

# 2018 New Brunswick Annual Sea Lice Management Report

Prepared by the Atlantic Canada Fish Farmers Association (ACFFA)

*Data for this report is generated from the Fish-iTrends Decision Support System. Fish-iTrends is the data collection system developed by the Atlantic Veterinary College (AVC) at the University of Prince Edward Island for use by the Atlantic Canadian salmon farming industry. This system is maintained by the AVC who has acted as a third-party monitor of data submissions by salmon farmers. Provincial fish health personnel have ongoing access to this data; AVC or regulators perform third party audits of the salmon farm lice counts to verify accuracy in reporting.*

*To further support this system and ensure data accuracy, the ACFFA supported the AVC in the development of a sea lice monitoring certification program for farm technicians. Training helps to ensure accurate counts are based on the Sea Lice Monitoring Program, a requirement under the New Brunswick Aquaculture Act and General Regulations and the Integrated Pest Management Plan for Sea Lice.*

## ACRONYMS

<b>ABMA</b>	Aquaculture Bay Management Area
<b>EDRs</b>	Emergency Drug Releases
<b>NBDAAF</b>	New Brunswick Department of Agriculture, Aquaculture and Fisheries
<b>DFO</b>	Department of Fisheries and Oceans
<b>PMRA</b>	Pest Management Regulatory Agency
<b>VDD</b>	Veterinary Drugs Directorate

## EXECUTIVE SUMMARY

The three-year Aquaculture Bay Management Area System (ABMA) implemented in New Brunswick (See map in Appendix A) not only supports improved environmental management but it has also provided the basis to improve fish health management practices, including sea lice management. Principles within the ABMA system include:

- Mandatory fallowing of production sites and the bay management area to help break pathogen lifecycles and support breaking the life cycle of sea lice;
- Single year class stocking at each farm site and within each management area; preventing older farmed salmon, which may have already been exposed to pathogens / parasites, from transferring it to incoming smolts.

In 2018, salmon farming companies continued to develop a sea lice management and treatment strategy in each Bay Management Area, product rotations and synchronized treatment strategies. Like all farmers, they relied on the professional advice of veterinarians who have access to approved products for use when animals are infected by a pathogen or threatened by parasites. All in feed sea lice treatments were authorized through a veterinarian's prescription and all treatments were reported to federal and provincial regulators.

Water temperatures and salinity continued to play an important factor in the management of sea lice impacts on fish farmers in the Bay of Fundy. As shown in Figure 1, water temperatures in 2018

in southwest New Brunswick rose through the early summer and remained unseasonably high until November. The highest average water temperature recorded over this six year period occurred in September, slightly above 2016 values. Average water temperatures were above 13°C for approximately one and half months between July and September. 2018 saw the coolest water temperatures since Fall 2013.

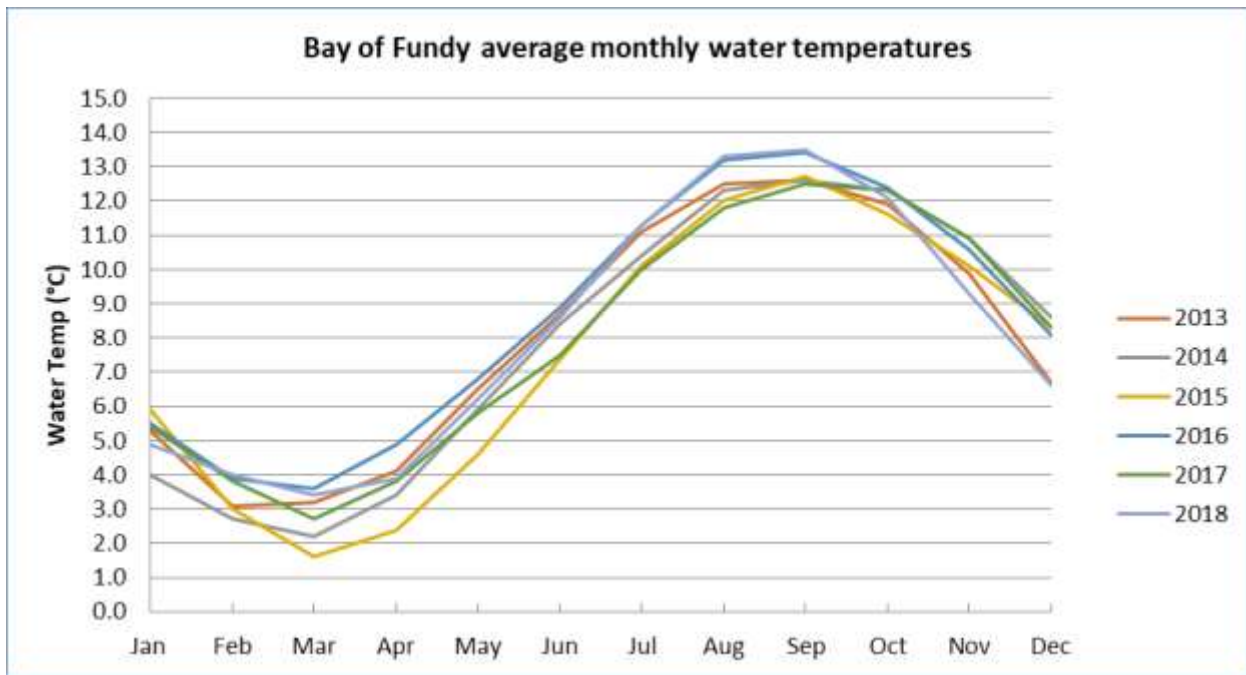


Figure 1: Average monthly water temperatures for 2013-2018

This report on sea lice management is based on the 2018 data obtained through individual farm reporting and data analysis of the sea lice counts within the specific ABMAs. The data represents the average sea lice count for adult female lice, which are indisputably the most critical life stage to control and the life stage generally reported by other jurisdictions.

