Report on Sea Lice Management in New Brunswick

Prepared by Atlantic Canada Fish Farmers Association

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The following report provides an overview of the status of sea lice management in New Brunswick. This report is an update to previous reports issued in 2011, 2012 and 2013. 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. This ensures accurate counts are made based on the Sea Lice Monitoring Program that is a requirement under the New Brunswick Aquaculture Act and General Regulations and the Integrated Pest Management Plan for Sea Lice.

EXECUTIVE SUMMARY

Salmon is New Brunswick's largest agri-food export. Salmon production has the potential to reach over 35,000 tonnes annually with a farm gate values that can exceed $280 million. The industry makes significant contribution (direct, indirect and induced) to the provincial GDP and is responsible for over 2500 jobs. Salmon farming is a primary employer in Charlotte County, NB with 16 per cent of the workforce is employed in aquaculture.

New Brunswick salmon farming companies are family-owned, and also operate in Nova Scotia and/or Newfoundland. These companies are responsible for upwards of fifty percent of all farmed salmon production in North America.

The men and women of Atlantic Canada's aquaculture industry have a proud history of marine stewardship and have always prided themselves on farming Canadian waters with care. No one is more committed to sustainable solutions to all farm operations than these salmon farmers who work hand-in-hand with colleagues at the federal, provincial and community level.

Like all farmers, salmon farmers are guardians of their animals and take appropriate measures to care for the health and wellbeing of their stock. Preventing disease and parasites are the top priorities. Like all farmers, salmon farmers are also stewards of the environment in which they operate. For almost forty years, New Brunswick salmon farmers have worked diligently to find ways to enhance their environmental management practices to ensure that future generations can farm the seas and safeguard the marine environment that supports the livelihoods of their friends and neighbours.

The three year Bay Management Area System implemented in New Brunswick 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 BMA system include:

- Reduced fish or rearing density on the farms

- Mandatory fallowing of production sites and the bay management area to help break pathogens and support breaking the life cycle of sea lice
- Ensuring only salmon stocked in a single year class are present at each farm site and within each management area; preventing older farmed salmon, which may have already been exposed to parasites, from transferring it to incoming smolts

Salmon farmers use sea lice treatments as a last resort only. However, like all farmers, they rely on the professional advice of veterinarians who have access to approved products for use when their animals are infected by a pathogen or threatened by parasites. Sea lice treatments can only be authorized through a veterinarian's prescription. All prescriptions and treatments are reported to federal and provincial regulators.

The following report provides a historical overview New Brunswick sea lice management since 2008; the development of an integrated pest management plan for sea lice management; R&D that supports product authorizations and farm management practices; and an overview of the sea lice populations in the Aquaculture Bay Management Areas of New Brunswick since 2009.

In 2014 salmon farming companies continued to develop a coordinated sea lice management and treatment strategy that included maintaining lice thresholds in each Bay Management Area, product rotations and synchronized treatment strategies.

Historically, sea lice populations can be very low January through to June. This ensures that any wild salmon leaving rivers are not at risk due to sea lice from salmon farms. To ensure that low lice abundance is maintained, strategic spring treatments begin in May/June in most areas using Interox Paramove®50 (hydrogen peroxide). Farmers are able to maintain relatively stable, low lice populations through the summer. The number of gravid females are allowed to increase marginally only on those farms to be harvested. As water temperatures begin to cool in October, farmers will again do a strategic fall treatment to knock back lice prior to winter.

In 2014 water temperatures in southwest New Brunswick rose through the summer, remaining quite warm into October. These temperatures held for an extended period of time causing increased lice populations lasting well into December. 2014 also saw higher water temperatures in Grand Manan than ever seen before. Average water temperatures in this area in November 2014 were 11.2 degrees Celsius compared to 9.9 in 2013.

Monitoring data shows that salmon farmers have been effective at keeping lice under control. However, this is only possible as long as they have access to a variety of treatment options that enable them to respond effectively when water temperatures are above 12 degrees centigrade.

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

BACKGROUND

Sea lice are a naturally occurring ecto-parasitic crustacean that can weaken the fish and increase their susceptibility to potentially fatal secondary infections. Sea lice cannot be eliminated from wild salmon, other wild sources or the environment; therefore, salmon farmers have developed management practices to reduce the likelihood and severity of infestations.

All farmed salmon enter the marine environment disease and parasite free; however, because lice travel on wild fish, ocean currents and even in zooplankton they can move freely between both wild and farmed fish. Elevated water temperatures and salinity can also result in increased lice populations.

Beginning in 2000, salmon farmers around the world had access to an anti-parasitic chemo-therepeutant, 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®. Beginning at that time, 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 to promote overall fish health management. Because the European aquaculture industry has had access to a variety of sea lice management tools for over a decade, the Atlantic Canadian salmon farming industry collaborated internationally, and continues to do so, on evaluation and research of new management opportunities. The goal is always to find new tools that will enhance and/or complement farm 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 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. Management of sea lice is further complicated by environmental conditions. Sea lice numbers are also impacted by a variety of environmental factors including salinity and water temperature.

Feed formulations have been developed 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. While these feed ingredients can be consumed by humans and fish that have been fed these ingredients can be imported for sale in Canada, they are not allowed for use in Canada because after almost four years, the Canadian Food Inspection Agency has not amended their list of approved ingredients for feed products.

In addition to issues impacting 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 continued in 2010, in 2012 and again in 2014. We often see these record high water temperatures maintained for longer periods than we have seen in the past.

As a result, an increase in the prevalence of sea lice in the Bay of Fundy was observed in both 2009 and 2010 and again, in some areas, in 2012 and again in 2014. Because of high temperatures and lack of stable access to sea lice treatment products, production was cut back in 2011 and again in 2012 which has had a significant impact on both jobs and revenue in the province.

SEA LICE TREATMENT 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

All of 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 therefore available to provide data to support Canadian risk assessments through Health Canada, in support of Emergency Drug Releases or Emergency Registrations pending local monitoring and surveillance data collection to support full registrations of the products. Local scientific research and monitoring and surveillance are being carried out to support Canadian product registrations; however, scientific permits, EDRs and/or ERs must be granted to enable this field work to be conducted.

Having multiple products does not contribute to increased chemical use. In fact, having a variety of products ensures that all are used strategically and generally results in an overall decrease in chemical use. Access to a variety of compounds is critical since many products are not effective on all life stages of the sea louse or under all environmental conditions.

Health Canada's Pest Management Regulatory Agency, responsible for authorizing the use of bath treatment products through an Emergency Registration, only does so for periods of up to one year. This process must be repeated annually pending full registration of the product in Canada – which requires scientific research and monitoring to support the application. It can take many years for a pharmaceutical company to gain full license approvals for their products in Canada.

All products are only available through a prescription by a veterinarian. All product use is reported to both federal and provincial regulators.

The following products are currently available for use in Canada:

SALMOSAN®

Salmosan® was previously registered and administered on New Brunswick farms in the 1990s; however, the registration lapsed when SLICE® was introduced. The Province received an ER for Salmosan® in November 2009. This permit was also subject to scientific monitoring; to date, sediment and water quality testing has shown little to no impact as a result of Salmosan® treatments.

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 2 net pens per day, depending on size, at a farm site. This restriction meant that on-farm

sea lice could not be completely eliminated and additional treatments were required. To avoid the risk of tolerance developing, the farming industry avoided product use in 2011 and again in 2012. However, the ER approval granted for product use June 2013 to June 2014 was 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 and replacing it with a restriction on the number of net pens that can be treated at the same time on one site.

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 in 2010 (November 4, 2010) and conditions that had to be met prior to use, many salmon farms had no 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 were 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® is in progress with PMRA and was expected to be complete in 2014. However, the process has been delayed. A 2015 completion is now expected.

INTEROX PARAMOVE®50

Interox Paramove®50 is a hydrogen peroxide product, benign in the environment, degrading quickly to water and oxygen. This product is relatively effective on all stages of sea lice; however, it is not recommended for use when water temperatures exceed 12 degrees centigrade. The product is most effective and economical when administered in well boats; however, in 2013 a new delivery technology was evaluated using a full tarp system.

Approval for use of this product through an ER was first received June 11, 2010; product delivery followed with a first application on June 26, 2010. However, by this time water temperatures in the area with the highest sea lice counts were already 14 plus degrees – well above the recommended high of 12.

Like Salmosan®, new applications for use have been 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 at temperatures above 12 degrees, using a lower dose; however, this also means reduced efficacy.

Research has been done on the efficacy of using Interox Paramove®50 as part of a neutralizing agent for the active ingredients in other sea lice chemotherapeutants. Lab studies with favourable results have been completed; however, field trials are pending as a result of restrictions in access of the various sea lice treatment products and conflicting regulatory processes. Research ended because Canada does not have a regulatory agency responsible for authorization of neutralizing agents.

Full product registration of Interox Paramove®50 is in progress with PMRA and was expected to be complete in early 2014; however, the process has been delayed into 2015.

AVERMECTINS

Avermectins such as SLICE® and Ivermectin may be used as an in-feed sea lice treatment under a veterinary prescription.

