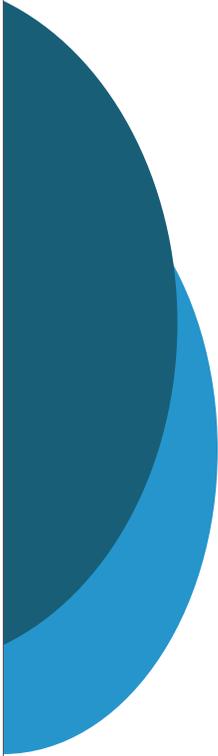


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MEMBERS OF THE:

Oceans and Coasts Network (OCN) - Canada



Canadian Coastal Science And Engineering Association (CCSEA)



OCN-Canada Background

Several organizations exist at present in Canada with overlapping mandates related to research and the monitoring of policy initiatives related to Canada's oceans and coasts. However, their efforts remain fragmented and largely uncoordinated. In March 2010 representatives of these oceans and coast focused organizations met in Ottawa, ON in a *Oceans and Coasts Networks Summit* to discuss the issues currently confronting their work. This meeting resulted in the formation of the Oceans and Coasts Network Canada (OCN-Canada).

The primary conclusion stemming from this meeting was the agreed upon need for coastal and oceans related groups to work more closely together as a 'network of networks'. OCN-Canada is envisioned to fulfill this role by providing a forum directed toward: (i) establishing greater communication among and across our Network memberships; and, (ii) achieving enhanced unity of purpose and direction within the context of our respective and overlapping mandates.

OCN-Canada Policy Briefs

This publication is a result of the *OCN-Canada Policy Briefs Program*. Launched in November 2010 by the OMRN, the *OCN-Canada Policy Brief Program* is a joint initiative by all participating members of the OCN-Canada partner organizations and are intended to address fundamental policy issues. The policy briefs reflect the knowledge and views of their author(s) and not any one network. Each brief is subject to peer review and comment by members of the various networks before they are disseminated.

For more information on OCN-Canada and the policy brief program, or to contribute by writing a policy brief, please review the *OCN-Canada Vision Statement* and other documents posted on the OMRN-RRGO website at www.omrn-rrgo.ca/smc/home.php.

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Hydrocarbons development in the Gulf of St. Lawrence: A challenge for policy and ecosystem sustainability

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Problem Statement: Energy Policy and Sustainability in the Gulf of St Lawrence

The Gulf of St. Lawrence is an important and unique natural ecosystem. It regulates the climate of the Atlantic provinces; provides food, recreation, spiritual solace and community identity; and is a source of livelihood for coastal communities in each of the five bordering provinces. Scientific reports prior to the year 2000 (Harding, 1992; Environment Canada, 1997) described the environmental threats facing the Gulf as including point and non-point, land based sources of pollution, shipping discharges, unsustainable fishing practices, coastal development and climate and air quality issues. Neither document mentions petroleum development, but the Gulf is believed to hold some potential for hydrocarbons. It has also been described as the most productive marine ecosystem in Canada, one that must be protected from impacts of petroleum development (Loutfi, 1973). More recently, the Department of Fisheries and Oceans' report on the state of Canada's oceans painted a gloomy picture of a Gulf in which average water temperature is rising, while the concentration of oxygen in its waters is dropping and ongoing inputs from surrounding lands continue to imperil inshore ecosystem health – a disturbing trend when placed in the context of rapidly emerging and expanding dead zones in oceans world-wide. The functioning of the Gulf ecosystem is described as “not well understood” (DFO 2010).

In 2002, during testimony before the Public Review Commission on the proposed exploration for gas in Parcel 1, off western Cape Breton Island, a DFO scientist noted that the Gulf is more sensitive to impacts of petroleum development than Georges Bank, where petroleum exploration is under moratorium because of fisheries and other values. This is clearly true; in their written assessment DFO noted that “Any impacts from oil and gas exploration activities will be amplified due to the small, shallow, enclosed nature of the environment and the high biomass and diversity year-round.” (DFO, 2001a) Then as now, significant gaps existed in scientists' understanding of potential impacts of petroleum drilling in the Gulf (DFO, 2001b) and at the conclusion of the Public Review the Commissioner acknowledged these gaps and recommended that the concerned parties should continue their dialogue in an attempt to resolve their differences. The federal Standing Committee on Fisheries noted their concerns that in the review process, DFO was “relegated to a mere advisory role”, that the process of issuing exploration licenses did not include consultation with “coastal communities and fishermen to identify sensitive areas before putting them up for bid”, and that the core principles of the Oceans Act – being integrated management, the precautionary approach, and sustainable development – were being ignored. They felt “that it may be prudent to consider placing this region under an oil and gas moratorium similar to that on the Georges Bank”; they exhorted the Department of Fisheries and Oceans to be more proactive under their mandate for integrated management; and they suggested a Gulf-wide

Strategic Environmental Assessment (Government of Canada, 2001). The Standing Committee also noted that the Fisheries Resource Conservation Council of the day had registered similar concerns over oil and gas activities in the Gulf. The Atlantic Policy Congress of First Nations Chiefs also went on record supporting a moratorium, as did various municipalities, NGOs, tourism operators and churches working together under the Save Our Seas and Shores Coalition. The end result of the inquiry was that the proponents suspended their efforts to explore for oil and gas in the southern Gulf.

Ten years later, the possibility of a commercial find of oil at the site called Old Harry in the Laurentian Channel has once again brought the debate over exploration and exploitation of the Gulf's petroleum resources back to the attention of local communities and governments. The Old Harry site is almost equidistant from Cape Anguille in Newfoundland and Labrador and the village of Old Harry on Quebec's Magdalene Islands (Corridor Resources, 2011; Coalition Saint-Laurent, 2010). Although the location of the prospect makes it an object of concern for all five provincial jurisdictions surrounding the Gulf, the proponent (Corridor Resources) had to apply only to the Canada - Newfoundland and Labrador Offshore Petroleum Board (CNLOPB) in order to receive an exploration permit, and permits to proceed with specific seismic testing and drilling activities. None of the other jurisdictions surrounding the Gulf of St Lawrence, including Quebec, has a direct role in the decision-making because Corridor proposes to drill in what is technically Newfoundland and Labrador waters, based on the borderline, known as the Stanfield line, for provincial marine jurisdiction established in 1964 (BAPE, 2004). The proposed exploration did spur the Quebec government to draft an MOU with the federal government regarding potential royalty agreements for petroleum development in the Quebec portion of the Gulf of St. Lawrence (Canadian Energy Law, 2010). The Province of Quebec also declared a moratorium on oil and gas development within the St Lawrence River, and initiated a Strategic Environmental Assessment process that includes public meetings within Quebec, to decide whether or not to extend the moratorium into Gulf waters under their jurisdiction.

Public awareness of the risks inherent in marine petroleum development has been heightened by the extensive coverage of the BP Deep Horizon oil well explosion in the Gulf of Mexico in 2010, and by ongoing news of damages and renewed leakage at that site. The Gulf of St. Lawrence is six times smaller than the Gulf of Mexico (Le Devoir, 2011) and a blowout within this semi-enclosed sea would have serious impacts on all five of the surrounding jurisdictions. Therefore, upon hearing about Corridor Resources' plans for Old Harry, residents of the Magdalene Islands quickly reached out to non-governmental organizations and their municipal government to find out what was going on, how they would be affected and if they had a voice in the matter. This started a movement of networking and information sharing within the Maritimes and Quebec to develop a clear picture of

the potential benefits, costs and risks of petroleum exploration and development, and what role local communities have to play in decision-making. It became clear that coastal residents and their governments (provincial, municipal and First Nation) outside of Newfoundland and Labrador have few opportunities to influence decisions concerning whether Old Harry should be permitted. Local residents may communicate with the CNLOPB – if they are aware of the development plans and know who is in charge. In this case, notices were placed in newspapers in St John's and on the CNLOPB website, and became known to interested parties in other jurisdictions because a Memorial University student born in Old Harry noticed the call for public comment on Corridor Resources' application for a permit to conduct seismic testing. Her efforts to inform fishermen's associations of the planned development led to widespread public engagement in the subsequent environmental screening for a permit to drill an exploratory well. After what was considered an unprecedented public outcry over the drilling proposal, the CNLOPB suggested to the Minister of Environment that a full panel review or at least a commission of inquiry be issued. The Minister requested public consultations, but not a formal commission. Meanwhile, concerned citizens are pursuing their only other option for influencing the decision — lobbying collectively, often in the media, under the umbrellas of several non-governmental organizations.