### **BACKGROUND**

Sea lice are naturally occurring parasites that feed on the skin and mucous of both wild and farmed salmon. The salmon sea louse cannot live in the fresh water of our hatcheries - therefore all smolts are free of sea lice before they enter the net pens. However, since sea lice can pass through the netting of the pens, farmed salmon may become infected with the sea lice carried by wild salmon or other fish in the surrounding water. Since this parasite cannot be eliminated from the marine environment, salmon farmers have developed management practices that reduce the likelihood of infection<sup>1</sup>.

These practices include:

- Selecting new farm sites with good flushing and water current
- Production sites are emptied of all farmed fish for periods of time (fallowed). Without a host, the sea lice population declines

<sup>1</sup> <http://www.aquaculture.ca/files/species-salmon.php>

- Only farmed salmon from a single year are present at each farm site – this prevents older farmed salmon (who may have received the parasite from the wild salmon) from transferring it to incoming smolts
- Employing bay management systems where hydrographic conditions severely reduce the possibility of year-class carry-over

Increasing ocean temperatures over prolonged periods of time and later in the year are having an impact on the number of sea lice in the Southwestern New Brunswick by reducing the number of weeks to reach the female adult stage by 60% (Figure 2).

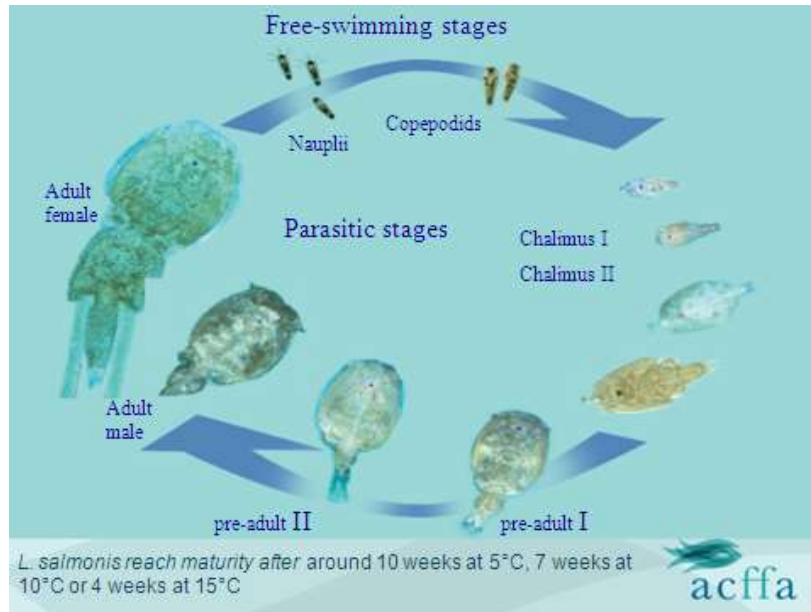


Figure 2: Maturity stages of *L. salmonis*

Therefore, salmon farmers have continued to invest in the development of proactive management practices to reduce the likelihood and severity of infestations. All farmed salmon enter the marine environment disease and parasite free. However, because sea lice travel on wild fish, ocean currents and even in zooplankton, they can move freely between both wild and farmed fish.

In 2000, salmon farmers around the world acquired access to an anti-parasitic chemo-therapeutant, emamectin benzoate – the active ingredient in SLICE®. This was the only product available for use in Canada until 2009.

In 2008, New Brunswick farmers observed a reduced efficacy to SLICE®. It was then that the New Brunswick salmon farming industry worked with federal and provincial governments, scientists and the National Fish Health Working Group to research and evaluate effective alternative options for controlling sea lice and promoting overall fish health management. The European aquaculture industry has had access to a variety of sea lice management tools for over a decade. Recognizing this, the Atlantic Canada salmon farming industry collaborated internationally and continues to do so for evaluation and research of new sea lice management opportunities. The objective is to find new tools that will augment and/or replace management practices already in place.

Efforts by salmon farmers to make real and lasting progress to support integrated pest management has been difficult. Fundamental to any integrated pest management plan (IPMP) is access to a variety of treatment options. In the past, there have been challenges in getting timely authorizations and/or permits to support the evaluation or use of products under alternative delivery methods.

Canada is the only jurisdiction that requires separate approvals from companies producing the active ingredients in treatment products used in commercial sea lice treatment products. Canada still does not have access to the same products that have been used in other jurisdictions for up to a decade. Not all products are appropriate for all life stages of lice. Furthermore, addressing sea lice impacts is further complicated by environmental conditions such as high winds and factors such as salinity and water temperature.

Scientific studies have shown that young pink salmon mount an effective immune response to sea lice infection<sup>2</sup>. This immune response causes the lice to be shed from the salmon – and thereby protects the young salmon from illness or death due to sea lice infection. Feed formulations have been developed, many using natural ingredients that can inhibit sea lice from attaching to farmed salmon or boost the salmon’s immune system. These feeds are being used in Norway and in the EU. It is of consumer interest to note that while humans can consume some of these feed ingredients and fish that have been fed these ingredients are being imported for sale in Canada, they are not permitted for direct use in Canada. Yet, after nearly seven years, the Canadian Food Inspection Agency has not amended their list of approved ingredients for infeed products.

