Agenda item 6.2
For information

Council

CNL(16)44

Aquaculture Management in Canada:
Advancing NASCO's International Goals

(Tabled by Canada)

AQUACULTURE MANAGEMENT IN CANADA: ADVANCING NASCO'S INTERNATIONAL GOALS

1. Overview of Canada's salmonid aquaculture in the North American Commission area

As a Party to NASCO and a member of the North American Commission, Canada supports NASCO's international goals to minimize impacts of aquaculture on wild Atlantic salmon, as expressed in the Williamsburg Resolution. Canada recognizes that interactions between farmed and wild Atlantic salmon must be avoided where possible, and minimized and mitigated if they do occur.

We also recognize that aquaculture is an important food production system and a significant contributor to stable economic prosperity in many rural and coastal communities and to an increasing number of Indigenous peoples.

Canada's regulatory regime at both the federal and provincial levels can respond best to environmental risks presented by aquaculture activities when these risks are characterized using the best available scientific information and peer-reviewed science advice. Management's decision-making processes are informed by scientific advice so that levels of risk are clearly established and precautionary approaches that protect aquatic ecosystems and the species that depend on them are adopted.

In Atlantic Canada, provincial and federal governments share management responsibilities in a well integrated system. Fisheries and Oceans Canada (DFO) is the federal lead in ensuring that aquaculture is managed sustainably across the country under the *Fisheries Act,* including where the provincial government has a lead leasing or licensing role. The Department has a regulatory role in protecting the environment and supporting the sector's economic prosperity. Provinces in Atlantic Canada issue aquaculture leases and licences. They use their own regulations and conditions of licence for day-to-day management, including, for example, reporting of escapes, fish health monitoring, setting standards for containment structures, collecting information, and maintaining records. Industry also has responsibilities through various Codes of Practice.

Although Atlantic salmon and rainbow trout are grown in the marine environment in Canada's part of the Commission area, natural biophysical and environmental conditions in the majority of the Atlantic region are not favourable to marine salmon aquaculture. Salmon farming is concentrated in the southwest portion of New Brunswick, on the south coast of the island of Newfoundland, and along the Atlantic coast and outer Bay of Fundy of Nova Scotia (Figure 1). In 2014 (the last year for which data are available), 30,000 tonnes of salmonids with a farm-gate value of $209.8 million were produced in these three provinces.