The important question that still has not been addressed at a Gulf-wide scale is whether or not exploitation of undersea petroleum resources should occur in an ecologically sensitive, semi-enclosed gulf that supports fisheries, aquaculture and tourism as well as a long list of species at risk (Corridor Resources, 2011). There has been no coherent, inclusive process of strategic policy development to define the energy future of Atlantic Canada, and the will of the general public remains obscure. Decision-making responsibilities with respect to development of energy resources are constitutionally divided among the federal and provincial energy ministries (Natural Resources Canada, 2006). Although Fisheries and Oceans Canada has established Large Ocean Management Areas and a framework designed to “guide the management approaches for conservation and development activities within the LOMA” (DFO, n.d.), the entrenched Petroleum Board system means that DFO cannot lead a multi-jurisdictional, integrated effort to manage industrial development affecting the Gulf and its renewable resources. Existing disagreements surrounding the gulf's territorial limits, recognition of borders and federal-provincial interpretation of jurisdictions, create an environment of conflict and uncertainty aggravating Quebec-Canada tensions and favouring competition among the provinces at the cost of integrated management (Dorion et Lacasse, 2011, Laforest et Montigny, 2006). The current regime for petroleum development involves piecemeal decision-making by provincial Petroleum Boards and the National Energy Board, each of which has a conflicting mandate to promote petroleum development, ensure worker safety and protect the environment. Our question is, how could this system be made to work more accountably and transparently, in the interests of the long term public good and ecosystem health, in the context of the current ecosystem deterioration and threats from climate change?

Opinion: Gaps and Flaws in Petroleum Development Regulation

We have identified a number of gaps and flaws in the current policy and regulatory framework for petroleum exploration and development in the Gulf of St Lawrence, namely: 1) the absence

of a publicly agreed-upon energy strategy for Atlantic Canada within which strategic and integrated management of natural resources can occur; 2) the lack of an inclusive process governing industrial developments in bodies of water that are multi-jurisdictional; 3) the lack of opportunities for public engagement in advance of the call for expressions of interest in petroleum exploration; 4) the limited opportunities for the concerned public to be informed of, and engaged in, the decision-making process; and 5) the apparent lack of application of the precautionary approach to petroleum development in poorly understood marine ecosystems.

We argue that a strategic vision and a multi-jurisdictional, integrated management approach that can balance the exploitation of renewable and non-renewable resources in the Gulf of St. Lawrence are necessary, to restore the health of this important ecosystem and achieve sustainability for its human communities. As noted by Folke et al. (2011), the state of the world's ecosystems calls for nothing less than “a fundamental shift in perspectives, world views, and institutions” that reconnects societal developments to the biosphere.

Article 30 of the Oceans Act states that Canada must abide by the principles of sustainable development, integrated management of estuaries and coastal and marine waters, and the precautionary approach, “that is, erring on the side of caution” (Department of Justice, n.d.). Over the past twelve years, the federal Department of Fisheries and Oceans, Oceans Branch, has been labouring toward integrated coastal and ocean management of the Gulf of St Lawrence. Some initiatives, such as the establishment of a Regional Committee of Coastal and Ocean Management, have advanced development of the architecture required for strategic management of Gulf resources. None of this has helped resolve conflicts over petroleum development. There have been public demands for a moratorium on hydrocarbon exploration in the Gulf until more can be known about its impacts, and people clearly expect DFO, which has responsibility for the health of Canadian marine ecosystems, to be active in the decision-making process and the public debate around Old Harry. Yet, as the project has moved into the environmental assessment phase, stimulating public forums and debate, DFO has remained quietly on the sidelines. For local stakeholders, this demonstrates that despite all efforts, the policy structures for handling resource exploitation are stuck in an out-dated and dangerous paradigm where there is no fit between governance institutions and the ecosystems governed. In the absence of a strategic vision for sustainability of the Gulf, industrial activities are permitted without any process to determine what types of development residents support, and where. Local governments are forced to be reactive rather than proactive in policy development. Yet “transparent, inclusive decision-making processes that are viewed as legitimate by stakeholders are a precondition for effective, adaptive governance systems to emerge” (Folke et al., 2011).

It is a serious flaw in the system, that the public only learns about a potential offshore oil or gas development after the responsible authority (provincial Petroleum Board or National Energy Board) has sold exploration rights to a corporation. In contrast, in the United States where petroleum exploration has not been permitted along the entire east coast, the public must be involved in deciding whether or not an area should be opened up for exploration. The Outer Continental Shelf Lands Act of 1953 “requires the Secretary of the Interior to submit five-year leasing programs that specify the time, location, and size of the areas to be offered. Each five-year leasing program entails a lengthy

multistep process that includes an environmental impact statement. After a public comment period, a final proposed program is submitted to the President and Congress, which may be approved by the Secretary after 60 days if there is no objection by Congress.” (Humphries et al. 2010:16)

There is no such automatic public engagement around whether or not to open up an area in Eastern Canada’s marine territory. Our offshore waters are open for business; even those areas within the Gulf that appear on maps as sensitive areas (Corridor Resources, 2011) are not off-limits to the petroleum industry. Members of the public who are paying attention learn about the opening of an area for exploration on a case by case basis, after the granting of an exploration license is made public, and may formally express concerns if and when environmental assessment processes are triggered. By this point, pro-development momentum has been established and the proponent has invested in research, paid for the exploration permit and developed expectations around return on these investments. Yet, the development may not be acceptable to the public and may not fit with municipal or provincial sustainability plans, meaning that concerted local resistance may prevent further activities, as was the case in the Southern Gulf in 2002. This is a high-risk, high-stress investment environment, both for those interested in petroleum development and for those dependent on the renewable resources in the Gulf.

Apart from the issue of the timing of public engagement, another serious flaw in the system is that local governments may express their opinions but most have no direct role in deciding what does or does not occur in the Gulf. Although the environmental, social, economic and health impacts of an actual operating oil field will be felt by all Atlantic Provinces and Quebec, only Newfoundland and Labrador has a formal role in the permitting processes for the Old Harry site. Whether the other provinces see Old Harry as a golden opportunity that should be shared equally, or as a threat to existing livelihoods in their communities, they do not have any avenue to stop, manage, or benefit from the development.

A further flaw in the system stems from the ultimate power of the federal minister with respect to environmental assessments. Even if a public review panel under the Canadian Environmental Assessment Act advises against a proposed development project after hearing public and local government concerns, the federal minister responsible does not have to follow that advice. Should the concerns and wishes of the people living around and dependent upon the Gulf of St. Lawrence be over-ridden in this way, the loss of public confidence in the system would undermine any future attempt at integrated management of natural resources.

Because five provinces and one federal government divide up the Gulf according to their jurisdictional boundaries, exploitation of natural resources has not been efficiently coordinated so as to minimize impacts on the ecosystem. The results include worrisome declines in aquatic resources, inconsistent regulation of human activities on land and in the sea, and a “gold rush” mentality with respect to hydrocarbon exploitation that is disconnected from both local place-based values and our international obligations to reduce carbon emissions.

Progress toward sustainability would be greatly enhanced if we had a publicly agreed-upon, high level energy strategy for Atlantic Canada that considers all possible alternatives for reducing energy consumption and meeting our remaining energy needs. A strategic, transparent and accountable process that would bring

the various jurisdictions together to develop coherent energy policy would essentially constitute a Gulf-wide strategic environmental assessment that could provide a framework for subsequent decisions around petroleum development projects. Allowing local jurisdictions and the general public to have clearly defined roles in the deliberations, setting policy consistent with international obligations for climate change mitigation, and clearly defining what types of sensitive areas should be set off-limits to industrial development, would reduce conflicts at the project level, avoid financial losses for proponents and build public trust. Conversely, it can be concluded that conflicts over natural resource projects such as Old Harry are not simply a reflection of the existence of opposing views concerning petroleum development. The lack of timely and inclusive public involvement in decision-making, and the lack of strategic planning in the pre-exploratory phase, encourage costly inter-sectoral and inter-jurisdictional conflicts and erode public confidence in government.