In addition to issues affecting access to treatment options or functional feeds, records maintained by salmon farmers show that water temperatures in New Brunswick waters continue to increase. We began to see a trend of increases by 2 degrees centigrade above historical levels in 2009; this trend has continued. We are seeing these high water temperatures maintained for longer periods and on average later in the year than we have seen in the past.

Traditionally, sea lice populations on salmon farms can be very low January through to June and to ensure that low sea lice abundance is maintained, strategic spring treatments begin in April / May where required. This minimizes the risk and ensures that any wild salmon leaving rivers are not exposed to sea lice from salmon farms. When water temperatures cool, farmers will again do a strategic final treatment to reduce lice prior to winter. The timing of treatments throughout the year is determined on an as needed basis.

## **CURRENT MEDICINAL SEA LICE TREATMENT OPTIONS**

### ***An Overview of International Options***

There are a range of compounds available internationally for sea lice management. These include:

- |                       |                                   |
|-----------------------|-----------------------------------|
| 1. Avermectins:       | SLICE®, Ivermectin                |
| 2. Chitin Inhibitors: | Calicide                          |
| 3. Organophosphates:  | Salmosan                          |
| 4. Pyrethroids:       | AlphaMax, Excis                   |
| 5. Hydrogen Peroxide: | Interox Paramove 50, Aquaparox 50 |

These products have been available for many years in other jurisdictions including Norway, the UK and Chile. In the USA, Maine has used Excis, Avermectins and Interox Paramove 50 under an Investigational New Animal Drug (INAD) permitting process. Extensive international research is available to provide data to support Canadian risk assessments through Health Canada for Emergency Drug Releases (EDRs) or Emergency Registrations (ERs) pending local monitoring and surveillance data collection to complete full registrations of the products.

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<sup>2</sup> <http://www.aquaculture.ca/files/species-salmon.php>

## ***An Overview of Canadian Options***

All in-feed products listed below are only available through a prescription by a veterinarian. Use of all products is reported to both federal and provincial regulators.

### **1. Salmosan®**

Salmosan® was previously registered and administered on New Brunswick farms in the 1990s and the registration lapsed when SLICE® was introduced. The Province received an ER for Salmosan® in November 2009. This permit was subject to scientific monitoring, and this sediment and water quality testing has shown little to no impact as a result of Salmosan® treatments (More information can be found at [www.atlanticfishfarmers.com](http://www.atlanticfishfarmers.com))

An ER permitting the use of Salmosan® through well boat treatments was granted in August 2010. However in 2010, PMRA imposed a limit of 2800 grams per day of Salmosan®; allowing the treatment of approximately two net pens per day, depending on cage size, at a farm site. This restriction meant that on-farm sea lice could not be quickly eliminated and additional treatments were required. This product use restriction was eventually changed to limit the number of treatments completed per day but to avoid the risk of tolerance developing, the farming industry avoided product use in 2011 and again in 2012. The ER approval granted for product use June 2013 to June 2014 was again changed to reflect data provided by the ACFFA and the Province removing the limit on the number of cages that can be treated per day. The 2016-2017 restriction for tarp treatments was on the number of net pens that can be treated simultaneously on one site. For well boat treatments, a maximum of three net pens could be completed per day per farm.

Pending full license approval of Salmosan®, yearly applications for access to this product must be submitted to PMRA. Due to the timing of the approval (November 4, 2010) and conditions that had to be met prior to use, many salmon farms did not have sea lice treatment product available for several weeks at a time when water temperatures remained high and new generations of sea lice were developing. This resulted in a significant increase in sea lice populations and impact to farm fish health that was beyond the control of the salmon farmer and is another example of where regulatory bottle-necks impact IPMP for sea lice.

Full product registration of Salmosan® with PMRA occurred in September 2017, though the industry operated under the ER until it expired on December 31, 2017.

### **2. Interlox Paramove®50 / AQUAPAROX 50**

Interlox Paramove®50 is a hydrogen peroxide product, benign in the environment, degrading quickly to water and oxygen. Approval for use of this product through an ER was received June 11, 2010 and the first application occurred on June 26, 2010. By that time water temperatures in the area with the highest sea lice counts were already 14 + degrees – well above the recommended high of 12 degrees.

Like Salmosan®, new ER applications for use were submitted annually. Over time, the salmon farming industry has developed protocols to enable the use of this product with minimal negative impact to our farm stock using a lower dose and at temperatures above 12 degrees, but this also means reduced efficacy.

Full product registration of Interlox Paramove®50 with PMRA occurred in March 2015. Another hydrogen peroxide product, Aquaparox 50 was registered in September 2016.

### **3. Avermectin**

Avermectins such as SLICE® and Ivermectin may be used as an in-feed sea lice treatment under a veterinary prescription, licensed through Health Canada's Veterinary Drug Directorate<sup>3</sup>. The Veterinary Drugs Directorate (VDD) evaluates and monitors the safety, quality and effectiveness, sets standards and promotes the prudent use of veterinary drugs administered to food-producing and companion animals.

### **4. Calicide®**

Calicide® is an in-feed treatment. Because Calicide® affects only early life stages of sea lice, administration timing was essential; it was also most effective when used in conjunction with bath treatments that affect later stages of sea lice. Use by the industry has been limited and as a result, producers have chosen not to maintain a supply of this product in Atlantic Canada.

### **5. Leufeneron**

Licensed in other countries, Leufeneron is an in-feed treatment given to smolt while in freshwater, prior to salt water transfer. It is only available from Health Canada's Veterinary Drug Directorate under an Emergency Drug Release and to date has been used for field trials in 2017 and 2018.