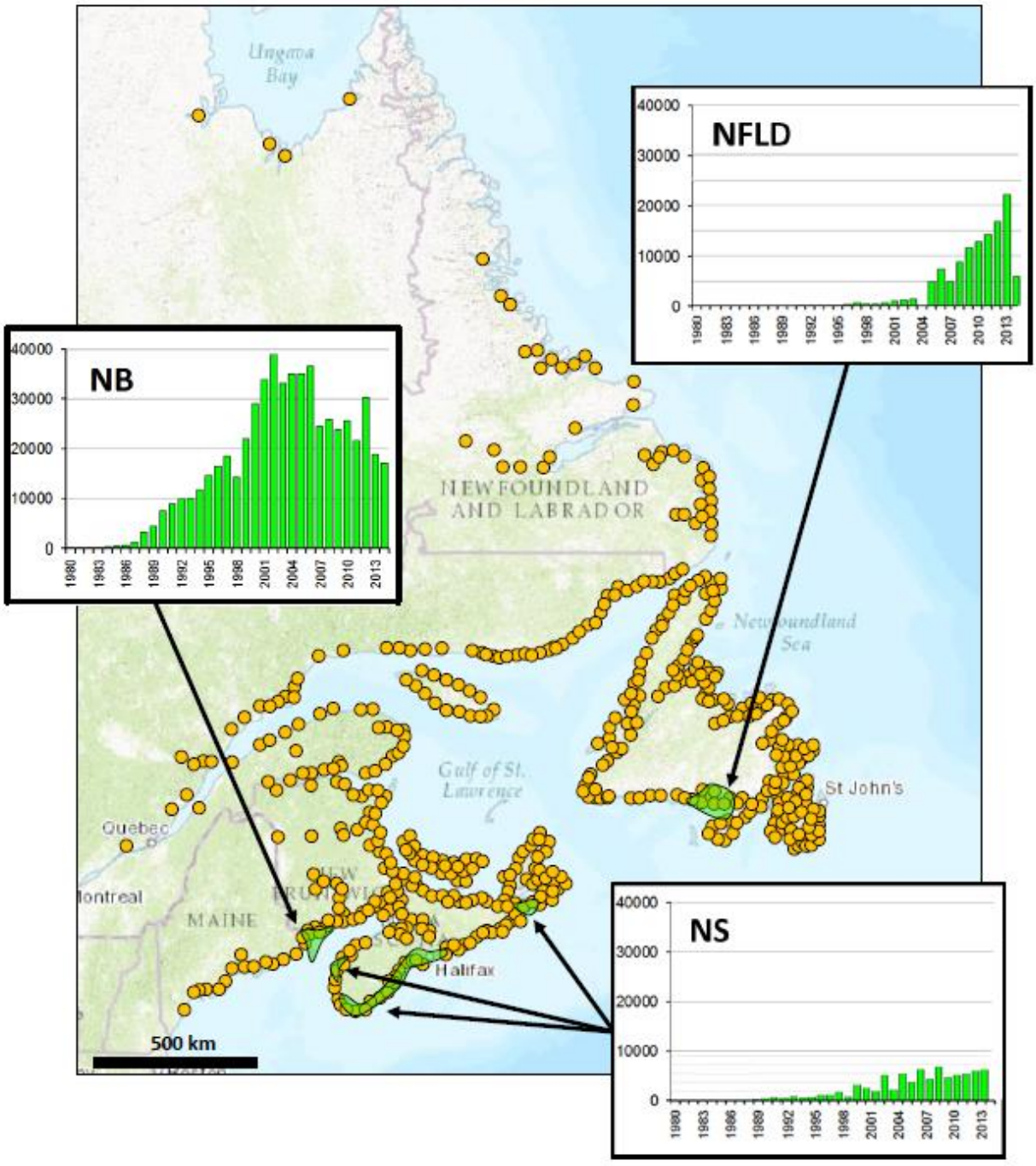

Figure 1: Distribution of Atlantic salmon rivers in eastern Canada indicated by orange circles. Atlantic salmon aquaculture sites are indicated with green shading. Salmonid aquaculture production (in tonnes) by year from the salmon producing areas in New Brunswick, Nova Scotia, and Newfoundland, 1980 to 2014 is shown by the insets.

Conservation and protection of wild species and the aquatic ecosystem are the first and most important responsibilities of Fisheries and Oceans Canada. The federal government and the provinces use responsible and science-based processes for developing policy and making decisions related to siting, management of sea lice, aquatic animal health, genetic and

ecological interactions, and containment to establish and maintain the conditions that allow for sustainable aquaculture development, while protecting wild species and ecosystems, including wild Atlantic salmon.

2. Approach to siting in Atlantic Canada

Siting is one of the most important mitigation measures that governments can use to minimize aquaculture impacts. Many of the potential impacts of aquaculture can be mitigated by applying good siting criteria (e.g., minimizing exposure to wind, avoiding proximity to commercial fishing grounds or currently populated wild salmon rivers, etc.) that are based on the biological and physical processes that characterize potential sites.

Because there are significant concerns with some populations of wild Atlantic salmon in the region, all proposed new sites and applications for expansion are assessed for their potential to result in interactions between wild and cultured salmon. DFO also estimates a site's risk to fish habitat. Where there are significant conservation concerns regarding the status of wild Atlantic salmon stocks, the protections of the *Species at Risk Act* are applied. The Introductions and Transfers Committees oversee and recommend approvals for movement and stocking of fish using assessment criteria based on fish health, genetics, and habitat considerations of the receiving marine and freshwater environments. Eggs are certified as disease-free and smolts are healthy when transferred to the marine environment.