Beyond the issues attached to petroleum exploration or exploitation in the Gulf, there are wider challenges to the sustainability of the Gulf ecosystem and its dependent communities. To meet these complex challenges also requires a strategic approach to controlling all sorts of human activities. Although the sustainability of the Gulf of St. Lawrence depends in large part upon stewardship by its people, political leadership is required to establish a common vision and inspire positive collaboration. If we had an inclusive public process to reach a clear and common idea of our ecological and social objectives, and an agreement as to what type of activities are appropriate and contribute to both of these types of objectives, then the policies and decision-making structures put in place by individual jurisdictions would be complementary and move the region towards greater ecological, social and economic sustainability. In any such process the well-being of those communities of people living and depending most on the Gulf should have the greatest weight. This includes those who have an economic interest and profit to make from the Gulf’s renewable and non-renewable resources, but also those who have been stewards of the Gulf for many generations, who cherish the quality of life that a healthy ecosystem provides, and for whom the Gulf is a cornerstone of cultural identity.

Recommendations

The benefits of taking an inclusive and strategic approach is that local communities will have an opportunity to influence decision-making, and development objectives will be contextualized by the recognition that resources need to be shared not only among current occupants in one specific province but also with residents of neighbouring provinces and future generations. Rather than the existing piece-meal approach, a common, publicly supported vision would ensure that decisions in all provinces are based on the best available knowledge and are made in the long term public interest. Legislation and policies would be more coordinated and complementary, diminishing the potential for inter-provincial competitions that encourage the setting of standards at the lowest common denominator level, rather than the level essential for future sustainability. The benefits gained from marine resources could be extended to all five jurisdictions to offset any negative environmental, health, social, political and economic impacts experienced because of a particular activity. Sharing the Gulf, rather than dividing up the Gulf “pie”, would be a true shining example of integrated management.

Our current policy regime is not ideal. In response to public concern over potential impacts of exploration at Old Harry, the CNLOPB requested that the federal Minister of Environment strike a federal review panel or appoint a commissioner. The minister chose to extend public consultations to the other affected jurisdictions. We argue that this remedy falls far short of what is necessary, which is to address the major flaws and gaps in the regulatory system. We therefore conclude that the following steps ought to be followed:

- Involve all jurisdictions and the general public in development of a coherent, holistic strategy for meeting energy and economic development needs of the Atlantic region.
- Mobilize the existing integrated oceans management structures and leaders in the Gulf region to develop and agree to a common vision for resource exploitation in the Gulf.
- Provide time, during which no costly exploration can occur, for appropriate study of the economic, social and environmental benefits and risks inherent in oil and gas exploitation in the Gulf.
- Considering DFO's responsibilities under the Oceans Act, the relationship between the Petroleum Boards and DFO must be clarified. A comprehensive evaluation of the strengths and weaknesses of the Petroleum Board system is required, with recommendations for improvement, especially for decision-making affecting bodies of water that are multi-jurisdictional.
- Ensure that all policies, processes and decision-making structures for managing human activities in the Gulf of St. Lawrence are true to the Oceans Act commitment to the Precautionary Approach.

References

- BAPE (Bureau d'audiences publiques sur l'environnement), 2004. *Rapport 193: Les enjeux liés aux levés sismiques dans l'estuaire et le golfe du Saint-Laurent*, Rapport d'enquête et d'audience publique, Août 2004 (<http://www.bape.gouv.qc.ca/sections/rapports/publications/bape193.pdf>).
- Canadian Energy Law, 2011. Quebec and federal government enter St. Lawrence offshore oil deal, Posted on April 6, 2011 (<http://www.canadianenergylaw.com/2011/04/articles/oil-and-gas/quebec-and-federal-government-enter-st-lawrence-offshore-oil-deal/>).
- Coalition Saint-Laurent, 2010. Oil and gas exploration and exploitation in the Gulf of St. Lawrence? Making an informed and responsible choice together. ([http://www.coalitionssaintlaurent.ca/data/Presentation enjeux hydrocarbures EN 2010-11-04.pdf](http://www.coalitionssaintlaurent.ca/data/Presentation%20enjeux%20hydrocarbures%20EN%202010-11-04.pdf)).
- Corridor Resources, 2011. *Project Description for the Drilling of an Exploration Well on the Old Harry Prospect – EL 1105*, CNLOPB, posted February 21, 2011 (http://www.cnlopb.nl.ca/pdfs/corridorresinc/proiectdescription_en.pdf).
- Department of Justice, n.d. *Oceans Act* (<http://laws-lois.justice.gc.ca/eng/acts/O-2.4/page-8.html?term=precautionary+principles#s-30>).
- DFO, 2001a. *Description of the Southern Gulf of St. Lawrence and Sydney Bight Marine Ecosystems in Relation to Oil and Gas Exploration*. DFO Maritime Provinces Regional Habitat Status Report 2001/01, 18p. viewed online 30 Oct. 2011 (<http://www2.mar.dfo-mpo.gc.ca/science/rap/internet/hsr2001-1e.pdf>).
- DFO, 2001b. RAP documents prepared for the Public Review Commission on petroleum exploration in the Southern Gulf of St. Lawrence, available from <http://www.meds-sdmm.dfo-mpo.gc.ca/csas-sccs/applications/publications/result-eng.asp?params=0&series=4&year=2001>.
- DFO, 2010. *2010 Canadian Marine Ecosystem Status and Trends Report*. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/030 (Revised).
- DFO, n.d. *Approach and Process for Managing LOMAs*. (<http://www.dfo-mpo.gc.ca/oceans/marineareas-zonesmarines/loma-zego/approach-approche-eng.htm>)
- Dorion, H. et J-P Lacasse (2011), *Le Québec : territoire incertain*, Collection territoires septentrion, 328 p.
- Government of Canada, 2001. *Report on the Oceans Act, October 2001*. Viewed online 30 Oct. 2011, at <http://www.parl.gc.ca/HousePublications/Publication.aspx?DocId=1032010&Language=E&Mode=1&Parl=37&Ses=1>
- Folke, C., A. Jansson, J. Rockstrom, P. Olsson, S. R. Carpenter, F. Stuart Chapin III, A-S.Crepin, G. Daily, K. Danell, J. Ebbesson, T. Elmqvist, V. Galaz, F. Moberg, M. Nilsson, H. Osterblom, E. Ostrom, A. Persson, G. Peterson, S. Polasky, W. Steffen, B. Walker, and F. Westley, 2011. Reconnecting to the biosphere. *Ambio* 40:719-738. Available online at <http://www.springerlink.com/content/h641170212g13tj6/fulltext.pdf>
- Harding, G.C., 1992. *A Review of the Major Marine Environmental Concerns off the Canadian East Coast in the 1980s*. Can. Tech. Rep. Fish. & Aquat. Sci. No.1885, 38p.
- Humphries, M., R. Pirog and G. Whitney, 2010. *U.S. Offshore Oil and Gas Resources: Prospects and Processes*. Congressional Research Service Report 7-5700. 33 p. (<http://fpc.state.gov/documents/organization/142736.pdf>).
- Laforest and Montigny, (2006), "Des réflexions sur le fédéralisme asymétrique", Chapitre 4, Le parlementarisme canadien, 4 édition revue et augmentée sur la direction de Réjean Pelletier et Manon Tremblay, Les Presse de l'Université Laval.
- Le Devoir, 2 mars 2011. Old Harry - Que vaut le golfe du Saint-Laurent? Coalition Saint-Laurent demande que soient évaluées les pertes économiques qu'entraînerait un éventuel déversement de pétrole, citation de Christian Simard (<http://www.territoires.qc.ca/nouvelles/236/old-harry-que-vaut-le-golfe-du-saint-laurent>; www.ledevoir.com/environnement/actualites-sur-l-environnement/317845/old-harry-que-vaut-le-golfe-du-saint-laurent).
- Loutfi, M.A. 1973. *Canadian Maritime Oil Exploration, Exploitation and Transport: A Multidisciplinary Study*. Montreal, Office of Industrial Research, McGill University.
- Natural Resources Canada, January 2006. "Legal and Policy Frameworks - Canada" in *North America: The Energy Picture* http://en.wikipedia.org/wiki/Energy_policy_of_Canada; <http://www2.nrcan.gc.ca/es/es/NA-enrgpic2006/p07can-e.htm>. Retrieved 2008-08-16.