## **CURRENT ALTERNATIVE SEA LICE TREATMENT OPTIONS**

### **Non-Chemotherapeutant Control Strategies**

Non-chemical control strategies such as cleaner fish, hydrolicers and warm water baths, are being used in controlling on-farm sea lice in several locations. The use of these non-chemical control strategies does not necessarily remove the need for therapeutant options as many of these alternatives involve physical handling of the fish which can be an animal welfare concern at high water temperatures. As there are currently only three units in operation in New Brunswick, these vessels cannot treat all the salmon required at this time.

#### **Warm Water Treatment**

The fish are corralled and pumped into the system where they pass through water at 32–36 Celsius degrees, depending on ambient sea temperature, for 25–30 seconds. The treatment water is filtered, aerated, oxygenated and reused in the system.

#### **Water Pressure Treatment**

With the water pressure unit (hydrolicer), the water pressure comes from behind the fish as they move through the system such that the lice cannot hold on to the fish and are removed. The treatment water is filtered, aerated, oxygenated and reused in the system.

## **RESEARCH AND ALTERNATIVE SEA LICE MANAGEMENT OPTIONS**

The ACFFA has played an active role on behalf of our industry working with researchers from government, academia, private institutions, and with industry at the regional, national and international level. Collaborative and coordinated research to support effective sea lice management has commonly focused on five key areas:

### **1. Regulatory Research**

- To support the evaluation, licensing and use of new treatment options

### **2. Environmental Dynamics**

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<sup>3</sup> <http://www.hc-sc.gc.ca/ahc-asc/branch-dirigen/hpfb-dgpsa/vdd-dmv/index-eng.php>

- To provide necessary answers regarding potential risk to the marine environment and non-target species as a result of sea lice management activities
- 3. Management Practices**
  - To support improved on-farm sea lice management practices
- 4. Novel Treatments / Green Technology**
  - Evaluation of non- chemical management options in addition to new technology to reduce the potential environmental impact of sea lice management and improve sea lice management performance
- 5. Modelling**
  - Collecting and using data to evaluate the effectiveness of sea lice management activities and/or to provide information on means of improving the effectiveness of new or current technologies

Industry continues to make significant financial and human resources investment since 2010 to support research critical to improving knowledge and understanding of sea lice dynamics and management.

The ACFFA regularly publishes proceedings from workshops at <https://www.atlanticfishfarmers.com/research-and-innovation>. Results from all collaborative research is publicly shared through workshops, communication with stakeholder groups at a variety of meetings, as well as industry and DFO websites. Interim research data from private and academic research is often available at these workshops and published as part of workshop proceedings.

Some examples that we can report from this research program include:

- ✓ The Fish-iTrends Decision Support System operated by the University of Prince Edward Island, continues to provide an online data management system that records all sea lice population data; these data are verified by a third-party audit and are being used to evaluate the effectiveness of sea lice management;
- ✓ Well boats and tarpaulins have been introduced to ensure all sea lice bath treatments are performed in closed systems, significantly reducing potential environmental impact and the quantity of products required for effective sea lice treatments
- ✓ Hydrological surveys to determine possible refinements to the current Aquaculture Bay Management Areas.
- ✓ Implementation and adjustment of alternative lice removal technologies (e.g., warm water)

Local research is continuing. Projects underway include:

- ✓ Evaluation on the use of cunner and lump fish as a sea lice cleaner fish;

#### **NON-TARGET SPECIES**

Wild salmon populations in Atlantic Canada fluctuate in a similar manner in areas both with and without salmon farms. Sea lice populations on salmon farms during the out-migration period are very low and pose little risk to wild smolt. There has been a range of field research and scientific monitoring conducted on all sea lice bath treatment products both in Canada and in other jurisdictions.

There have been no significant changes in the landings for the traditional fishing sector since 2007<sup>4</sup> while lobster landings have steadily increased since 1999<sup>5</sup>. To view fishery data visit <http://www.dfo-mpo.gc.ca/stats/commercial/sea-maritimes-eng.htm>

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<sup>4</sup> <ftp://ftp.fao.org/FI/STAT/summary/a1a.pdf>

<sup>5</sup> <http://www.dfo-mpo.gc.ca/fm-gp/sustainable-durable/fisheries-peches/lobster-homard-eng.htm>

## SEA LICE MANAGEMENT ON FARMED SALMON 2018

In 2018, Avermectins were used in-feed with Salmosan®, Aquaparox 50 and Interlox Paramove®50 used in closed treatment systems. A number of non-chemical control strategies including a hot water shower system was implemented in spring 2017 for certain sites and cleaner fish were introduced at more farms in 2017. As well a vessel equipped with a Hydro-Licer unit was used in some specific locations. This system mechanically removes the lice by passing the fish through a series of pumps. These new strategies will continue to be implemented and expanded as they become more effective.

Salmon farming companies continue to prepare a coordinated sea lice management and treatment strategy that includes controlling lice numbers in each Bay Management Area, product rotations and synchronized treatments. This strategy is communicated to traditional fishing groups and a meeting was held to provide details on an area-by-area basis.

As shown in Figure 3, cooler water temperatures experienced kept sea lice numbers relatively low on most farms until mid-April leading into the traditional strategic spring treatment using warm water treatments initially and Interlox Paramove®50 on May 3<sup>rd</sup>.