CALICIDE®* and *ALPHAMAX®

These products are not currently available for use in Canada.

Calicide® is an in-feed treatment and was licensed through Health Canada's Veterinary Drug Directorate. However, because Calicide® affects only early life stages of the sea louse, it was only effective when used in conjunction with bath treatments that affect later stages of the sea louse. Use by the industry was very low and so the producer chose not to continue to register the product.
AlphaMax® was the first alterative bath product recommended for use by the National Fish Health Working Group. Monitoring of this product was conducted for ten years in Norway; results indicated there was no impact to wild fishery harvests of crab, prawns or lobster. The product has also been available for use for over ten years in the UK.

In 2009, an Emergency Registration for AlpaMax® enabled trials in Bay Management Area 2A area where tolerance to SLICE® was most evident. This emergency registration was in place for the period July to October, 2009 and was conditional upon a comprehensive monitoring and surveillance program. This work was conducted by the Department of Fisheries and Oceans, Environment Canada, the NB Department of Agriculture and Aquaculture and the NB Department of Environment with cooperation by the salmon farming industry. All field research and scientific monitoring conducted on AlphaMax® in 2009 indicated that this product posed little to no risk to the marine environment or to non-target species when used as prescribed.

A second approval was granted in 2010 for the period October to December 31 in well boat use only. It too, was conditional upon a second comprehensive monitoring and surveillance program. Due to restriction on use, this product was used on an extremely limited basis in BMA 1 only. Results from scientific field trials once again indicated that this product poses little to no risk to the marine environment or to non-target species.

This product has not been used since 2010.

RESEARCH AND ALTERNATIVE MANGEMENT OPTIONS

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

1. Regulatory Research
    - To support the evaluation, licensing and use of new treatment options
2. Environmental Dynamics
    - 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

Since 2010 significant financial and human resources have been invested by industry to support research critical to improving our knowledge and understanding of sea lice dynamics and management. Between 2010 and 2012, industry investment resulted in leveraging support from federal and provincial governments and the expansion of research collaborations. Since that time there have been significant cuts to research funding and support by governments negatively impacting new research collaborations. Industry, however; continues to invest in evaluating new products, development of novel treatments and new technology.

The ACFFA regularly publishes proceedings from research workshops at http://www.atlanticfishfarmers.com/research-program-project-reports.html. Results from all collaborative research is made public through workshops, communication with stakeholder groups at a variety of meetings, through industry and DFO websites, etc. Interim research data from private and academic research is also often available at these workshops and published as part of workshop proceedings.

Some significant findings that we can report from this research program include:

- To date no sea lice bath treatments have resulted in mortality to non-target species when the sea lice treatment product is used as prescribed in regulation
- There has been no impact to the sediments as a result of sea lice treatments
- The Fish-iTrends Decision Support System has been created and records all sea lice population data; these data are verified by a third party audit and the data are now being used to evaluate the effectiveness of sea lice management
- A certification program has been established for sea lice monitors to ensure accurate sea lice data are reported from farm sites
- Well boats and tarpaulins and unique delivery systems 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
- We have been successful in neutralizing the active ingredient, deltamethrin, in a laboratory by over 80 per cent using Fenton's Reagent (hydrogen peroxide plus iron)

Local research is continuing. Projects underway include:

- Evaluation on the use of cunner fish as a sea lice cleaner fish
- Development and evaluation of alterative lice removal technologies
- Effectiveness of mussels as a filter for sea lice nauplii
- Effectiveness of sea lice traps, and
- Continued hydrological surveys for possible refinement of Aquaculture Bay Management Areas

Internationally, feed companies have developed formulations using natural ingredients that 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. While these feed ingredients can be consumed by humans and fish that have been fed these ingredients can be imported for sale, they are not currently available in Canada because they are not on the Canadian Food Inspection Agency's list of approved ingredients for feed products.

NON TARGET SPECIES

There has been a range of field research and scientific monitoring conducted on all sea lice bath treatments both in Canada and in other jurisdictions. Field research indicates that these products pose little to no risk to the marine environment or to non-target species when used as prescribed.

The data from research conducted by Fisheries and Oceans Canada and the NB Department of Agriculture Aquaculture and Fisheries have been reported publicly by federal and provincial researchers. Data was shared with fishery and conservation organizations at a variety of meetings hosted by the ACFFA, by DFO and by NBDAAF and are also available on the ACFFA and DFO websites.

There have been no significant changes in the landings for the traditional fishing sector since 2009 and lobster landings have generally increased.

There is no scientific evidence that sea lice from farmed salmon have had a negative impact to wild species populations in New Brunswick. 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. Data from the St. George fishway monitoring reports issued each fall indicate most returning fish have no sea lice, occasionally there may be less than five lice per fish.

To view lobster and other wild fishery data visit http://www.dfo-mpo.gc.ca/stats/commercial/sea-maritimes-eng.htm

SEA LICE MANAGEMENT ON FARMED SALMON 2009 - 2014

SLICE® was used exclusively for sea lice management on salmon farms up until July 2009. Since that time New Brunswick salmon farmers have evaluated and conducted research on AlphaMax®, Calicide®, Salmosan® and Interox Paramove®50. In 2014 avermectins were used in-feed with Salmosan® and Interox Paramove®50 used in closed bath treatments.

2009

In June 2009, an emergency registration for AlphaMax® was granted with the use by New Brunswick salmon farmers limited to BMA 2A only. The product was applied as a bath treatment in skirted net pens. Extensive environmental monitoring was conducted in addition to non-target species testing.

In November 2009 an emergency registration for Salmosan® was obtained.

Water temperatures in BMA 1 Passamaquoddy Bay hit record high temperatures, tolerance to SLICE® was increasing so farmers in this area were left with virtually no treatment option from the spring through to November.

Traditionally winter, when water temperatures drop, is a time when sea lice will die naturally and there is seldom a new set of lice on a farm from December to March. However, the winter of 2009/2010 saw higher than normal water temperatures continue. This factor, combined with the higher than normal lice loads left on the fish because of inadequate treatments options in the summer and fall of 2009,

made it critical that the industry take aggressive action in March / April of 2010 to prevent lice populations from escalating and to safe-guard the health of farmed salmon stocks.

2010

All of the salmon farming companies worked together to prepare a coordinated treatment plan that included establishing treatment thresholds in each Bay Management Area and a synchronized treatment strategy. Salmon farmers also invested in well boat technology; ultimately three well boats were available for use in New Brunswick during 2010. Well boats supported the introduction and use of Interox Paramove®50, an environmentally benign hydrogen peroxide product, resulting in increased treatment efficacy and ultimately a significant reduction in the quantity of treatment product required for each treatment.

However, the aggressive treatment plan could not be fully implemented. Interox Paramove®50 approval was not obtained until July so Salmosan® was the only product available. By the time Interox Paramove®50 was approved, water temperatures had exceeded the recommended 12 degrees; however, the treatment dose was adjusted to accommodate the higher water temperatures, although this impacted treatment efficacy.

Lice populations in Bay Management Area 1 increased significantly through the summer where second year fish were located. This was due to higher than normal water temperatures (2 degrees C higher than the historical high), the inability to fully utilize Interox Paramove®50, and restrictions on the use of Salmosan® and later AlphaMax®.

2011

The salmon farming companies again prepared a coordinated treatment strategy that included establishing treatment thresholds in each Bay Management Area, product rotations and synchronized treatments.

The strategy could not be fully implemented because the only products available were Interox Paramove®50 and Salmosan®. Farmers avoided the use of Salmosan® because of concerns that restrictions on the use of the product could lead to the development of tolerance. This approach was successful because water temperatures remained in the normal range and salmon were stocked in areas of New Brunswick that traditionally have lower water temperatures, and/or where sea lice do not normally pose a serious threat.

Sea lice data in 2011 indicated that having timely access to the appropriate treatment options enabled salmon farmers to control this parasite. However; it was also evident that it continued to be critical to ensure that a fully operational integrated pest management plan is implemented and supported by access to a suite of treatment products. Having access to a single product is not in the best interests of fish health management. A variety of treatment products does not mean increased use of therapeutants; it means that the correct product is used strategically to obtain optimal results resulting in an overall decrease in the number of treatments required and the amount of product used, regardless of the environmental factors such as water temperatures.

2012

Salmon farming companies again prepared a coordinated treatment strategy that included establishing treatment thresholds in each Bay Management Area, product rotations and synchronized treatments.

In late 2011 salmon farmers were forced to make the critical decision not to stock all salmon farms in BMA 1 which is prone to high water temperatures. Despite three years of local scientific research and monitoring supported by international research, our industry still did not have the stable access to a variety of treatment options to implement a fully operational integrated pest management plan. Access to in-feed sea lice inhibitors is also not an option because of continued regulatory constraints. This resulted in lost jobs, lost market access, a significant reduction in provincial tax revenue from this industry, and a critical loss to industry competitiveness.

In 2012 water temperatures once again hit record high levels throughout southwest Bay of Fundy. Not only did temperatures reach as high as 18 degrees in some areas of BMA 1, but temperatures of 14 to 16 degrees were maintained for an extended length of time throughout the region.