DFO's *Fisheries Act* and the *Aquaculture Activities Regulations* (AAR) are daily operational tools used to manage the direct impact of sites on the marine environment. Under the AAR, licence applicants must provide comprehensive information to DFO related to the predicted contour of the footprint of the biochemical oxygen-demanding matter that will be deposited during farming operations, as well as information on the fish and fish habitat on the seabed and in the water column of the proposed farm site. After all risks have been evaluated, siting advice is provided to provinces which then make the licensing decisions.

3. Management of sea lice in Atlantic Canada

It is generally accepted that the vast majority of wild Atlantic salmon mortalities occur at sea. The ICES Report of the workshop on possible effects of salmonid aquaculture on wild Atlantic salmon populations in the North Atlantic (March 2016), concluded that the downturn in survival of Atlantic salmon during their marine phase "is evident over a broad geographical area and is associated with large-scale oceanographic changes." We have observed this phenomenon in Atlantic Canada where declines in returns of wild salmon have occurred throughout the entire region, even where there is no – and has never been any – marine salmon aquaculture. However, declines have been more severe in the southern regions of eastern Canada.

As noted in the ICES advice, population-level effects of sea lice on wild salmon stocks cannot be estimated independently of the other factors that affect marine survival. At the same time, there is growing evidence that effective sea lice management contributes to more efficient

aquaculture production and reduces the risks of negative interactions with wild Atlantic salmon. Effective sea lice management integrates farm-based systematic monitoring of sea lice abundance on fish with approaches for reducing the sea lice burden. All provinces in Atlantic Canada where salmon are farmed in the marine environment have regulations and/or conditions of licence in place to monitor sea lice and the use of therapeutants.

In Canada, any product used to treat sea lice must be registered with Health Canada under the Food and Drugs Act (for in-feed control products) or the Pest Control Products Act (for bath treatment control products). An environmental risk assessment is conducted before any pesticide product is authorized for sale and on-label use. Once authorized, federal and provincial governments add further requirements governing how products can be deposited.

Nationally under the *Aquaculture Activities Regulations,* licence holders are required to notify Fisheries and Oceans Canada regarding their intent to deposit pesticides, and to report annually on their use of drug and pest control products. Information on deposits of substances collected through the *Aquaculture Activities Regulations* will be publicly reported, with the first report becoming available in early 2017.

As well, Fisheries and Oceans Canada uses its scientific and research capabilities to study sea lice and their possible impacts on both farmed and wild salmon. Some research activities are conducted within the Department, while others are conducted in collaboration with scientists and researchers from universities or governments across Canada, industry, and international partners. Numerous studies have been conducted in the Atlantic and Pacific to look at effects of sea lice on wild salmon, including:

- modelling in support of sea lice management, genomics studies of host-parasite interaction, and other issues,
- measuring and modelling the transport, dispersal and dilution of therapeutants,
- estimating the potential for effects on non-target organisms,
- measuring the degree of therapeutant mixing within treatment containers and the implications to therapeutant efficacy, and
- developing and/or evaluating innovative alternative control measures that could replace the use of chemicals.

Sea lice are ubiquitous in the marine environment. Sea lice abundance in the wild rises in the spring in association with warming water temperatures and decreases in winter as annual temperatures reach their minima. The greatest risks of adverse effects from sea lice are on the smaller and early marine migration phase of juvenile Atlantic salmon. Wild Atlantic salmon smolts migrating out from rivers between mid-April and early June would likely encounter the initial build-up of sea lice as they become physiologically more active in the warming sea temperatures in late spring (i.e., >5^{o}C). This situation is even more challenging for the smolts that remain close to shore where they are also susceptible to a variety of other stressors.

On salmon farms where sea lice abundances are amplified, the aquaculture industry undertakes mitigation strategies as part of management programs to keep sea lice abundance low during

the warmer months (late April – October). Based on advice from veterinarians, operators may also employ the strategic use of chemotherapeutants as necessary. In choosing which therapeutants to use, veterinarians base their decisions on a range of biological and environmental factors, and product characteristics.