It was mid-June 2018 before the water temperatures increased above 10 degrees Celsius, a month earlier than 2017, and once temperatures did increase, they again held for an extended period contributing to sea lice populations into mid-December. Salmosan® in full tarps began to be used in July and its use continued into October.

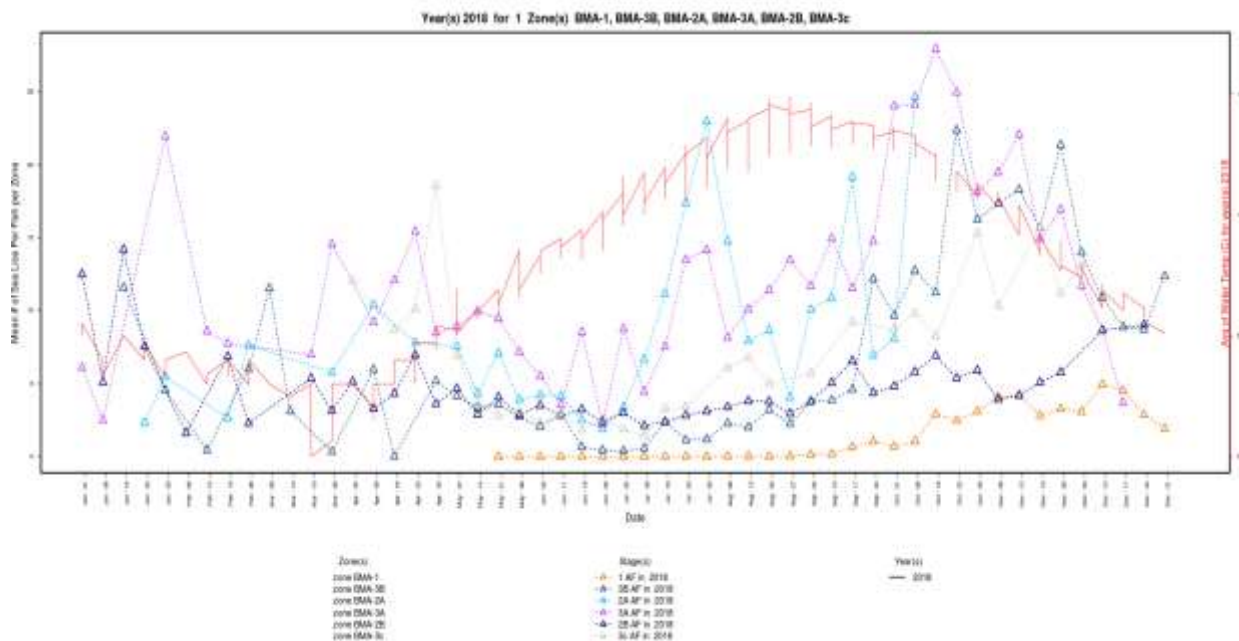


Figure 3: Average adult female *Lepeoptherius salmonis* sea lice per BMA and average water temperature for 2018

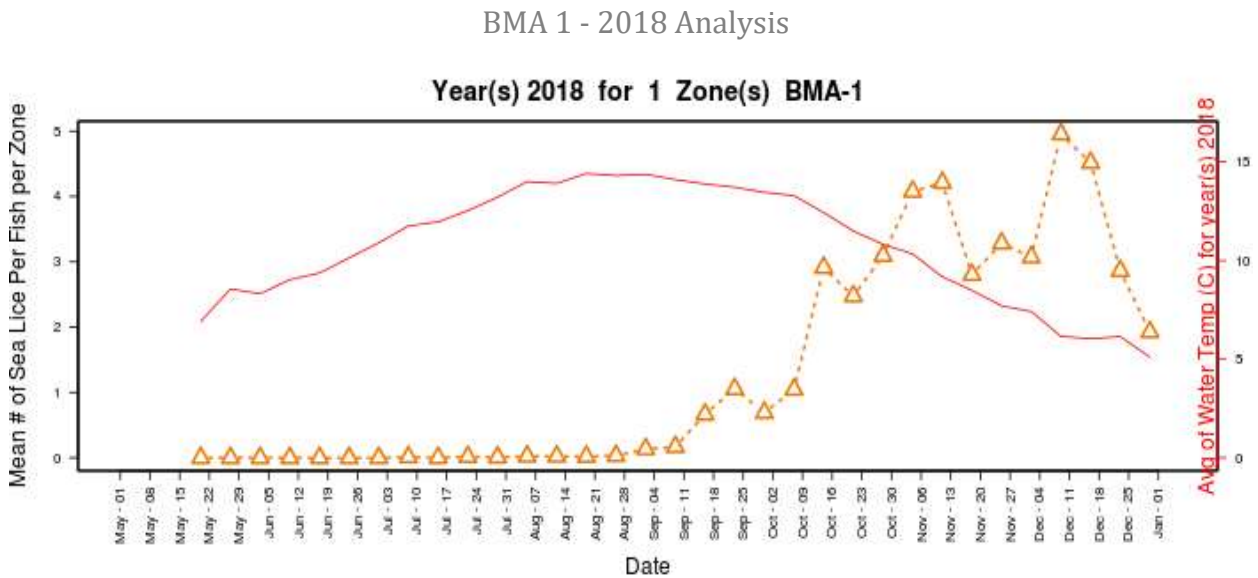
## 2018 ANALYSIS BY BAY MANAGEMENT AREA



The following data charts are generated from the Fish-iTrends data base system developed in 2009 through collaboration with the Atlantic Veterinary College at the University of PEI. Fish-iTrends supports sea lice management by the Atlantic salmon farming industry.