The salmon farming industry once again relied on Interox Paramove®50 for the majority of its sea lice treatments. We have been cautioned that sea lice can also develop a resistance to this product so it is becoming even more critical that salmon farmers throughout Canada have access to a full suite of treatment options.

2013

By early this year both Interox Paramove®50 and Salmosan® were in the full application process with Health Canada's Pest Management Regulatory Agency. Full registration for these products is anticipated to be complete in 2014. Both products were available to salmon farmers throughout 2013 through an emergency registration.

Salmon farming companies continue to prepare a coordinated sea lice management and treatment strategy that includes maintaining lice thresholds in each Bay Management Area, product rotations and synchronized treatments.

Management of sea lice this year started off very well with relatively stable populations on most farms leading into the traditional strategic spring treatment using Interox Paramove®50. Lice populations remained stable through the summer, with the number of gravid females allowed to increase marginally only on those farms that were to be harvested.

High water temperatures in some areas of New Brunswick were not observed until late summer; however, these temperatures again held for an extended period and caused an increase in lice populations in October. However, early data indicates that except for this rise, lice populations were kept lower than in the past four years.

Interox was used for early lice control but Salmosan® in full tarps was used to support the fall 'clean up' of lice on farms. During 2013 the NB salmon farming industry also tested a new delivery system for bath treatments in full tarps that supports a better mixing and improved treatment efficacy.

It should be noted that in 2013 Admiral Fish Farms closed their operations. The financial losses this company experienced in 2010 and into 2011 as a result of not having timely access to effective sea lice chemotherapeutants was a contributing factor.

2014

Full registration evaluation of both Interox Paramove®50 and Salmosan® continued with Health Canada's Pest Management Regulatory Agency. Full registration for these products is expected in 2015. Both products continued to be available in 2014 through an emergency registration.

Salmon farming companies continue to prepare a coordinated sea lice management and treatment strategy that includes maintaining lice thresholds 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.

Management of sea lice this year started off very well with relatively stable populations on most farms leading into the traditional strategic spring treatment using Interox Paramove®50. Lice populations remained stable through the summer, with the number of gravid females allowed to increase marginally only on those farms that were to be harvested.

Although it took longer for water temperatures to increase in 2014, once temperatures increased, they held for an extended period causing sea lice populations to continue to increase into late November. Higher than average temperatures occurred in Grand Manan for the first time in many years. Data indicates that until water temperatures increase, farmers were able to keep lice abundance lower than any year except 2013.

Interox was used for early lice control but Salmosan® in full tarps began to be used on some farms in mid-July and it's used continued to support the fall 'clean up' of lice on farms due to the unseasonably high water temperatures.

HISTORICAL TREND ANALYSIS BY BAY MANAGEMENT AREA

The data charts following 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. It should be noted that while there has been a significant effort to include data from 2009, not all data entry for that year was complete. 2009 data are not available for BMA 3A or 3B.

Appendix A includes charts for each Bay Management Area containing 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.

BMA 1 - Trend Analysis
2009 – The only product available for treatment is SLICE®; farms are just being stocked
2010 - Counts coming into the spring are reasonable and pose no threat to farm fish health or other species. Treatments in spring bring numbers down; however, lice numbers begin to increase in late June because approvals for use of hydrogen peroxide and access to well boat were delayed. Water temperatures increase (2 degrees C higher than historical high) causing lice numbers to increase. Treatments using reduced levels of Interox Paramove®50 and Salmosan® administered through to October; but efficacy reduced due to restrictions on use (water temps and regulatory). Full concentration of Interox used in November; numbers are drastically reduced.
2011 – Increased lice count in March is normal; timely treatment using Interox Paramove® results in significant drop and numbers are being maintained well below five. Fish being harvested

2012 – Fish in this area are harvested into February; stocking of smolt begins in April. An in feed treatment of Ivermectin has maintained lice numbers well below two throughout this monitoring period. A strategic treatment in the fall with Interox Paramove®50 was scheduled. Water temperatures reached as high as 18 degrees in some areas of this Bay.
2013 – These fish were stocked in 2012. Lice numbers remained relatively low well into the winter. Treatments began in this area in April. Farms were treated using Interox Paramove®50 in well boats until September when some Salmosan® started to be used based on water temperature. Where a well boat was not available, full tarps were used.
2014 – These fish entered the water in 2012; all fish must be harvested by February 2015. Bath treatments start in May as part of the spring strategic treatment; other treatments on these second year fish continued into November with either Interox or Salmosan. Lice numbers in this area varied based on site harvest plans.

BMA 2A Trend Analysis:
2009 – Approval to use AlphaMax® on a trial basis beginning in June 2009; numbers maintained at low level; spike in October occurred because fish were being harvested so no treatment was conducted on the remaining farm
2010 – First year smolts were being stocked into this BMA in 2010; lice counts maintained at low level but increased in August to December at which time there was a strategic treatment with Interox Paramove® 50
2011 – Counts spike in the spring which is a normal trend with treatments planned and conducted using Interox Paramove®50. This timely application results in maintaining lice number at one or less throughout the summer and into the fall. Numbers began to increase; however, lice were again eliminated during the late fall strategic treatment using Interox Paramove®50.
2012 – This area contains second year fish in the process of being harvested. Spikes in sea lice numbers are a result of farms avoiding treatment because harvesting was either underway or scheduled. Farms treating to reduce numbers used Interox Paramove® 50 with some Salmosan® when water temps are high.
2013 – This area was stocked in 2013. Lice numbers have remained below one gravid female throughout the monitoring period. Any treatments administered were done using in-feed products.
2014 - Spring treatments with Interox began mid-May on these second year fish; female lice numbers remained generally low well into September. Treatments mid-August to November were done using either Interox or Salmosan.

BMA 2B Trend Analysis:
2009 – No fish stocked in this area.
2010 – Water temps are cooler in this area. Sea lice on first year smolts were managed through use of Interox Paramove and/or Salmosan. Spikes in July and November managed using Interox Paramove® 50
2011 – Counts spike in the spring which is a normal trend; spring treatment using hydrogen peroxide; timely application results in maintaining lice numbers well below one through to October. Lice are once again treated as part of the end of year strategic treatment with Interox Paramove®50 and counts are reduced below two.
2012 – Fish in this area are now in the final grow-out phase. Spring treatments are done using Interox Parmove®50. Water temperatures are in the 14 degree range; however, any treatments required prior to harvest are done using Interox Parmove®50 at a reduced dose.
2013 – Water temperatures in this area of Grand Manan are generally cooler in the summer. Fish were stocked in this area in 2013 and lice numbers remained well below one gravid female. Any treatment administered was done using in-feed products.

2014 – Spring treatments with Interox occurred in June on these second year fish with female lice numbers remaining generally low until September. However, water temperatures were unusually high in the area resulting in higher lice numbers. The majority of treatments since September have been done using Salmosan.

BMA 3A - Trend Analysis:
2009 – No data available
2010 – Water temps are cooler in this area. Sea lice abundance is managed through use of Interox Paramove®50 and/or Salmosan®. Harvesting of fish stocked in 2008 begins.
2011 – Stocking of fish began in April / May. Counts remain low; sea lice abundance is managed through the use in-feed treatments.
2012 – Counts are maintained at very low levels with Interox Paramove®50 until mid-summer when water temperatures begin to rise. Fish in this area being treated using Interox Paramove® 50 at an adjusted dose level.
2013 - This area contains second year fish scheduled for harvest. Spikes in sea lice numbers were accepted because fish were being harvested from farms and use of treatment products were avoided. Any treatments in this area in the spring or pending harvest were done using Interox Paramove® 50.
2014 - Stocking began in the area in May and in-feed treatments kept lice numbers very low. Farms in this area received bath treatments using Interox August to December.

BMA 3B Trend Analysis:
2009 – Data only available from a single farm as database is established;
2010 – Water temps are traditionally cooler in this area. Sea lice abundance on farms is managed through use of Interox Paramove®50 and/or Salmosan. Fish stocked in 2008 began to be harvested
2011 – Smolts are stocked in April/ May. Counts remain low well into the fall when a strategic treatment using Interox Paramove®50 is used throughout the area resulting in numbers below three going into the winter.
2012 - Sea lice numbers begin to increase as water temperatures remain at levels well above 14 degrees. Strategic treatment using Interox Paramove®50 or Salmosan® begins in October and numbers drop significantly.
2013 - This area was stocked in 2011 so lice numbers were allowed to increase on farms where harvest was either underway or scheduled. The farm that required a spring treatment used Interox Paramove® 50. No other treatments were required until late fall when Salmosan® was used in full tarps.
2014 - Stocking of this area began in June and in feed treatments has kept lice numbers very low. Two sites required treatment using Interox between November and December.

See Appendix A for the annual mean number of sea lice per fish for each Aquaculture Bay Management Area for 2014.