Salmon Cage Aquaculture in Canada: Issue Analysis

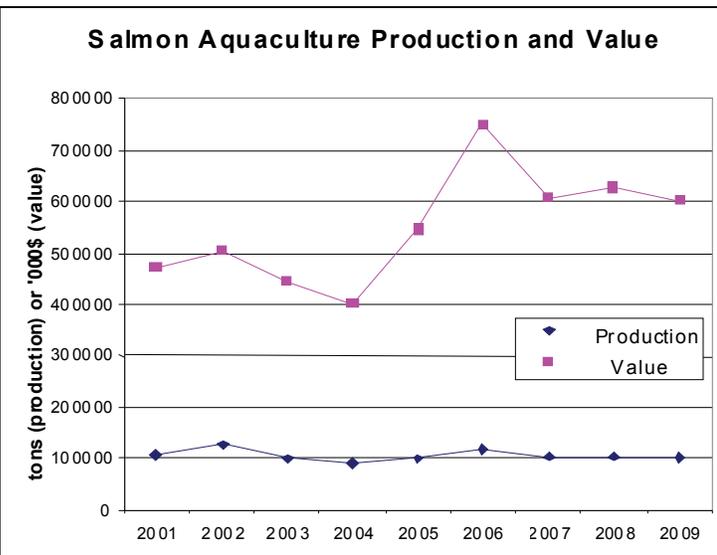
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Problem Statement

Salmon cage aquaculture has developed relatively recently in Canada, and has shown rapid growth. There are substantial controversies about environmental and social impacts of this food production system. Our objectives in writing this brief are to clarify the issues and draw conclusions on how this food production system can be developed sustainably.

Salmon aquaculture has grown rapidly in the past two decades. From its beginnings in the 1980s, salmon aquaculture currently produces around 100,000 tons/year valued at around \$600m/year (Statistics Canada 2009). For comparison, the total value of Canadian fisheries production in 2009 was \$1,700m (DFO 2010a). Aquaculture salmon exports have been valued at around \$500m/year in recent years (Statistics Canada 2009). Canada produces 8% of the world's farmed salmon (DFO 2009).



Source: Statistics Canada (2009)

Farmed salmon is a nutritious food, high in protein and omega-3 fatty acids. Improved aquaculture production techniques have increased cost-effectiveness of production, allowing sale prices to consumers to remain relatively low. However, sustainability of the industry has been questioned, with concerns about negative effects of salmon farming systems on wild salmon populations, impacts on water quality and biological diversity in coastal waters, use of fish meal and fish oils in feeds, and negative social and economic impacts on coastal communities (Atlantic Coalition for Aquaculture Reform 2011; Coastal Alliance for Aquaculture Reform 2011). There are uncertainties about some of the possible environmental impacts.

Regulation of salmon aquaculture is complex: federal and provincial governments both have roles in regulating the industry (although a recent court decision has determined that responsibilities formerly assumed by the British Columbia government should be with the federal government) (BC Supreme Court 2009). The lead federal department, Fisheries and Oceans Canada (DFO) is mandated both to regulate and to support the industry, complicating the regulatory task.

Aquaculture production of salmon is conducted in floating net cages anchored in coastal areas. Atlantic salmon is the main cultured species. Young salmon (smolts) from hatcheries are seeded into the net enclosures and are fed with processed foods. Wastes sink through the cage netting and are either dispersed in the water or sink to the bottom. The primary areas for salmon aquaculture are in British Columbia (around 70% of national production) and in New Brunswick (around 25% of national production). According to Statistics Canada's (2009) value added analyses of aquaculture (all species – but dominated by salmon) for 2009, feeds are the primary input cost (51% of total) followed by purchase of young fish (11%) and maintenance and repairs (8%). The aquaculture industry as a whole (again, dominated by salmon) paid \$114m in salaries in 2009, directly employing about five thousand persons on a full time equivalent basis (Statistics Canada 2009).

East and West Coast Aquaculture Performance. Aquaculture production grew rapidly on Canada's east and west coasts during the decade of 1990-2000. However, from 2000-2009, aquaculture production has levelled off and even declined on both coasts (Tables 1 & 2).

Aquaculture plays an important role in Canada's fish production, particularly on the west coast where in 2009, aquaculture accounted for 32.7% of the volume and 62.3% of the value of total fishery production at the primary level in comparison to only 8.4% and 20.1 % on the east coast. On the west coast, salmon culture dominates the aquaculture industry, with production exceeding and compensating for fluctuating and declining commercial salmon landings (Table 3). Cultured salmon accounted for over 70% of total West Coast production for most of the period 2000 to 2009.

On the east coast, salmon culture dominates only in New Brunswick, the largest producing province on this coast. However salmon production declined from 29.1 thousand tonnes to 24 thousand tonnes during the period 2000 to 2009. In Nova Scotia, salmon production increased from 3.4 thousand tonnes to 7.6 thousand tonnes during the period and, although statistics are not available, it likely increased in the other Atlantic provinces.

Table 1. Aquaculture Contribution to Fish Production, East Coast, 2000-2009

	Commercial Fisheries		Aquaculture		Total fish Production		Aquaculture Contribution to Fish Production	
	Volume of Landings	Value of Landings	Volume	Value*	Volume	Value		
	'000 tonnes	(\$ million)	'000 tonnes	(\$ million)	'000 tonnes	(\$ million)		
2000	855.3	1,769.0	66.1	289.0	921.4	2,058.0	7.1	14.0
2001	864.4	1,772.1	70.4	278.9	934.8	2,051.0	7.5	13.6
2002	881.3	1,859.9	71.6	283.6	952.9	2,143.5	7.5	13.2
2003	901.9	1,906.4	69.5	283.2	971.4	2,189.6	7.1	12.9
2004	921.0	1,902.4	70.6	266.8	991.6	2,169.2	7.1	12.3
2005	848.1	1,746.6	75.8	345.7	923.9	2,092.3	8.2	16.5
2006	889.6	1,531.8	86.2	396.5	975.8	1,928.3	8.9	20.5
2007	846.0	1,593.6	66.2	321.5	912.2	1,915.1	7.2	16.8
2008	785.2	1,606.6	67.2	336.3	852.4	1,942.9	7.9	17.3
2009	767.6	1,391.4	70.6	352.2	838.2	1,743.6	8.4	20.1
A.R.G	-1.2	-2.7	0.7	2.1	-1.0	-1.8		

* Value at secondary production level. Source: DFO website statistics on fisheries and aquaculture - <http://www.dfo-mpo.gc.ca/stats/stats-eng.htm>

An aquaculture workshop

To contribute to greater clarity on controversies about the impacts and benefits of salmon aquaculture to coastal zones and to Canada as a whole, C-FOAM (the Canadian Fisheries, Oceans and Aquaculture Management research cluster at Telfer School of Management, University of Ottawa) organized a panel discussion with invited aquaculture specialists to speak to the various issues and points of view. The panel discussion was held April 6, 2011, and brought together about 25 participants as well as the panellists (CFOAM 2011).

The invited panellists were:

- Tillmann Benfey, Professor of Biology at University of New Brunswick, Fredericton, to speak on aquaculture science
- Ruth Salmon, Executive Director of the Canadian Aquaculture Industry Alliance, to speak on the industry's perspective
- Trevor Swerdfager, Director General of Conservation and Protection (and former Director General of Aquaculture Management) at Department of Fisheries and Oceans, to speak on the federal government's perspective
- John Werring, Aquatic Habitat Specialist, David Suzuki Foundation, to speak on the perspective of an environmental non-governmental organization

Each panellist spoke for around 20 minutes, and a general discussion with questions from the audience followed.