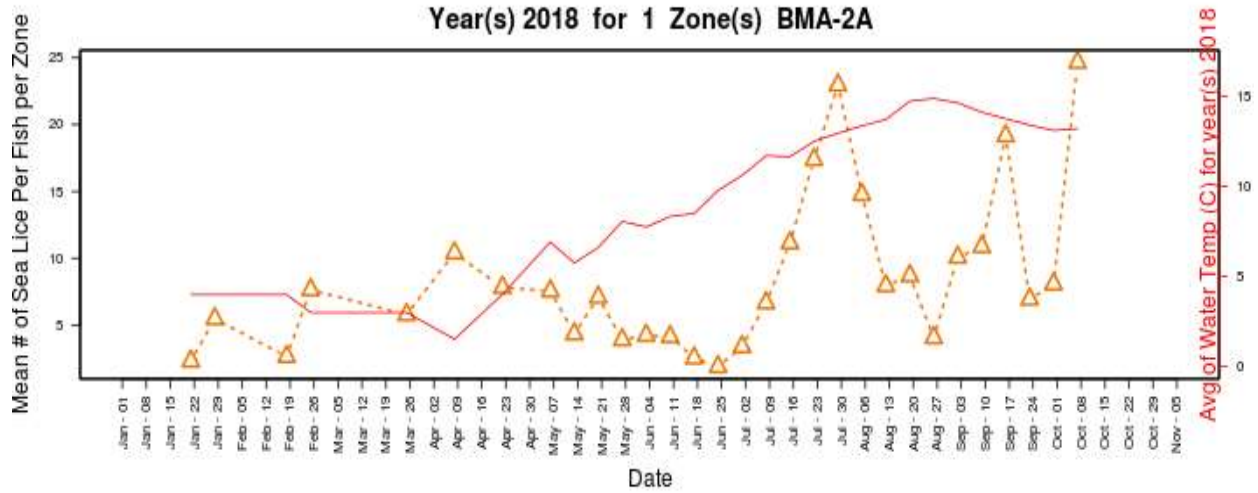
Charts for each Bay Management Area contain the average count, by month, for adult female *Lepeoptherius salmonis* sea lice. These lice are considered the most critical to the management of sea lice populations within a salmon farm. Information specific to the management area is provided below.

Note that the Y-axis scale (numbers of lice) varies from one graph to another.



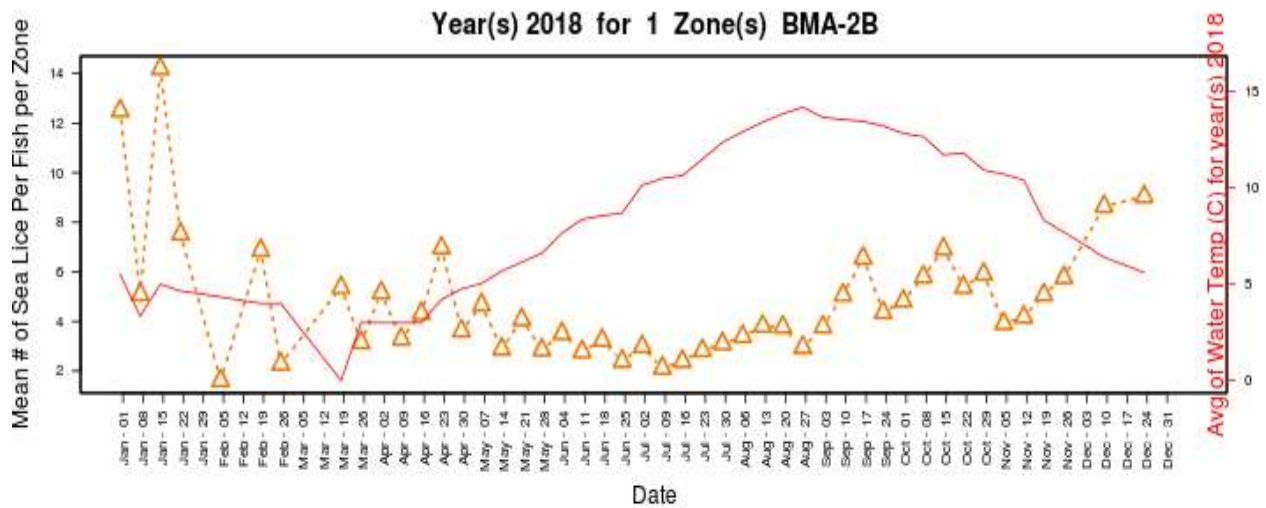
**2018** – First year fish. Primarily in-feed products and three warm water treatments. Nine bath treatments occurred over November and early December using hydrogen peroxide almost exclusively