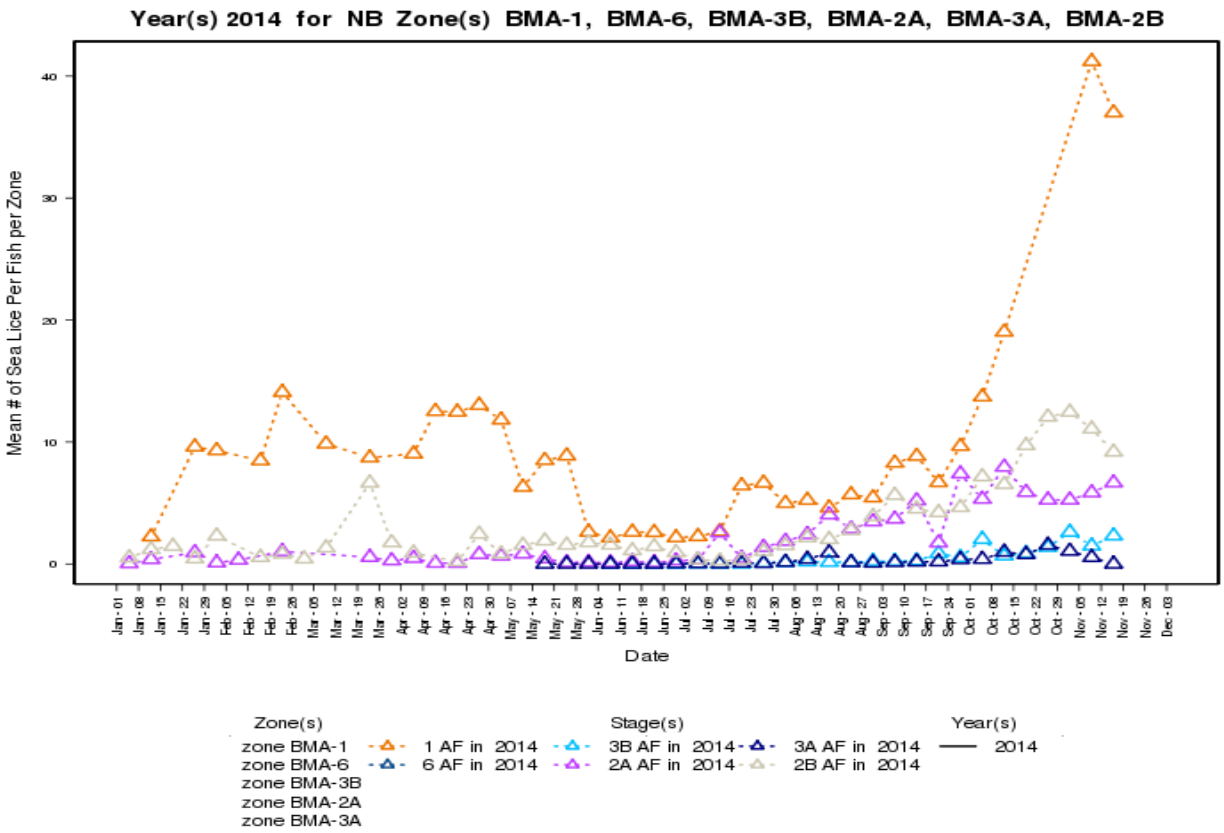
The following graph provides data on the mean number of adult female sea lice in New Brunswick since 2009. This data demonostrates that the salmon farming industry has been relatively effective in keeping adult female lice populations at a manageable level. However, effectiveness can only be maintained if farmers and their veterinarians have access to a variety of mangement tools.

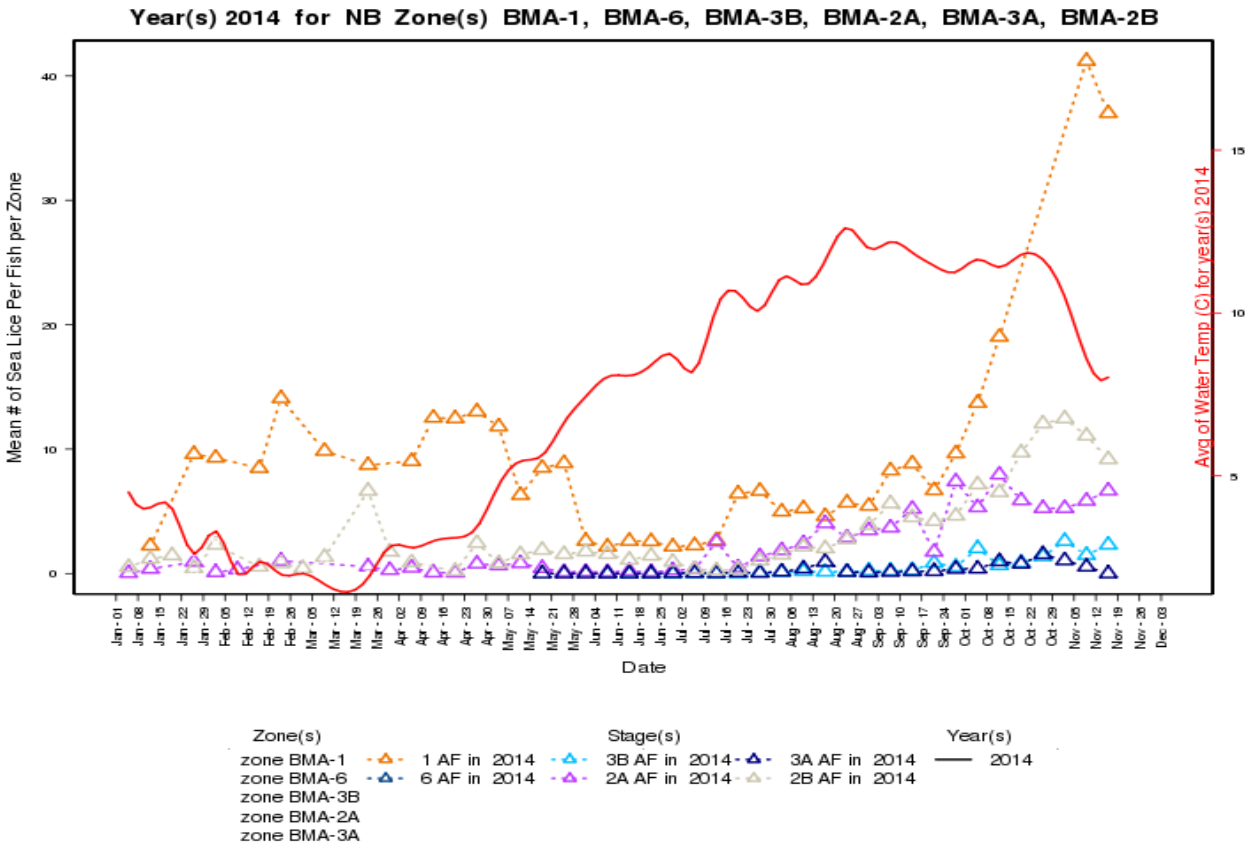
These tools must include research support to develop non-chemical mangement options such as the use of cunner fish as cleaner fish, evaluaton of lice traps, etc. Research and monitoring is also critical to the approvals of new sea lice medicines.

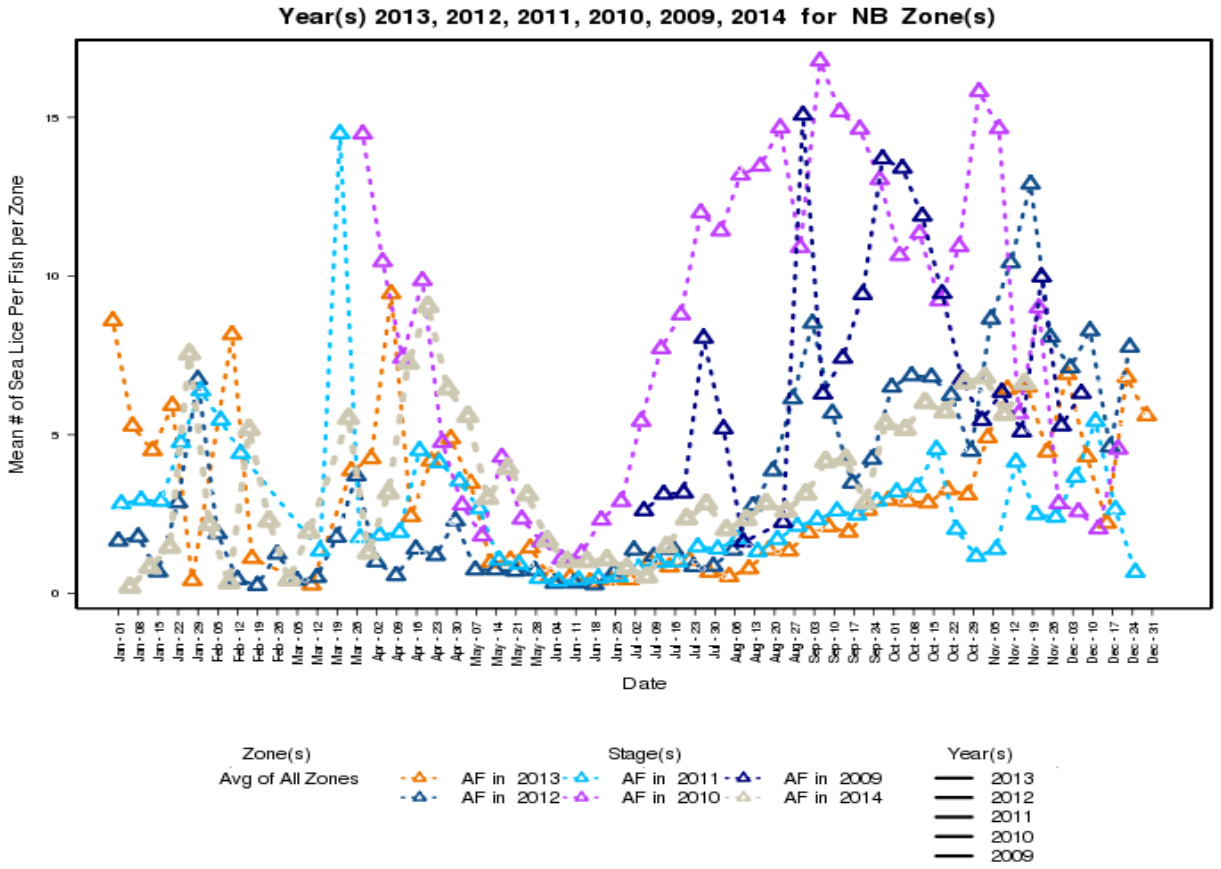
Sea lice inhibitors in new feed formulations offer great promise but require regulatory changes to be able to access to new feed ingredients. While the use of medicines and therapeutants is always a last resort, access to a range of products available and approved for use in other countries, must also be supported. New research needs to encouraged. Adoption of a Minor Use Minor Species program for fish health and feed products is a critical component Canada's National Aquaculture Development Strategy.