Adult salmon returning to rivers to spawn in the spring (and in the fall in some regions), are unlikely to be significantly affected by sea lice as lice cannot survive in freshwater environments. Additionally, these larger mature salmon are less impacted by sea lice infestations, although mortalities can still occur.

Figure 2 shows that smolt out-migrations and returns of adults to rivers in Canada's Atlantic region occur at times when sea lice abundance is at its hypothesized natural peak in the wild but at its lowest levels on farms because of treatment.

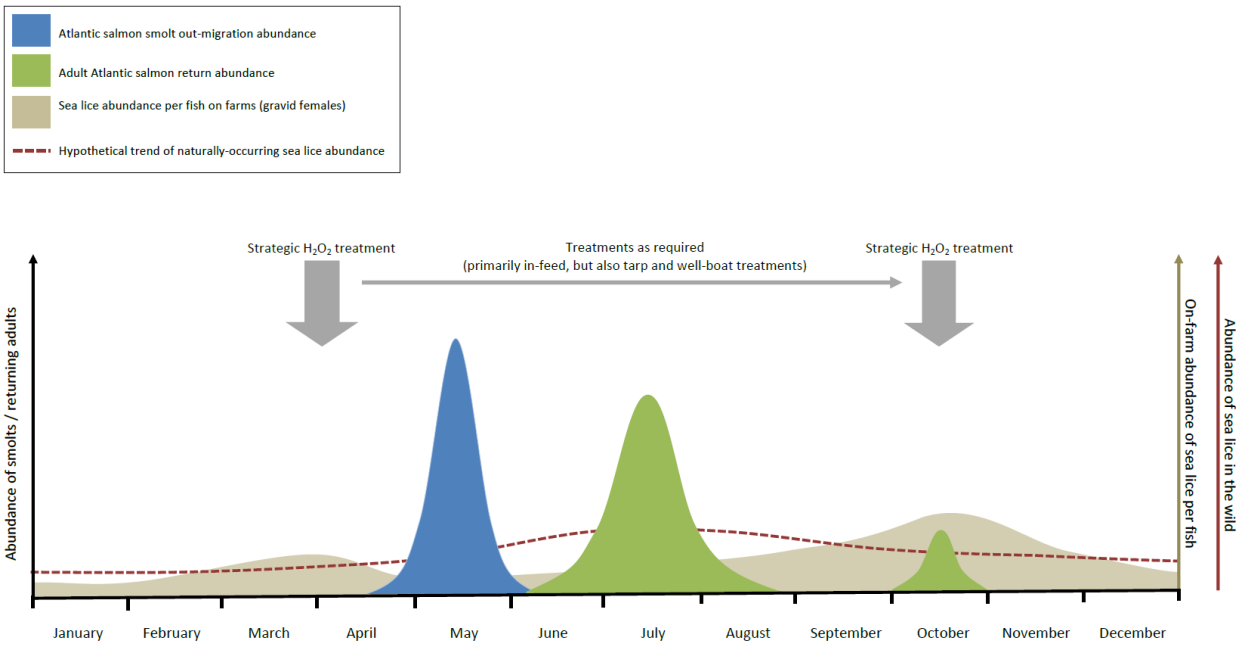

Figure 2: Generalized abundance trends for Atlantic salmon smolt out-migration and adult returns in Atlantic Canada, gravid female sea lice per fish on Atlantic salmon farms, and a hypothesized trend for naturally occurring sea lice abundance per wild fish.

The need to develop treatments for pests and pathogens that are effective but have minimal environmental impacts is a challenge for all salmon-farming jurisdictions. In the past, Canadian companies had access to only one in-feed drug to control sea lice. Over the past eight years, emergency registrations of pesticides made additional treatments available, although these have also posed risks. Due to the decreasing efficacy and environmental impact of both drug and pesticide treatments, companies and governments have continued to invest in research to explore a variety of methods for the control of sea lice on farmed fish, including new and experimental approaches such as warm-water showers, vaccines, or the use of cleaner fish.