BMA 2A – 2018 Analysis



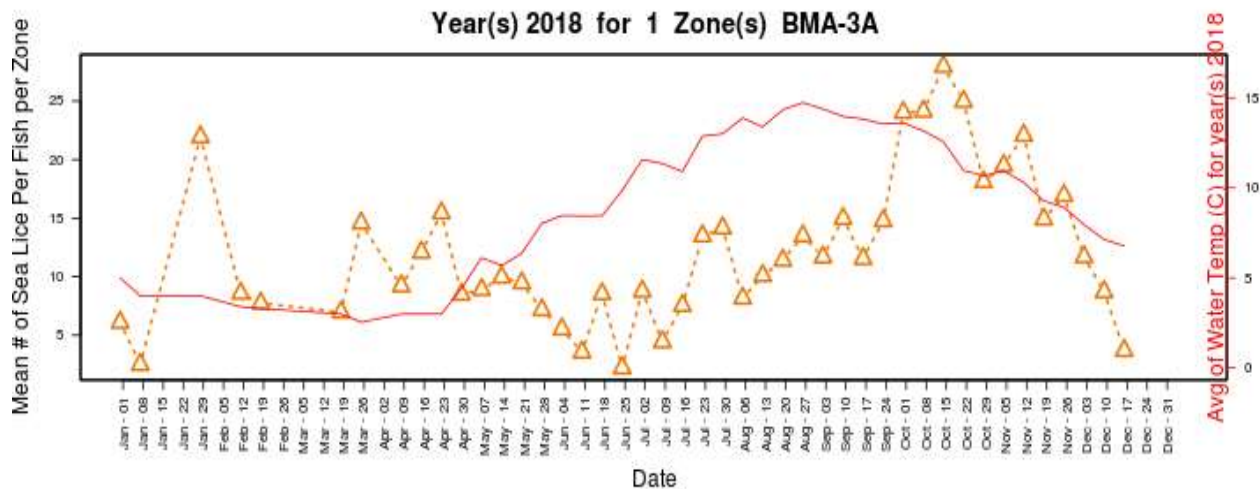
**2018**– Pre-market / market fish. There were two warm water treatment, and two bath treatments with Salmosan; one in July, one in August

BMA 2B - 2018 Analysis



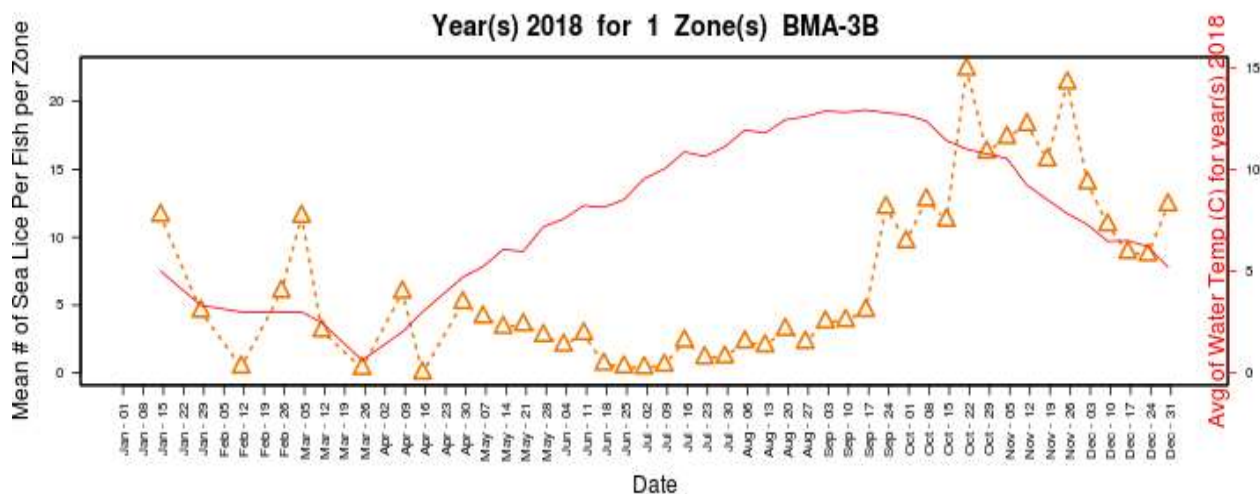
**2018**– Pre-market / Market fish. There were no bath treatments

## BMA 3A - 2018 Analysis



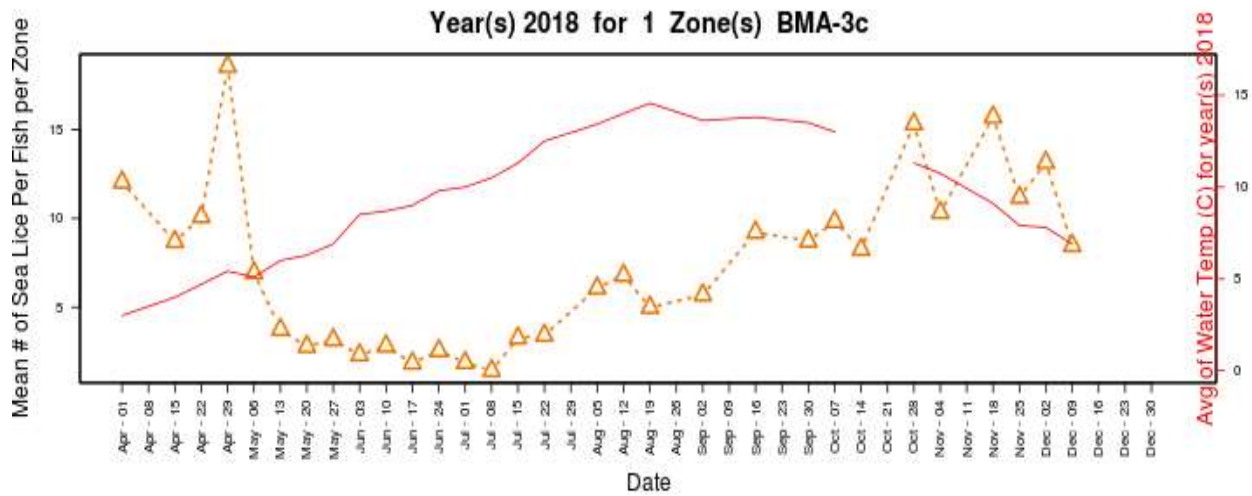
**2018** – Second year fish. There were 9 warm water treatments and 6 water pressure treatments. Starting in early September, seven bath treatments with Salmosan.