The access to a full suite of tools would considerably alter the graphs and ensure fewer and smaller peaks in lice numbers. Having multiple products does not contribute to increased chemical use. In fact, having a variety of products ensures that all are used strategically and generally would result in an overall decrease in chemical us. A fully operational integrated pest management approach for sea lice will also mean fewer losses and/or downgrades of fish, increased employment, and a strengthened New Brunswick economy attributable to a stronger farmed salmon industry offering greater potential for growth.

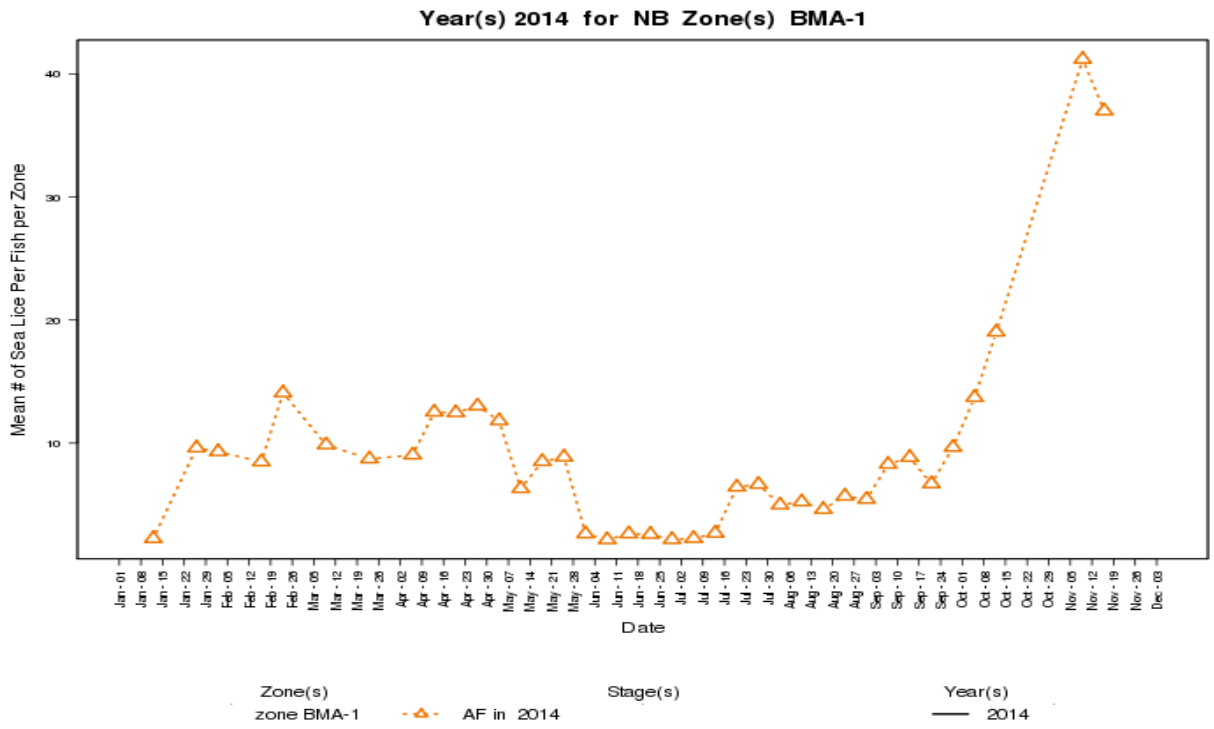
Finally, Canada's regulatory and policy framework for aquaculture must become more responsive to enable the salmon farming industry to adopt new research, technology and other innovations in a more timely manner. This is not only critical to effective fish health management but will ensure Canada's salmon farming industry and our individual companies remain competitive.

