 1919-1927: A Study in Canadian Regionalism* (Montreal-Kingston: McGill-Queen's University Press, 1979), 83; MacDonald, *If You're Stronghearted*, 147.
45. "Report of the Department of Public Works," *Journal of the Prince Edward Island Legislative Assembly* (1916): 10.
46. Beverley Sanderson, "History of Greenwich, Prince Edward Island" (1976) [in possession of Guy Sanderson].
47. M. Robertson to Road Master's Office, 13 August 1914, RG 11, Department of Public Works, ser. 2, vol. 31 (1913-14, 2nd Queen's), PARO.
48. "Diary of Annie, Maggie, and Lottie Anderson, January 1, 1877-June 30, 1881."
49. Brian Black, *Petrolia: The Landscape of America's First Oil Boom* (Baltimore: Johns Hopkins University Press, 2000), 74.
50. See, for example, "Editorial," *Summerside Journal*, 27 February 1890.
51. William W. Anderson, "Reflections on Life on a Farm at St. Peter's at the Turn of the Century" (recorded by Doris M. Anderson), 4, University of Prince Edward Island (UPEI) Special Collections.
52. Weale, "The Mud Diggers," 26.
53. Kennie MacWilliams, *Estuarine resource inventory: St Peter's Bay, P.E.I.* (Charlottetown: Prince Edward Island Department of Fisheries, 1974), 6-7.
54. Wells, *Fishery of Prince Edward Island*, 159.
55. Dean Bavington, *Managed Annihilation: An Unnatural History of the Newfoundland Cod Collapse* (Vancouver: UBC Press, 2010).
56. The notion of a limitless supply of mussel mud is evident in the 1871 census of PEI (see especially the "near to inexhaustible beds" in Lot 4); Chandler, Geological Survey of Canada, *Annual Report* (1890), 134, 138-9; and Watson Griffin, "Canada: The Land of Waterways," *Journal of the American Geographical Society of New York* 22 (January 1890): 351-441, 354. For concerns about the depletion of oyster beds and the immediate "extinction of oysters in Prince Edward Island," see Canada, *Sessional Papers, 1880-81* (vol. 6): no. 11A, 239, as well as "Annual Report of the Department of Marine and Fisheries, 1898."
57. *Journal of the House of Assembly of Prince Edward Island* (1863): 25.
58. Farquharson to Davies, Department of Fisheries, RG 23, Canada Fisheries, vol. 145-146, roll T-2833, file 388 pt. 1, 00082, LAC.
59. Kemp, *Oyster Fisheries of Canada*, 93-4.
60. J. Stafford, "On the Fauna of the Atlantic Coast of Canada, Second Report – Malpeque, 1903-1904," *Contributions to Canadian Biology, 1906-1910*, 37-44, 38.
61. Robertson, "Report on Barren Bottom Oyster Culture," 55.
62. MacBride, "Oyster Culture and Clam Fishing, Prince Edward Island," 217-18.
63. Weale, "The Mud Diggers," 30.
64. Geoff Cunfer, "Manure Matters on the Great Plains Frontier," *Journal of Interdisciplinary History* 34 (Spring 2004): 539–67; Richard C. Sheridan, "Chemical Fertilizers in Southern Agriculture," *Agricultural History* 53, no. 1 (Winter 1979): 308-18; Shutt and Wright, *Peat, Muck, and Mud Deposits*, 24.

65. Cunfer, "Manure Matters on the Great Plains"; Sheridan, "Chemical Fertilizers in Southern Agriculture."
66. *Goin' to the Corner*, 105; see also the Acadia University business program case study, http://aics.acadiau.ca/case_studies/musslemud/ and *Interim Report of the Superintendent, 1921* [Dominion Experimental Farms, Experimental Station, Charlottetown] (Ottawa: F.A. Acland, 1922).
67. J.A. Cousins, "Primary Resource Industry Waste on Prince Edward Island," prepared by the Institute of Island Studies for the Prince Edward Island Department of Fisheries, the Department of Environment Energy and Forestry, and Enterprise PEI (September 1997). See, in particular, "Compost from Waste."
68. Young Han Lee et al., "Composted oyster shell as lime fertilizer is more effective than fresh oyster shell," *Bioscience, Biotechnology and Biochemistry*,74, no. 8 (2010), 1517-21.

Parenteau, "Making Room for Economy, Efficiency and Conservation"

1. Statement of J.E. Michaud (Madawaska), in *Synoptic Report of the New Brunswick Legislative Assembly* [*NB Assembly Debates*] (1918): 38; "Committee on Forests of the Commission of Conservation," quoted in *Annual Report of the New Brunswick Department of Lands and Mine*s (1919): 19.
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5. The classic statement on the subject is David F. Noble, *America by Design: Science, Technology and the Rise of Corporate Capitalism* (London: Oxford University Press, 1977).
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