## BMA 3B – 2018 Analysis



**2018** – Second year fish. There were 8 warm water treatments and 6 water pressure treatments. Starting in mid-September, there were four bath treatments with Salmosan, one with hydrogen peroxide product.

BMA 3C – 2018 Analysis



**2018** – Second year fish. Only two bath treatments with hydrogen peroxide product in May

**2013- 2018 TREND ANALYSIS**

The following graph provides data on the mean number of adult female sea lice in New Brunswick since 2013.

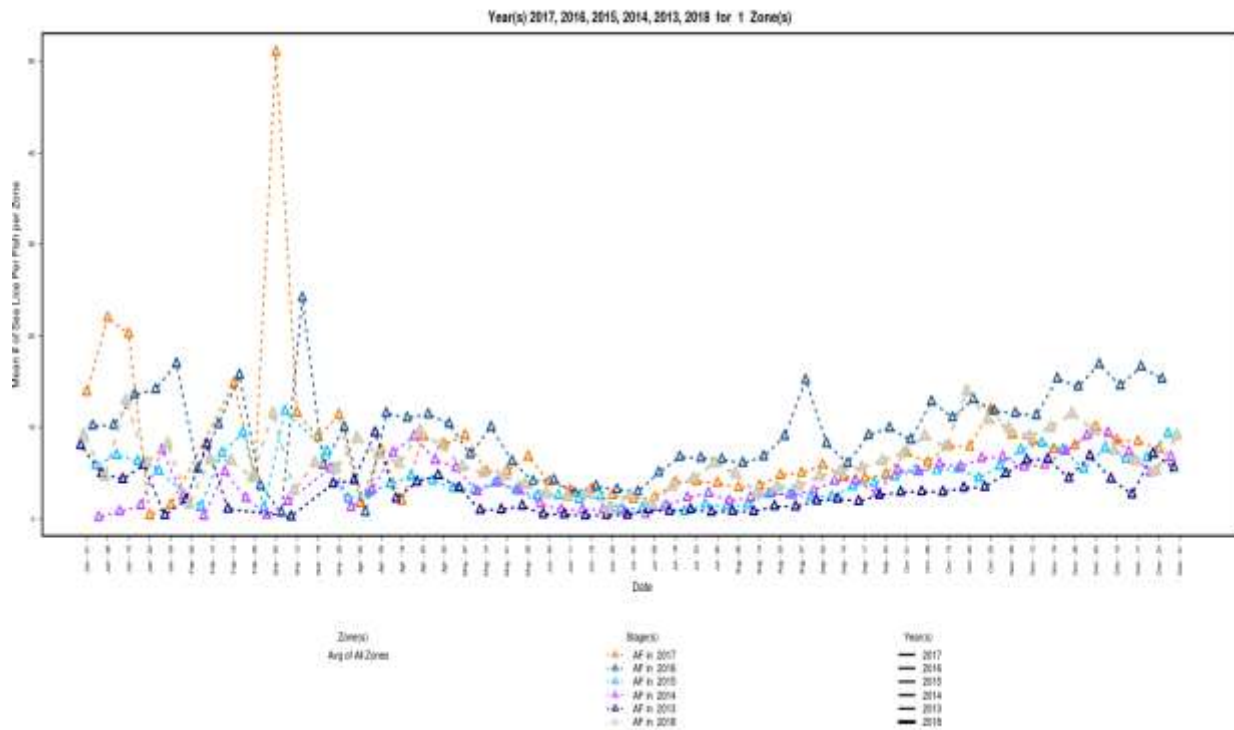


Figure 4: Average number of adult female *Lepeophtherius salmonis* sea lice per BMA from 2013-2018

## **SUMMARY AND RECOMMENDATIONS**

There is no doubt that although this report shows the industry has been effective overall in mitigating the impacts of sea lice populations, uncontrollable climate change effects (e.g., prolonged warm waters), continue to make this increasingly challenging. There is a recognized ongoing need to access more proactive tools to ensure the industry can continue to minimize its footprint on the environment.

These tools can only be developed through continued research that support the continued development of more non-chemical management options such as the use of cleaner fish, warm water showers and sea lice retention filters. Research and monitoring is also critical to the approvals of new sea lice medicines and vaccines.

Additionally, sea lice inhibitors in new feed formulations and vaccines offer great promise but require regulatory changes to access new feed ingredients. While the use of medicines and therapeutants is a last resort action, access to a range of products available and approved for use in other countries that are exported to Canadian consumers, must also be supported domestically.

The access to a full suite of tools would alter the graphs and ensure fewer and smaller peaks in lice number by having access to a variety of products with less ecological impacts. Incorporated in an operational integrated pest management plan, this would increase production with fewer fish losses which would relate to increased socio-economic benefits in coastal communities through the Atlantic region.

As a final point, the ACFFA will continue to promote new research and the adoption of a Minor Use Minor Species program for fish health and feed products which is a key component of an Aquaculture Act in Canada, now being framed under the leadership of the Minister of Fisheries and Oceans in collaboration with the provincial regulatory agencies. We are hopeful that Canada's regulatory and policy framework for aquaculture will be more effective to enable the salmon farming industry to adopt new research, technology and other innovations in a timelier manner.

This is not only critical to fish health management but also to our communities and consumers who rely on Canada's salmon farming industry, and that our individual companies remain competitive.

# APPENDIX A

## Aquaculture Bay Management Areas of New Brunswick