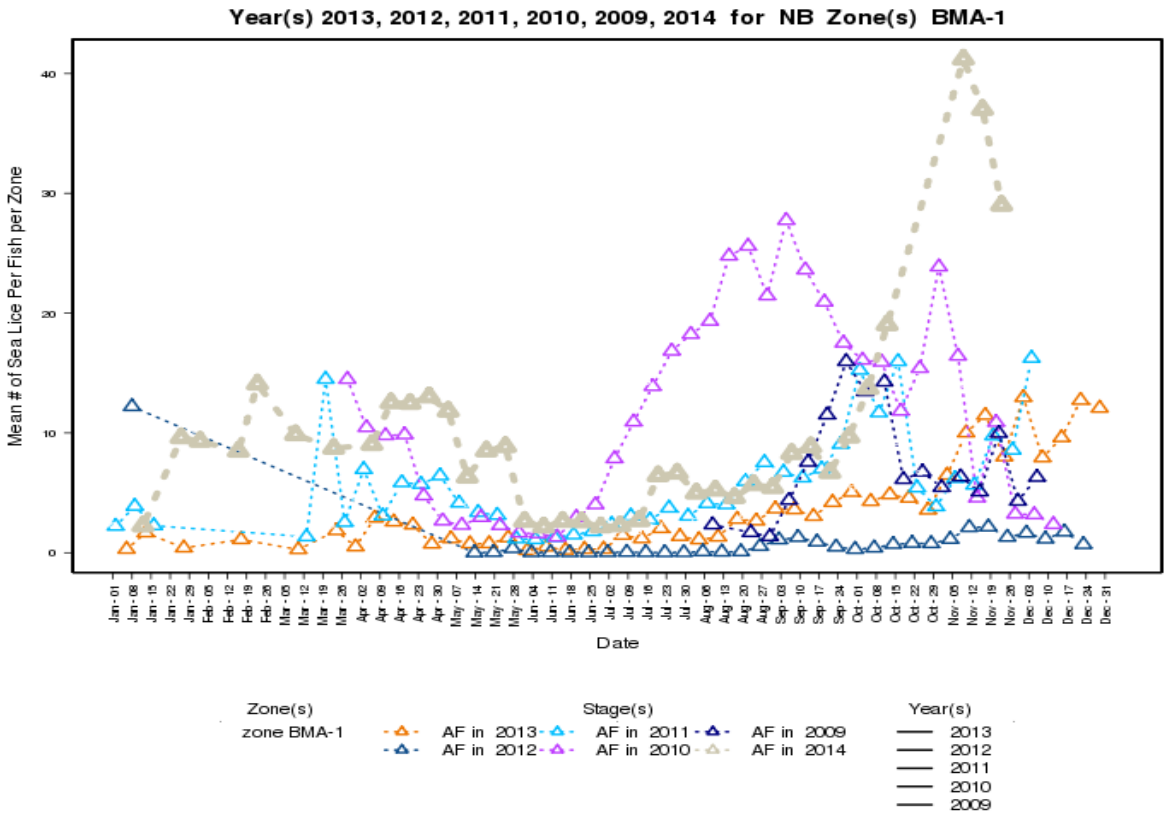


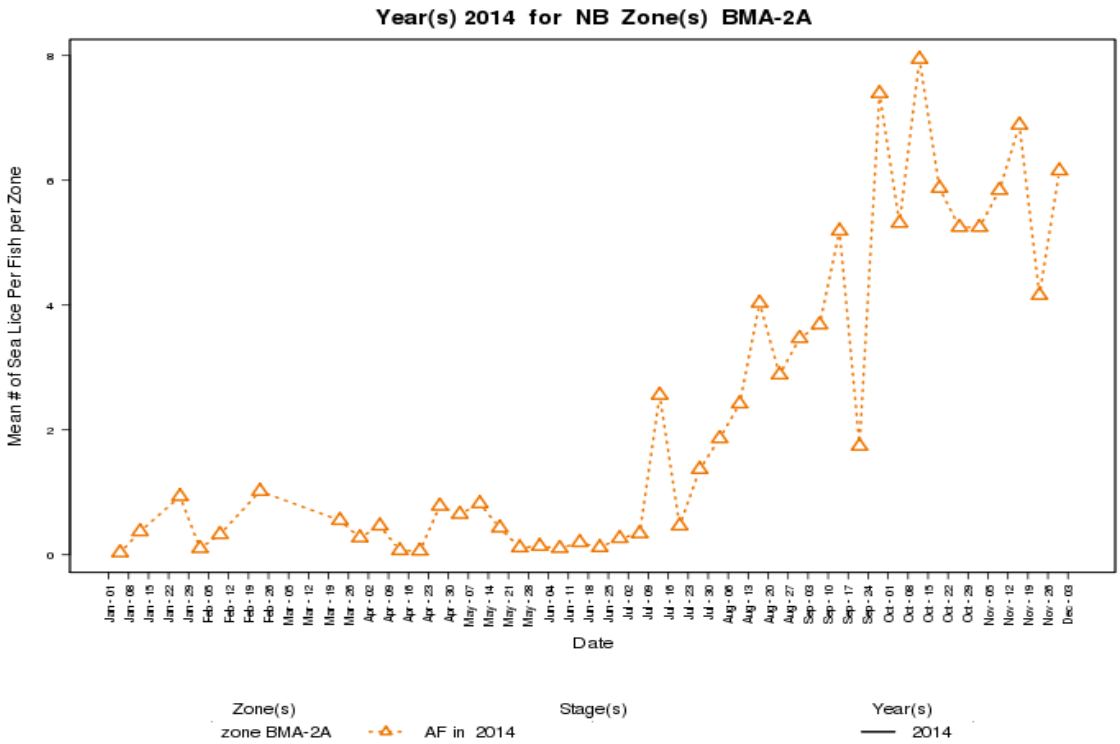

Year(s) 2014 for NB Zone(s) BMA-1, BMA-6, BMA-3B, BMA-2A, BMA-3A, BMA-2B
Mean # of Sea Lice Per Fish per Zone
Avg of Water Temp (C) for year(s) 2014
Date
Zone(s)
zone BMA-1
zone BMA-6
zone BMA-3B
zone BMA-2A
zone BMA-3A
Stage(s)
1 AF in 2014
6 AF in 2014
3B AF in 2014
2A AF in 2014
3A AF in 2014
2B AF in 2014
Year(s)
2014

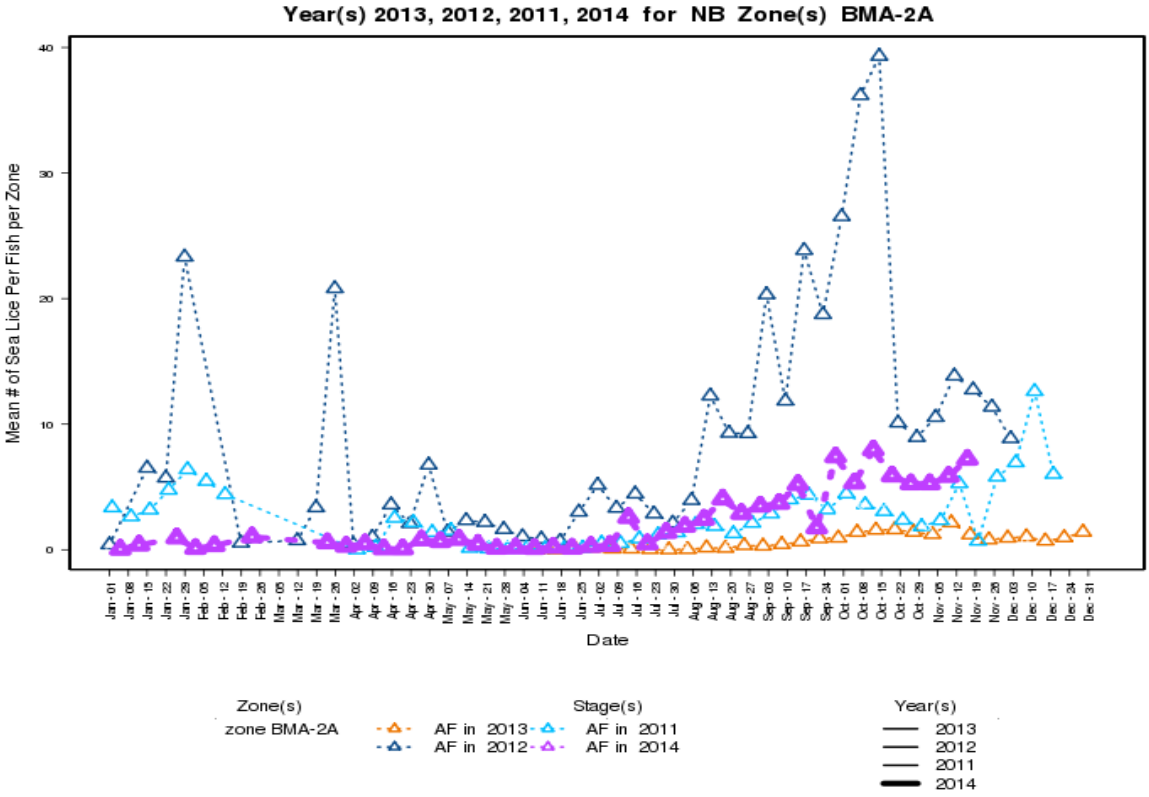

Year(s) 2013, 2012, 2011, 2010, 2009, 2014 for NB Zone(s)
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
Avg of All Zones
Stage(s)
AF in 2013
AF in 2012
AF in 2011
AF in 2010
AF in 2009
AF in 2014
Year(s)
2013
2012
2011
2010
2009

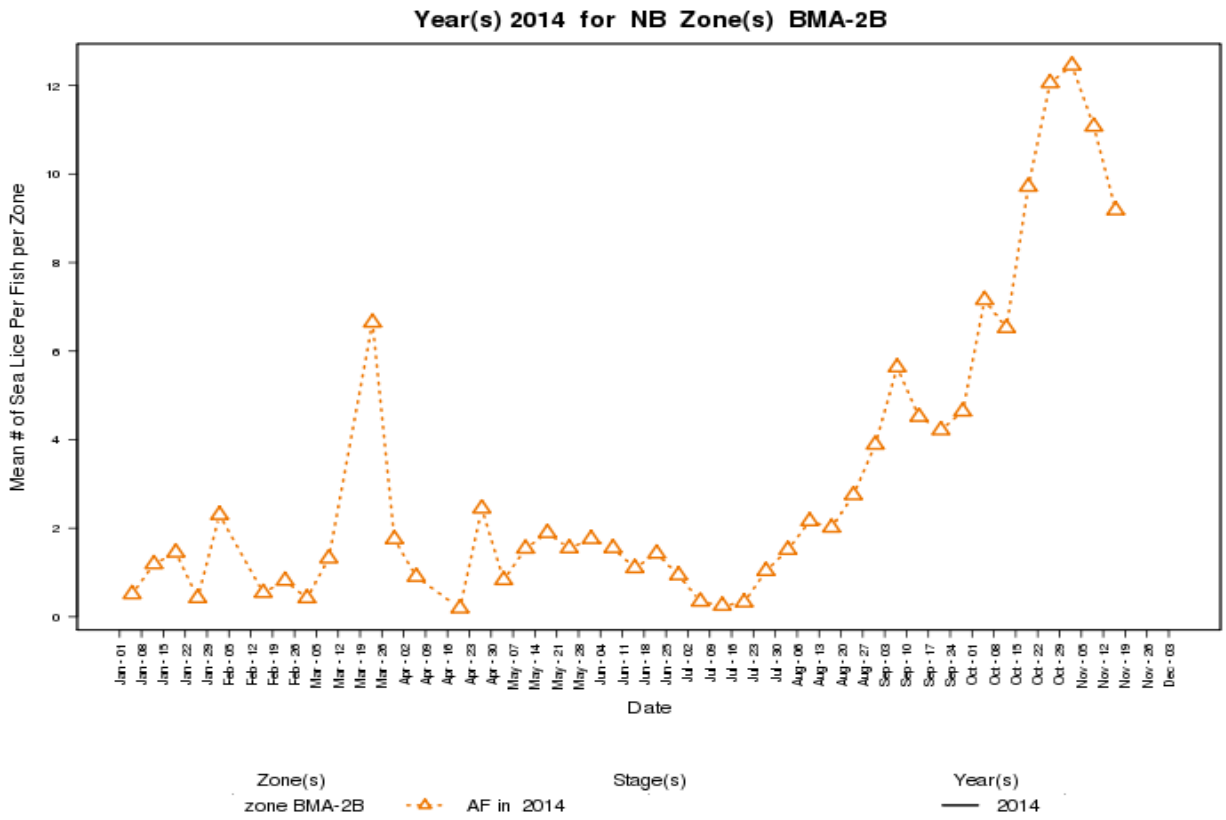
APPENDIX A
Aquaculture Bay Management Areas Sea Lice Data 2014