In the following text, we do not intend to represent the point of view of any participant in the panel discussion session – our objective is to attempt to identify the key issues raised, based on the presentations, the discussion, and our subsequent analysis.

While we attempted to get as broad a set of perspectives as possible, the perspective of coastal communities was notably missing from the discussion. Accordingly, this perspective may not be well represented in what follows.

Issue analysis

The Regulatory Framework. The regulatory framework for salmon cage aquaculture is poorly defined and fragmented, with responsibilities for various components of regulation with the federal and provincial levels of government. It appears that there is no single governance forum in any jurisdiction, at which the various interests could meet to express points of view and seek solutions together. The *Fisheries Act*, DFO's primary legislative mechanism, does not address aquaculture explicitly; the *Oceans Act*, which provides for integrated oceans management, has not been applied in aquaculture management. One workshop participant expressed the view that Canadian legislation on aquaculture should be revised to provide a stronger and more effective regulatory framework; specific legislation for aquaculture exists in other countries.

Table 2. Aquaculture Contribution to Fish Production, West Coast, 2000-2009

	Commercial Fisheries		Aquaculture		Total fish Production		Aquaculture Contribution to Fish Production	
	Volume of Landings	Value of Landings	Volume	Value*	Volume	Value	Volume	Value
	'000 tonnes	(\$ million)	'000 tonnes	(\$ million)	'000 tonnes	(\$ million)	%	%
2000	148.2	368.8	55.7	292.4	203.9	661.2	27.3	44.2
2001	188.9	364.4	77.0	288.5	265.9	652.9	29.0	44.1
2002	192.7	338.1	93.1	304.4	285.8	642.5	32.6	47.4
2003	218.1	364.2	75.1	273.5	293.2	637.7	25.6	42.9
2004	255.2	354.1	65.7	241.8	320.9	595.9	20.5	40.6
2005	248.5	330.1	73.6	337.2	322.1	667.3	22.8	50.5
2006	214.9	324.3	80.7	427.5	295.6	751.8	27.3	56.9
2007	175.8	293.9	81.4	407.8	257.2	701.7	31.6	58.1
2008	154.0	236.0	81.4	428.2	235.4	664.2	34.6	64.5
2009	157.2	250.2	76.4	413.0	233.6	663.2	32.7	62.3
A.R.G	0.6	-4.3	3.5	3.8	1.5	0.03		

* Value at secondary production level. Source: DFO website statistics on fisheries and aquaculture - <http://www.dfo-mpo.gc.ca/stats/stats-eng.htm>

Ecosystem impacts. Salmon cage aquaculture certainly has impacts on the marine ecosystems in which it operates – but there is lack of consensus on whether these are serious or not, whether they are well managed or not, and whether they are well known or not. The potential impacts include impact of wastes on bottom and midwater biological communities (e.g. Wiber et al 2011); transfer of parasites (sea lice) from cage farms to wild stocks (e.g. Harvey 2008); escape of individuals from farms, which could bring inappropriate genetic strains to natural stocks (e.g. Naylor et al 2005).

Economic challenges. Canadian salmon aquaculture operates in a highly competitive global marketplace for seafood; major producers include Norway and Chile (where production costs are low). The national marketplace is also highly competitive and margins are low; there may have been oversupply in recent years. As such, the industry must seek efficiencies wherever possible. Production systems have become standardized, semi-industrial, and dependent on inputs at lowest cost possible (for example feeds).

There is disagreement between industry and government on the one hand, and environmental organizations on the other hand, about the real economic benefits of salmon cage aquaculture to coastal communities and to Canada as a whole. Sceptics argue that the benefits in terms of employment and economic returns

are overestimated by government and industry, that the costs (particularly environmental) are underestimated, and that concentration of ownership may lead to excessive benefits to investors, to the detriment of communities. Disagreement about economic returns are probably to be expected given the different values given to costs and benefits of economic activities by different sectors of society.

Lack of transparency. A lack of easy access to information on production systems and on specific issues (for example, sea lice infestations) was cited as a problem by several workshop participants. A need for increased transparency both on the part of industry and of government was noted, to enhance confidence of coastal communities and environmental organizations that production systems are indeed sustainable and ecosystem impacts are being well assessed and managed.

Dealing with uncertainties. Uncertainties exist about some of the potential impacts, for example the potential for transfer of sea lice from farms to wild salmon. At the same time, there is substantial scientific knowledge about net pen culture and its impacts, and this is steadily increasing. In this situation, it is possible to structure debates around available knowledge, and the uncertainties can be clearly defined such that they can be dealt with through additional scientific work. One current of

opinion at the panel discussion suggested that debates were not always based on an objective assessment of available knowledge. On the other hand, it can be difficult to locate the latest and most reliable information on specific issues, in the widespread scientific and regulatory literature.

We experienced this uncertainty in attempting to find basic information on aquaculture production and value in Canada – figures provided by Statistics Canada, DFO and by the industry can be very different.

The situation is evolving. Scientific knowledge of the ecosystem impacts of salmon aquaculture is improving, and governments have taken measures to improve regulation and related activities.

The Pacific Salmon Forum studied potential aquaculture impacts on wild salmon populations over a four-year period and funded several original studies on sea lice transmission and other issues (Pacific Salmon Forum 2009). Their report provides a current summary of issues related to salmon aquaculture impacts and identifies research and monitoring priorities for the future.

The federal-provincial-territorial Council of Fisheries and Aquaculture Ministers published a National Aquaculture Strategic Action Plan in November 2010 (DFO 2010b). In his presentation to the panel discussion, Mr. Swerdfager indicated that DFO has recently received new funding for a sustainable

aquaculture program; that public information systems to publish information related to regulation of the industry were expected to be in place by June 2011; and that new scientific staff (34) are being hired to conduct research related to regulation of the industry.

Conclusions, Recommendations and Follow-up

Salmon cage aquaculture will certainly be part of food production systems in Canada and globally for the foreseeable future, given the pressure on food security and the availability of economically viable production systems. This production system provides enough benefits in Canada that it is likely to remain an important part of our food industry. The challenge, as with other food production systems, is to ensure that production is sustainable on all measures – ecological, economic, and social.

Sustainable development of aquaculture represents a particular challenge in that it is a “new” industry with no long-term tradition in coastal communities (as opposed, for example, to fishing or lumbering). The industry also makes “new” demands on a common resource, the ocean. As such there are bound to be uncertainties about impacts and benefits, conflicts, and differences of opinion on how best to proceed to develop the industry. From what we have seen, the various players in development of the industry – industry, community and

Table 3. The Contribution of Salmon Aquaculture to the BC Salmon Industry, 2000-2009

	Commercial Salmon Fisheries		Salmon Aquaculture		Total Salmon Production		Aquaculture Salmon Contribution to Total Production	
	Quantity	Value	Quantity	Value *	Quantity	Value	%	%
	'000 tonnes	(\$ million)	'000 tonnes	(\$ million)	'000 tonnes	(\$ million)		
2000	19.5	52.4	49.0	278.4	68.5	330.8	71.5	84.1
2001	24.7	37.1	68.0	270.9	92.7	308.0	73.3	87.9
2002	33.3	57.3	84.2	288.9	117.5	346.2	71.7	83.4
2003	38.5	48.9	65.4	255.8	103.9	304.7	62.9	83.9
2004	25.8	53.2	55.6	225.2	81.4	278.4	68.3	80.8
2005	27.2	34.0	63.4	318.3	90.6	352.3	70.0	90.3
2006	23.7	59.5	70.2	407.4	93.9	466.9	74.8	87.3
2007	19.9	30.5	71.0	348.1	90.9	378.6	78.1	91.9
2008	5.4	21.6	73.3	409.3	78.7	430.9	93.1	95.0
2009	18.5	23.7	68.7	394.2	87.2	417.9	78.8	94.3
A.R.G %	-0.6	-8.8	3.7	3.9	2.7	2.6		

* Value at secondary production level. Source: DFO website statistics on fisheries and aquaculture - <http://www.dfo-mpo.gc.ca/stats/stats-eng.htm>

environmental groups, government – are playing their roles appropriately in the development of the industry. Canadians can be grateful that industry players have developed a new industry which provides benefits; that community and environmental groups are raising questions and seeking transparency; and that governments are working to improve the regulatory and governance frameworks.