Recently, full registration of hydrogen peroxide has provided another, more benign option for treatment of sea lice. In Atlantic Canada in 2013 Salmosan® and Paramove® were used to treat sea lice events but 99 per cent of the volume of treatment product used was Paramove®, the active ingredient of which is hydrogen peroxide.

Canada will continue to manage potential aquaculture impacts from sea lice on wild Atlantic salmon populations through rigorous and scientifically-informed regulations, applied at both the federal and provincial levels. To support this objective, ongoing, systematic monitoring of wild juvenile salmonids should be evaluated in order to assess the efficacy of sea lice management strategies, while taking into consideration the conditions imposed by the at-risk status of Atlantic salmon in some provinces and sub-regions.

4. Managing escapes through effective containment

Canada agrees with the NASCO objective, expressed in the Williamsburg Resolution, of minimizing escapes of farmed salmon "to a level that is as close as practicable to zero." Indeed, it is always the objective of regulators and farmers to ensure that 100 per cent of farmed salmon are retained on all production sites as escapes represent a significant economic loss to fish farmers.

Effective containment techniques and prompt reporting of breaches are essential to reducing and eliminating competition for food and potential genetic interactions between wild and farmed Atlantic salmon. Consequently, every effort in the areas of technology, science, and regulatory enforcement is being employed to ensure that containment structures are strong and breaches are reduced to the lowest level possible, even though the impact of genetic introgression of farmed fish on wild population fitness is currently unknown.

Containment practices are managed by provincial authorities in Atlantic Canada by means of regulations, conditions of licence, and adherence to codes of containment. All provinces require cage structures to be designed, installed and maintained to limit the risk of a breach. Fisheries and Oceans Canada has undertaken analyses and provided scientifically peer-reviewed advice on the technological, oceanographic, and training considerations that are critical to the design of net pen containment structures to optimize structural integrity, and therefore minimize the likelihood of breaches.

If and when breaches do occur, companies must implement pre-developed and approved response protocols and report to provincial authorities within a prescribed period of time. Industry has additional responsibilities established through Codes of Containment. In New Brunswick and Nova Scotia, adoption of the Code is voluntary; in Newfoundland, it is incorporated by reference into conditions of licence. In the event of an escape, Fisheries and Oceans Canada must be notified so that recapture licences can be issued, should recapture be a viable option.

Data on salmonid escapes are reported to NASCO annually through the North American Commission (Figure 3). Accounting for inventory in marine cages remains a difficult task. Large breaches are readily identified and reported, but trickle losses from marine production are difficult to estimate. Moreover, recapture programs for escaped salmon in the marine environment are not generally effective.

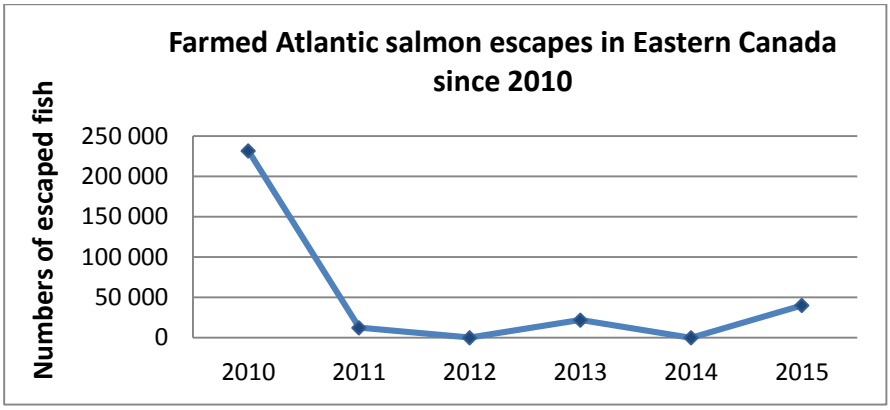

Figure 3: Reported numbers of farmed Atlantic salmon escapes in Atlantic Canada reported to NASCO through the North American Commission, 2010 - 2015.