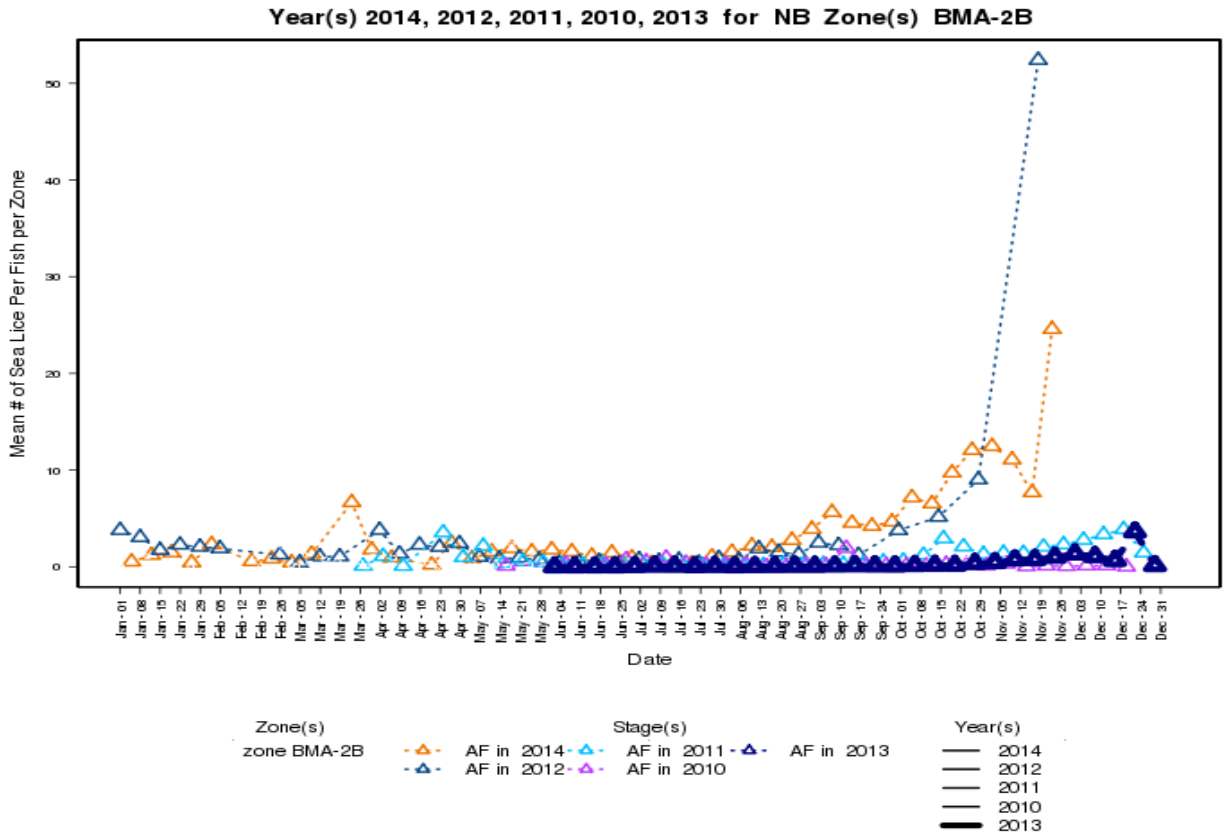


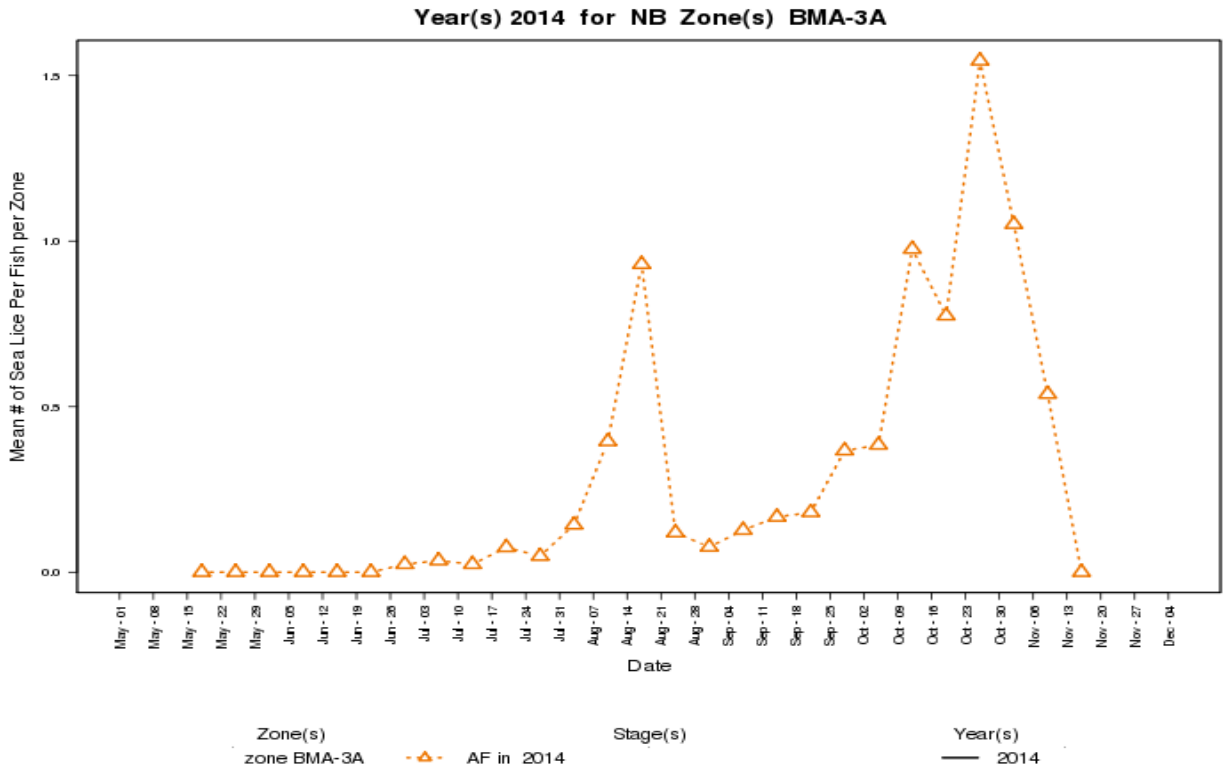


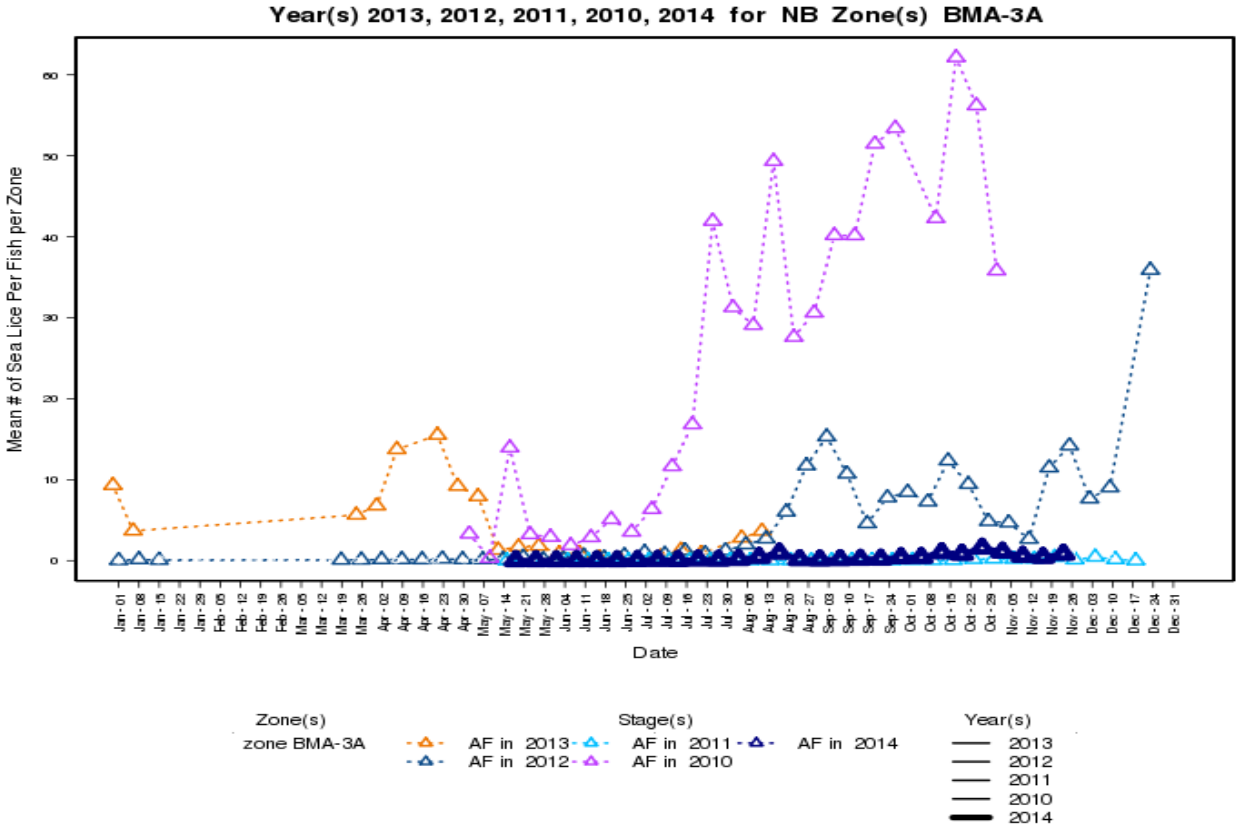

Year(s) 2014 for NB Zone(s) BMA-2A
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-2A
Stage(s)
AF in 2014
Year(s)
2014