The principal need, in a situation like this, is for strong governance forums to allow for questions to be raised, information to be made available, opinions to be aired, and regulatory decisions to be made based on sound information and decision-making processes. The impact of a major disease outbreak on Chilean cage salmon production in recent years was exacerbated by a lack of information-sharing between farms and government institutions.

Although there have been improvements to aquaculture governance in Canada over the past decades, our impression is that governance is still not particularly solid – with the result that the debates on aquaculture seem to be “dialogues of the deaf” with each side repeating positions. In this context the recent (2010) publication of the National Aquaculture Strategic Action Plan Initiative (NASAPI) by the Canadian Council of Fisheries and Aquaculture Ministers (federal, provincial and territorial) is promising (DFO 2010b). Although the governance section of this Plan consists of a series of more or less unrelated initiatives, without an overall direction to improving governance of aquaculture, the “Social Licence and Reporting” component of the Plan does identify transparent information-sharing mechanisms, sustainability reporting, and resource mapping as part of public engagement and communication, which are important contributions to improved governance.

Creating concrete mechanisms to meet these commitments to improved governance and information-sharing is probably the key challenge for governments at this time. We believe that setting up multi-stakeholder forums (perhaps on a provincial or regional basis) for information exchange and discussion of issues would help to create better governance and a more sustainable future for this important industry.

Acknowledgements

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References

Atlantic Coalition for Aquaculture Reform 2011. http://www.conservationcouncil.ca/Fundy-Bay-Keeper/Atlantic_Coalition_for_Aquaculture_Reform.aspx

BC Supreme Court 2009. Morton v. British Columbia (Agriculture and Lands), 2009 BCSC 136. Available at <http://www.courts.gov.bc.ca/jdb-txt/SC/09/01/2009BCSC0136err1.htm>

Coastal Alliance for Aquaculture Reform 2011. see <http://www.farmedanddangerous.org/>

C-FOAM 2011. Sustainability in Aquaculture: Expert Panel Seminar. C-FOAM Seminar Series on Best Practices. April 6, 2011. http://www.c-foam.management.uottawa.ca/docs/Aquac_workshop_report1.doc

DFO (Fisheries and Oceans Canada) 2009. Aquaculture in Canada – Facts and Figures. Brochure. Available at <http://www.dfo-mpo.gc.ca/aquaculture/ref/stats/aqua-ff-fc-2009-eng.htm>

DFO (Fisheries and Oceans Canada) 2010a. Canada’s Fisheries, Fast Facts 2010. Available at www.dfo-mpo.gc.ca/communic/statistics/main_e.htm.

DFO (Fisheries and Oceans Canada) 2010b. National Aquaculture Strategic Action Plan Initiative – Overarching Document. 20pp. Five regional documents also make up the Plan. Available at <http://www.dfo-mpo.gc.ca/aquaculture/lib-bib/nasapi-inpasa/index-eng.htm>

Harvey, B. 2008. Science and sea lice – what do we know? Prepared for the BC Pacific Salmon Forum. February 22, 2008. 78 pp. Available at <http://www.livingoceans.org/sites/default/files/reports/ScienceandSeaLiceFinalFeb22-08.pdf> (note: this NGO web site appears to be the most accessible source for this report at the time of writing)

Naylor, R. K. Hindar, I. A. Fleming, R. Goldberg, S. Williams, J. Volpe, F. Whoriskey, J. Eagle, D. Kelso and M. Mangel 2005. Fugitive salmon: assessing the risks of escaped fish from net-pen aquaculture. *BioScience* 55: 427-437.

Pacific Salmon Forum 2009. Final Report and Recommendations to the Government of British Columbia, January 2009. 96 pp. Available at <http://www.marineharvestcanada.com/documents/BCPSFFinRptqSm.pdf> (note: this industry web site appears to be the only or at least the most accessible source for this report at the time of writing)

Statistics Canada. 2009. Aquaculture statistics 2009. 39 pp. Available at <http://www.statcan.gc.ca/pub/23-222-x/23-222-x2009000-eng.pdf>

Wiber, M. G., S. Young and L. Wilson 2011. Aquaculture-traditional fishery interactions in southwest New Brunswick: implications for future research. OCN (Oceans and Coasts Network) Canada Policy Briefs 1(1): 4-9. Available at http://www.omrn-rngo.ca/docs/OCN-Canada_PolicyBriefs_vol1.pdf

COMMENTS AND RESPONSES

The OCN is pleased to present feedback from its readership on its previous policy briefs. The attributed comments below refer to :

Wiber, M., Young, S., & Wilson, L. (2011). *Aquaculture-Traditional Fishery Interactions in Southwest New Brunswick: Implications for Future Research*. OCN-Canada Policy Brief, vol. 1(1): 4-9.

Comment 1 by Pamela Parker, Executive Director, Atlantic Canada Fish Farmers Association (ACFFA)

Comment 2 by Bradley Walters, Professor of Geography and Environment, Mount Allison University

Response by Melanie Wiber (UNB Fredericton), Sheena Young (Fundy North Fishermen's Association), and Lisette Wilson (Dalhousie University, Halifax)

COMMENT 1

The ACFFA is disappointed that the research methodology did not include even a single focus group with salmon farmers despite the fact that the brief was about aquaculture and traditional fishery interaction. We are concerned that the methodology accepts a process whereby anecdotes are not tested for accuracy before they are printed.

We are also concerned that the peer review process enabled this paper to be published despite a significant amount of information gaps, the use of outdated science, research and newspaper articles. Ultimately, if an exercise such as this is to be undertaken, we believe the data gathering needs to come from all parties that can make a contribution.

The following research, published papers and/or other publicly available materials failed to be included by the authors:

(i) Previous studies on wild/farmed interactions that include:

- Walters, B.B. 2007. Competing use of marine space in a modernizing fishery: salmon farming meets lobster fishing in the Bay of Fundy, New Brunswick. *The Canadian Geographer* 51:139-159.
- Fisheries and Oceans Canada. 2003. A scientific review of the potential environmental effects of aquaculture in aquatic ecosystems. Volume I. Far-field environmental effects of marine finfish aquaculture (B.T. Hargrave); Ecosystem level effects of marine bivalve aquaculture (P. Cranford, M. Dowd, J. Grant, B. Hargrave and S. McGladdery); Chemical use in marine finfish aquaculture in Canada: a review of current practices and possible environmental effects (L.E. Burridge). Can. Tech. Rep. Fish. Aquat. Sci. 2450: ix + 131 p.
- McLaughlin, M. and Couturier, C. 2005. Mitigating Fisheries and Aquaculture Interactions: A Case Study of Involving Salmon and Mussel Farms in New Brunswick and Newfoundland and their Impact on Lobster Fishing. *Aquaculture Canada 2005*
- Ennis, J. 2006. Will Current Management Practice Ensure Sustainability of the Fortune Bay Lobster Fishery?

Biodiversity 7(2) 2006.

(ii) Extensive research has been conducted on the impacts of in-feed sea lice treatment products; this work is contained on DFO's website among others. These are available through a Google science search. Some include:

- Roth, M., R.H. Richards, and C. Current practices in the chemotherapeutic control of sea lice infestations in aquaculture: A review. *J. Fish Disease* 1993 p. 1-126
- Sea Lice treatments on salmon farms have no adverse effects on zooplankton communities: a case study *Marine Pollution Bulletin* 50 (2005) 806-816
- The toxicity of emamectin benzoate, an aquaculture pesticide, to planktonic marine copepods *Aquaculture* 221 (2003) 289-297
- Environmental effects of the anti-sea lice (Copepoda: Caligidae) therapeutant emamectin benzoate under commercial use conditions in the marine environment *Aquaculture* 260 (2006) 163-180

(iii) Health Canada's Pest Management Regulatory Agency conducts very rigorous risk assessments for all externally administered sea lice chemotherapeutants using research from around the world. PMRA did meet with fishery groups and provided this information in 2009 and again in 2010. In addition, to providing assurance to local stakeholders that these products can be used safely without impact to wild fish populations, research and scientific monitoring has been taking place in southwest New Brunswick since 2009 when the first approvals for use were given. Preliminary research results have been shared at a variety of meetings with traditional fishers and conservation organizations; results have been reported in media (*St. Croix Courier and Telegraph Journal*) and are available on www.atlanticfishfarmers.com website. In addition DFO and the Province of New Brunswick held meetings with the traditional fishing sector.