All provinces and stakeholders have worked, and continue to work, to reduce escapes. New Brunswick has revised its Governance Framework for Containment and is working on changes to its Aquaculture Act and General Regulations. The Government of Nova Scotia's new Aquaculture Management Regulations require finfish licence holders to include a containment management strategy in their Farm Management Plans. This strategy must be audited by a third party annually and immediately following any reported breach. Marine cage site designs must also be approved by a qualified engineer before deployment. The Newfoundland and Labrador Code of Containment, reviewed annually, continues to be implemented as a condition of the aquaculture licence. Discussions continue on developing a Pan-Atlantic approach to containment.

The Government of Canada is neutral on the technological approach for environmental challenges; it sets performance and outcome standards through policy and regulations and leaves it to industry and innovators to find and implement optimal technological advances. Fisheries and Oceans Canada has made significant scientific and financial contributions to a number of different types of containment projects, including the development of closed containment technology. However, based on all the information available, particularly data coming from a DFO-funded closed containment facility in British Columbia, this technology is not yet ready for commercial application.

The Williamsburg Resolution encourages the use of reproductively sterile salmonids provided the risk of adverse effects on wild salmon stocks is minimal. The use of triploids presents the opportunity to significantly decrease the risk of successful interbreeding between wild and farmed Atlantic salmon. Further, improvements in technology have resulted in considerable

success in achieving high levels of triploid induction. Moreover, the production of all-female triploids offers the further advantage of minimizing potential ecological interactions from escapees, such as competition for reproductive resources.

5. Conclusion

Canada is committed to working collaboratively with all salmon-producing countries to share best practices. Every year since 2008, Canada, Norway and Scotland have met to discuss aquaculture management practices based on science advice that supports regulatory decision making, particularly with respect to salmonids. In 2012, Chile joined this group, and in 2015, the four countries signed a Joint Statement on Aquaculture. The Joint Statement supports further collaboration and sends an important signal that the four governments are working together to raise the bar for sustainable aquaculture management in each country.

Fisheries and Oceans Canada is committed to ongoing engagement with provinces, territories, Indigenous nations and all stakeholders. Further, we are committed to transparency in public reporting and accountability in the management of the sector. We are aided in these respects by the efforts of industry whose members have taken additional steps to become certified to rigorous and credible third-party standards that include the four pillars identified by the FAO as necessary for responsible aquaculture: food safety, animal welfare, environment, and social responsibility. All salmon production entering the market from companies in the Atlantic region is certified according to these criteria. Most companies also produce annual sustainability reports documenting their management practices and progress towards identified objectives.

The current Canadian management approach has provided federal and provincial regulatory authorities with a framework through which to identify the impacts of aquaculture on the conservation of Atlantic salmon, their habitat, dependent ecosystems, and environmental sustainability. However, there remains an ongoing and crucial need for improved knowledge to enable the implementation of stronger and better-integrated monitoring programs for sea lice and genetic interactions. In particular, we need to be able to discriminate aquaculture impacts from those of other human and ecological impacts as they affect wild salmon populations. This knowledge could be used to inform the assessment of environmental risks, the choice of effective indicators to monitor impacts, and the establishment of acceptable tolerance levels.

To that end, Fisheries and Oceans Canada and provinces will continue to work on:

- Minimizing interactions between farmed and wild species;
- Implementing and enforcing regulatory regimes to maintain the overall risk from aquaculture at a minimal and acceptable level;
- Encouraging best management practices, making use of all new scientific knowledge and innovative solutions;
- Studying, modelling and assessing the risks and impacts of pathogen and sea lice transmission between wild and farmed salmon, the fate and effects of sea lice pesticides

on non-target organisms, and alternate tools for the management of diseases and sea lice;
- Conducting studies on the fate, influencing factors, and genetic and ecological impacts of escapement; and
- Developing genetic tools to identify the genetic profile of Atlantic salmon (i.e., wild stocks, escapes, and wild-escape hybrids).

Collectively, these will contribute towards Canada's management of a sustainable aquaculture sector, while meeting various international obligations to conserve and protect wild Atlantic salmon, and minimize impacts on them from all sources.