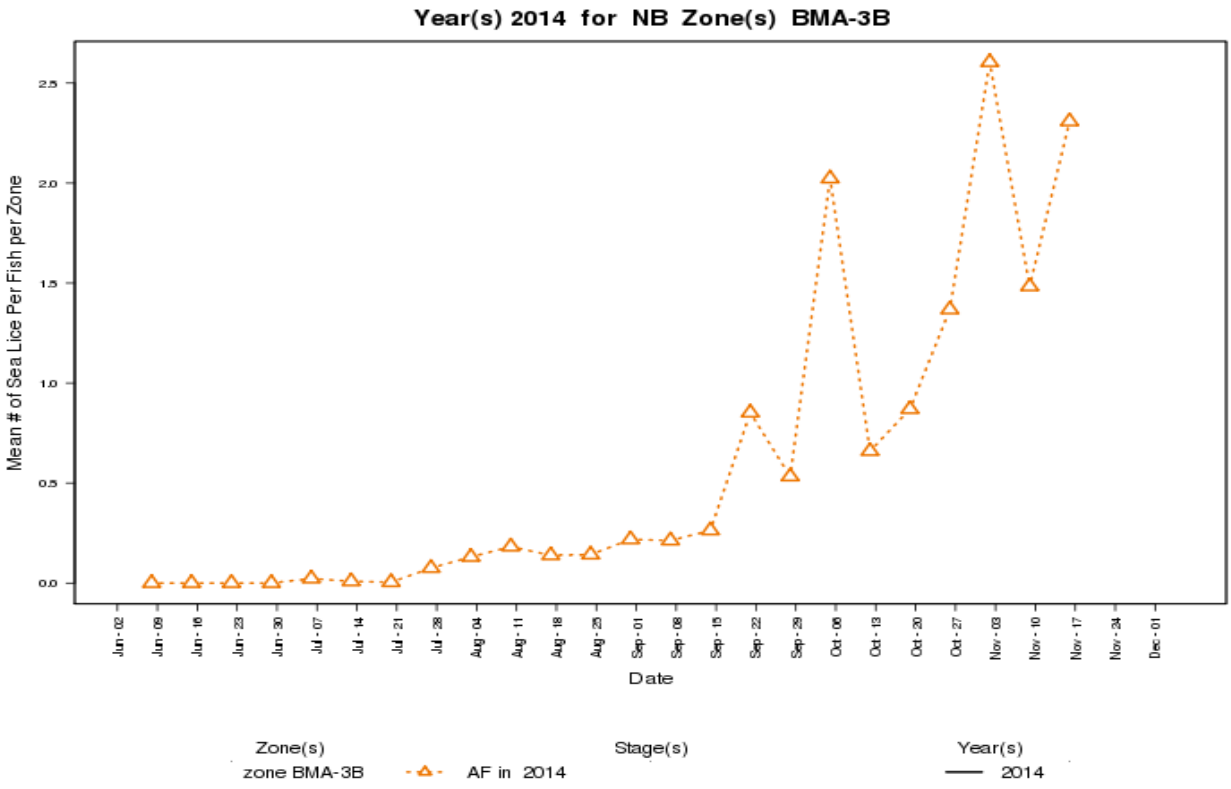

Year(s) 2013, 2012, 2011, 2014 for NB Zone(s) BMA-2A
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-2A
Stage(s)
AF in 2013
AF in 2012
AF in 2011
AF in 2014
Year(s)
2013
2012
2011
2014

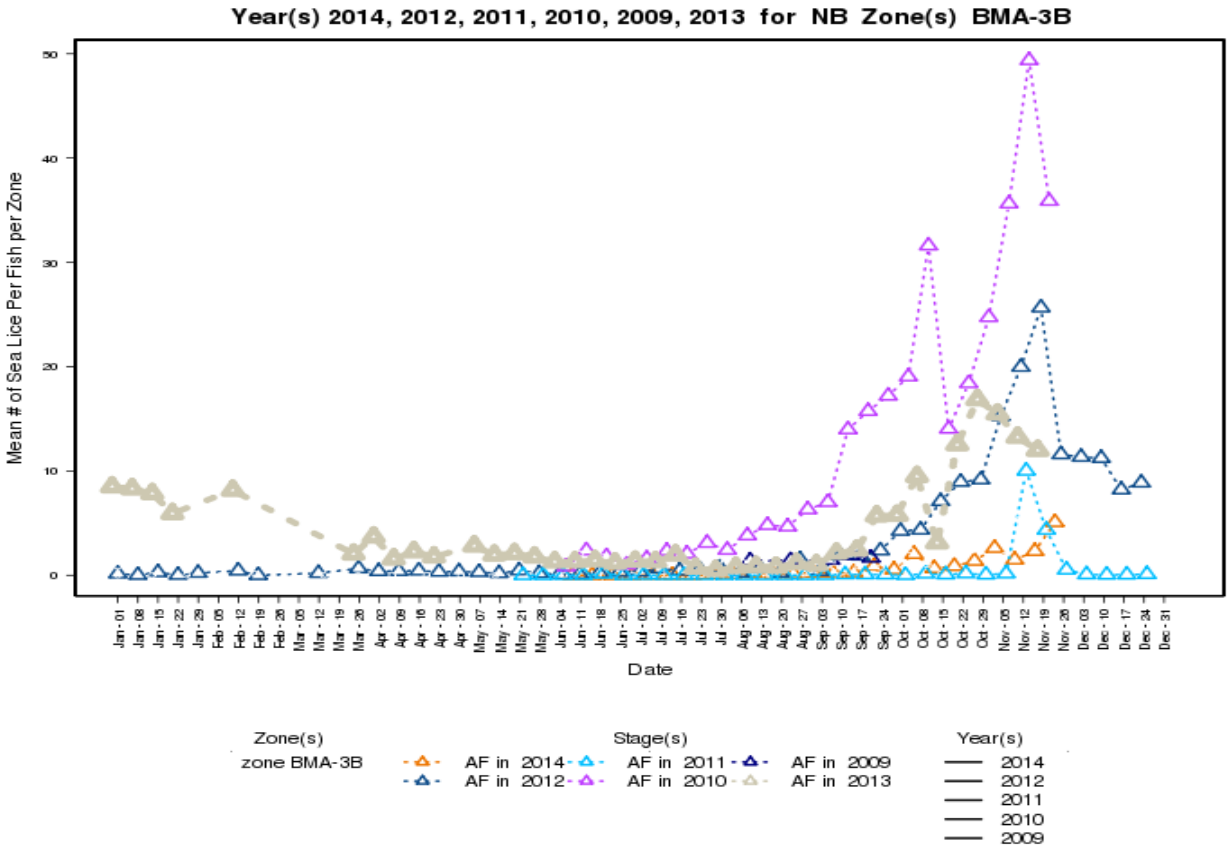

Year(s) 2014 for NB Zone(s) BMA-2B
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-2B
Stage(s)
AF in 2014
Year(s)
2014


Year(s) 2014, 2012, 2011, 2010, 2013 for NB Zone(s) BMA-2B
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-2B
Stage(s)
AF in 2014
AF in 2011
AF in 2013
AF in 2012
AF in 2010
Year(s)
2014
2012
2011
2010
2013


Year(s) 2014 for NB Zone(s) BMA-3A
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-3A
Stage(s)
AF in 2014
Year(s)
2014


Year(s) 2013, 2012, 2011, 2010, 2014 for NB Zone(s) BMA-3A
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-3A
Stage(s)
AF in 2013
AF in 2012
AF in 2011
AF in 2010
AF in 2014
Year(s)
2013
2012
2011
2010
2014


Year(s) 2014 for NB Zone(s) BMA-3B
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-3B
Stage(s)
AF in 2014
Year(s)
2014


Year(s) 2014, 2012, 2011, 2010, 2009, 2013 for NB Zone(s) BMA-3B
Mean # of Sea Lice Per Fish per Zone
Date
Zone(s)
zone BMA-3B
Stage(s)
AF in 2014
AF in 2012
AF in 2011
AF in 2010
AF in 2009
AF in 2013
Year(s)
2014
2012
2011
2010
2009

APPENDIX B

Aquaculture Bay Management Areas of New Brunswick