This brief calls for research into the environmental 'degradation' of farm sites and talks about "mildew" below sites, etc. This is not responsible research. The researchers ignored the fact that third party monitors conduct annual video surveillance of the ocean floor beneath fish farms and conduct regular sampling of

the sediment. The New Brunswick Department of Environment's website has information available to the public and to researchers on the Environment Monitoring Program prescribed by regulation (www.gnb.ca/0009/0004-e.asphis). In addition, annual reports of the findings of the sediment analysis are made public at www.gnb.ca/0009/0369/0017/0002-e.asp.

(iv) The brief calls for an independent socio-economic study of the aquaculture industry when such a study was already contracted by DFO and released in 2010. The DFO and ACFFA, among others, issued media releases when this report was released. The report can be found at www.dfo-mpo.gc.ca/aquaculture/ref/aquacult2009-eng.pdf. Charlotte County, NB was profiled in the Community Impact section of this report.

(iv) We challenge the validity of comparative analysis of ecosystems in Norway or British Columbia, which have very different tidal conditions, benthos, etc. than that of the Bay of Fundy.

Additionally the paper's authors call for a variety of other information, which has already been collected and/or is already in the public domain, is available upon request and is already being used by government and academic researchers. These include:

- Salmon farmers regularly collect water temperature data. As a result, we can confirm that since 2009 water temperatures in southwest New Brunswick have been at least two degrees above average. This variation could be a significant influence on wild species population and the health status of herring, krill, zooplankton, location of whales, seals, sea birds, etc. Variations could also be the result of a multitude of other factors beyond the scope of aquaculture.
- A third party audit system is in place for sea lice monitoring to support regulatory compliance; the salmon farming industry established a database for the collection of the farm sea lice counts and the audit counts and this information is available to the regulators.
- Chemotherapeutants are used only under the prescription of a veterinarian. The use of products is tracked by regulators and the product vendors also make regular reports to government regulators.
- The map that is used in the policy brief shows licensed sites; however, many of these sites are not in operation. It would have been more accurate if the authors had used a map showing sites that were stocked with fish.
- Salmon farming requires a pristine ocean environment to grow healthy fish. This paper suggests our industry is responsible for the careless disposal of waste, fish mortalities, etc. New Brunswick, in fact, has become a model of optimal biosecurity and disease management protocols and other countries, like Chile, have adopted this model. Contrary to what the brief alleges, salmon farming companies are already responsible for the following costs: environmental monitoring such as sediment sampling and water temperature collection; waste management; biosecurity, and fish health monitoring.
- A preliminary scan of the DFO data on commercial fishery landings from 2005 to 2009 that is posted on their website at www.dfo-mpo.gc.ca/stats/commercial/sea-maritimes-eng.htm in relation to herring, scallops, lobster, urchin and other species seems to indicate that there is little change in traditional catches. While there are variations both up and

down, the trend indicates that landings are relatively stable. Again, this was not reflected in the brief, and this source has not been cited to confirm verbal discussions.

The paper's authors discuss the need for fishery and conservation organizations to be engaged in the development of research agendas. The Atlantic Canada Fish Farmers Association, on behalf of the salmon farming industry, has repeatedly invited input from the fishery and conservation organizations into research priorities and projects since 2009. Fishery groups have also been engaged in the development of a framework for an integrated pest management plan for sea lice. Effective integrated management strategies will only be successful if all parties are willing to meet. It should be noted that the traditional fishing sector left the NB/DFO Aquaculture and Traditional Fishery Working Group in the fall of 2010 in order to form their Atlantic Coalition for Aquaculture Reform. Requests for meetings made by the aquaculture sector have been rejected since that time.

The closing paragraph of this brief refers to a BC court case that has no relevance in New Brunswick. It also misrepresents the facts surrounding alleged lobster poisonings. It should be noted that any use of illegal products in the marine system is a criminal offense and must be investigated as such by the responsible authority – in this case Environment Canada. This is being done and the salmon farming industry is cooperating fully. We too would like this issue resolved.

Salmon farming is one of the most highly regulated food production systems in Canada. Salmon farmers, many of whom are also fishermen, have worked in southwest New Brunswick for over 30 years and have significant ecological knowledge that could have benefited this paper. Consultation with the aquaculturists would also have made sure that the information included in the policy brief was considered by the authors.

This brief attempts to pass off anecdotes as peer reviewed science and this inaccurate and incomplete document is now in the public domain. We believe that lack of due diligence and omission of critical information jeopardizes the integrity of OCN-Canada.

COMMENT 2

I read with interest the policy brief by Wiber *et al.* (2011) which summarizes recent research on local fishers' knowledge as it pertains to salmon aquaculture and environmental change in southwest New Brunswick. This is not the first study of its kind in the region. Marshall (2001) examined the impact of salmon farming on the herring weir fishery of Grand Manan and I studied interactions between lobster fishing and salmon farms on Grand Manan and Deer Islands (Walters, 2007). It is perplexing that Wiber *et al.* failed to cite this earlier research given obvious parallels in the findings and the policy issues raised by them. For example, Marshall (2001) echoing Stevenson (1990) documented the challenges facing weir fishermen in the face of expanding salmon farms, including declining herring catches and displacement of weirs from traditional sites.

Like Wiber *et al.* (2011), I learned that many lobster fishermen have serious concerns about salmon farms polluting coastal waters and encroaching on critical lobster habitat (Walters, 2007). However, I also found that perceptions of change and impact var-

ied greatly among fishermen. For many, the level of concern had moderated over time as their worst fears failed to materialize and as they adapted their practices and grew accustomed to the presence of the farms. For example, many fishermen had shifted effort offshore, away from salmon farms. This change was driven mostly by technology—bigger, faster boats; better navigational tools, etc.—but also the better catches obtained further from shore (Walters, 2007).

Such changes to fishing technologies and practices are matched in SW New Brunswick by changes in the marine environment, both natural and anthropogenic. These various changes influence what fishermen perceive and learn about the environment. Some changes are likely to challenge fishermen's ability to identify and assess aquaculture-related impacts. For example, the shift in fishing effort offshore means less time and attention devoted to nearshore sites where salmon farms and their effects are concentrated.

Broader environmental changes can also swamp the local effects of aquaculture, further confounding interpretations of impacts. For example, steady increases in lobster landings (both inshore and offshore) coincided with the arrival and development of salmon farming. More than any other factor, this coincidence probably explains why fishermen were willing, albeit grudgingly, to tolerate continued expansion of the aquaculture industry (Walters, 2007). Yet, no fishermen, aquaculturist or scientist would claim that expansion of salmon farming caused the increase in lobster landings.

As with all knowledge claims, local knowledge should be approached critically, with an appreciation that fishermen vary greatly in what they know, and while they are likely to know a lot about fishing, they do not always know that much about subjects of interest to fisheries and marine environmental scientists (and visa-versa) (Ruddle and Davis, 2011). Of course, such knowledge gaps create opportunities for mutual learning and the setting of research priorities. In a nutshell, this is the value of Wiber *et al.*'s (2011) general survey of local knowledge. But this is only a first step, and we should not have illusions about how easy the next steps will be.

The integration of local and scientific knowledge in fisheries is a worthy endeavor and should be encouraged and supported. But credible answers to research questions about the impacts of aquaculture on specific fisheries or components of the marine environment will not readily emerge simply because scientists and fishermen start talking to one another. Investigators will need to formulate clear questions of interest and pursue subsequent investigations in a sharply focused, dogged manner, interrogating the relevance, accuracy and plausibility of specific knowledge claims using whatever means available (Davis and Ruddle, 2010; Vayda *et al.*, 2009). As with science in general, local knowledge collaborations are as likely to increase as they are to narrow the uncertainties, and will raise many more questions than they credibly answer.

References

- Davis, A., and K. Ruddle. 2010. Constructing confidence: rational skepticism and systematic enquiry in local ecological knowledge research. *Ecological Applications* 20(3):880-894.
- Marshall, J. 2001. Landlords, leaseholders & sweat equity: changing property regimes in aquaculture. *Marine Policy* 25:335-352.
- Ruddle, K., and A. Davis. 2011. What is "ecological" in local ecological knowledge? Lessons from Canada and Vietnam. *Society & Natural Resources* 24:887-901.
- Stephenson, R.L. 1990. Aquaculture collides with traditional fisheries in Canada's Bay of Fundy. *World Aquaculture* 21 (2):34-45.
- Vayda, A.P., B.B. Walters, and I. Setyawati. 2009. On knowing what not to know about knowing: A critical view of local knowledge studies. In: A.P. Vayda, *Explaining Human Actions and Environmental Changes*. AltaMira Press, Lanham, MD. pp.79-109.
- Walters, B.B. 2007. Competing use of marine space in a modernizing fishery: salmon farming meets lobster fishing on the Bay of Fundy. *The Canadian Geographer* 51(2):139-159.
- Wiber, M., S. Young and L. Wilson. 2011. Aquaculture-traditional fishery interactions in Southwest New Brunswick: Implications for future research. *OCN-Canada Policy Briefs* 1 (1):4-9.

RESPONSE

Policy briefs are by their nature brief. Thus we welcome the opportunity afforded by the OCN Policy Brief review process to expand on the results of our study into fishermen's observations of the impacts of aquaculture on the inshore fishery in Southwest New Brunswick. Our study is more fully reported in the final research report (online at <http://www.coastalcura.ca/news.html>) and in a new article in *Human Ecology* (2012).

Parker comments that our methodology did not include sampling from salmon growers. This is usual in studies of local ecological knowledge that focus on the knowledge system of a particular group. It is also usual that a great deal of aquaculture research (much of it funded with federal dollars) has not consulted fishermen. For example, the DFO socio-economic analysis that Parker refers to was undertaken through: "information obtained through extensive interviews with leading aquaculture companies on both the Pacific and Atlantic coasts" (2010:2). No mention is made here of interviewing fishermen.

Walters's older study did include fish growers. But that study (cited in our full report and in the *Human Ecology* publication) did not focus on our three study areas and on the conditions pertaining there today. Our study sampled fishermen in three contrasting areas on their local ecological knowledge about the impact of salmon farming on fish stocks and fish habitat. In our resulting publications, we have also cited scientific studies that either agree with or contradict specific fishermen's observations.

Parker faults us for citing the wrong literature. Literature that we failed to include in our policy brief was due to space limitations – most of the references cited by Parker are included in the

Human Ecology paper including some that she does not cite (such as Fairchild et al 2010). Parker states that we used outdated science, research and newspaper articles. One of the references she cites is dated 1993 – so we can assume that she does not defined “outdated” by reference to date? Perhaps she feels that the aquaculture industry has addressed some of these issues in more recent years and thus our results are “outdated” – if so, the fishermen we spoke to would disagree.

Parker objects to fishermen’s descriptions of changes to the ocean floor under salmon cages. These changes around fish farms have been well documented in the literature that we cite, while recovery times are only now being addressed in a few studies (see <http://www.friendsofportmoutonbay.ca/docs/Study-Of-Geochemical-and-Faunal-Sediments-Port-Mouton-Bay-Dalhousie-2009-2010.pdf>).

Parker notes the regulation under which salmon growers operate. Regulation by the state and province, and assurances by ACFFA, mean very little when successive occurrences of lobster kills have been recorded over a number of years. Parker also alleges that we “misrepresented the facts surrounding alleged lobster poisonings” so it is useful to clarify fishermen’s concerns. Testing by Environment Canada in October 2010 demonstrated a link between illegal chemical use and lobster mortality (Gustafson 2010). Several criminal charges have now been laid regarding use of deleterious substances in the waters of SWNB. Fishermen view the consequences of such regulatory system failure as very serious.

Parker challenges the validity of making comparative analysis of aquaculture operations in New Brunswick with Scotland, Norway, and Chile. But these comparisons are frequently made in the aquaculture literature and can be indicative of general problems (see, for example, Burrridge et al. 2010 on relative volumes of chemical use comparing Norway, Chile and Canada). Parker’s comment does suggest that the specificity of local conditions is important to understand, which is exactly what fishermen called for with respect to Southwest New Brunswick. Further, many of the recent scientific studies into cumulative effects of chemical use in the Bay of Fundy also call for more research (see for example, Jackman et al. 2010).

With reference to the map we included in the policy brief, Parker states that many of the sites marked there “are not in operation”. Under the Province of New Brunswick three bay site policy, sites rotate in operation and must include a fallow year. But fallow sites return to operation and in any case, conditions there may continue to affect wild stocks.

Parker refers to fishery landings and maintains that there “is little change in traditional catches”. This is certainly not true for all species. While our study made no mention of landings, fishermen in our study did note that the cost to fishermen of achieving those landings has changed. And unlike Walters’s earlier findings, which relate primarily to Grand Manan, the fishermen in our study area continue to fish within the same waters that are occupied by aquaculture operations.

Finally, with respect to the Aquaculture and Traditional Fisheries Working Group, our *Human Ecology* paper outlines the

breakdown in communications that led to the fishermen’s organizations walking away from that table. This breakdown in communication related to the introduction of well boats for the application of sea lice chemicals and the assurances made to the working group that if fishermen supported the introduction of well boat protocols, the aquaculture operators would utilize hydrogen peroxide instead of pesticides. Fishermen later discovered that without informing those at the working group table, the Province of New Brunswick on behalf of the aquaculture industry had applied for and received emergency registration for the use of pesticides in well boats.

Fishermen sit on and participate in many management institutions, including stock management committees. As fishermen noted, however, being invited to the table to be told what will happen is not the same as working together to improve the management of ocean resources. Unlike Walters, we have confidence that local knowledge collaborations can be an important source of both questions and information for resource managers.

References

- Burrridge, Les, Judith S. Weis, Felipe Cabello, Jaime Pizarro, Katherine Bostick. 2010. Chemical use in salmon aquaculture: A review of current practices and possible environmental effects. *Aquaculture* 306:7-23.
- Fisheries and Oceans Canada. 2010. Aquaculture in Canada. Socio-Economic Impact of Aquaculture in Canada. Available on the web at: <http://www.dev.ncr.dfo-mpo.ca/aquaculture/ref/aqua-es2009-eng.htm>
- Fairchild, W.L., Doe, K.G., Jackman, P.M., Arsenault, J.T., Aubé, J.G., Losier, M., Cook, A. M. 2010. Acute and Chronic Toxicity of Two Formulations of the Pyrethroid Pesticide Deltamethrin to an Amphipod, Sand Shrimp and Lobster Larvae. *Canadian Technical Report of Fisheries and Aquatic Sciences* 2876.
- Gustafson, Bob. 2010. Aquaculture. Test of Alphamax Shows Results....or does it? Are salmon pen pesticides killing lobster? *The Working Waterfront*, Thursday, December 30th.
- Jackman, Paula, Ken Doe, William Ernst, and Les Burrridge. 2010. Azamethiphos Toxicity to Marine Aquatic Organisms. Pp. 39-42 in M. D. B. Burt and P. G. Wells (Eds). Threats to the Health of the Bay of Fundy: Potential Problems Posed by Pollutants. *Proceedings of a Workshop organized under the auspices of BoFEP’s Working Group on Stress and Cumulative Effects*, Fairmount Algonquin Hotel, St. Andrews, New Brunswick, 30 April 2010. Bay of Fundy Ecosystem Partnership, Technical Report No. 5. Bay of Fundy Ecosystem Partnership, Wolfville, NS. 72 p.
- Wiber, M. G., Sheena Young and Lisette Wilson. 2012. Impact of Aquaculture on Commercial Fisheries: Fishermen’s Local Ecological Knowledge. *Human Ecology*. Available to subscribers on the web at: <http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s10745-011-9450-7>