Sea Lice Management in New Brunswick

Prepared by Atlantic Canada Fish Farmers Association

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The following is an update to New Brunswick Sea Lice Management Report issued by the ACFFA in September 2011. Data for this report comes from the Decision Support System which is a data collection system that was developed in collaboration between New Brunswick salmon farmers and the Atlantic Veterinary College at the University of Prince Edward Island. Data are submitted by salmon farmers to a database maintained by AVC. AVC also performs third party audits of the salmon farm lice counts to verify accuracy in reporting. To further support this system, the ACFFA supported the AVC in the development of a sea lice monitoring certification program for farm technicians. This contributes to ensuring accurate counts are made based on the Sea Lice Monitoring Program which is part of the New Brunswick Fish Health Regulations and the Integrated Pest Management Plan for Sea Lice.

The New Brunswick salmon farming industry leads in salmon production in Atlantic Canada with a farm gate value that can reach up to $280 million and represents the province’s largest agri-food export.

In addition to being a key contributor to the provincial economy, salmon farming is a significant employer in coastal and rural communities throughout the region. In Charlotte County almost 20 per cent of the workforce is employed in aquaculture. New Brunswick salmon farming companies are all family-owned, and two of the largest producers also operate in Nova Scotia and/or Newfoundland. No one is more committed to the sustainability of their farm operations than salmon farming companies who work hand-in-hand with partners at the federal, provincial and community level.

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.

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

The three 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; to help break pathogens and support breaking the life cycle of sea lice
- Mandatory fallowing periods for all BMAs before restocking of any farm can occur
- Ensuring only salmon stocked in a single year are present at each farm site and within each management area; preventing older farmed salmon, which may have already been exposed to the parasite, from transferring it to incoming smolts

Salmon farmers use treatment products as a last resort only. However, like other farmers, they rely on the professional advice of veterinarians who have access to approved products when their animals are infected by a pathogen or threatened by parasites. Treatments can be authorized through a veterinarian’s prescription only.
The following report provides an overview of the challenges faced by salmon farmers in New Brunswick in sea lice management since 2008; processes that have been followed to support the implementation of an integrated pest management plan for sea lice management; a look at the R&D that supports product authorizations and farm management practices and an overview of the sea lice population in the bay management areas of New Brunswick from 2009 to 2012.

In this overview report, the sea lice populations are reported monthly by Bay Management Area. These data are obtained from an analysis of the sea lice counts submitted by each farming site within the specific BMA. The data in this report represent the average sea lice count for adult female lice, which are arguably the most critical life stage to control and 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 or other wild sources; therefore, salmon farmers have developed management practices to reduce the likelihood and severity of infestation.

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 result in increased lice populations.

Beginning in 2000 salmon farmers around the world had access to an anti-parasitic chemo-therapeutant, emamectin benzoate – the active ingredient in SLICE®. This was the only product registered 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 began work 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 had access to a variety of management tools for over a decade, the Atlantic Canadian salmon farming industry collaborated internationally, and continues to do so, on the evaluation and research of new management opportunities. The goal is to find tools that will enhance and/or complement farm management practices already in place.

To date, efforts by salmon farmers to make real and lasting progress have been very difficult. Lack of advancement is largely a result of the inability to make progress in achieving regulatory approvals for a full suite of treatment options - fundamental to an effective integrated pest management approach. In addition, timely authorizations or access to permits have also not always been available to support the evaluation or use of products under alternative delivery methods, such as well boats (whose use instead of tarpaulins result in a 75 per cent reduction in the quantity of product required for each treatment).

Managing sea lice is further complicated due to influences by both biological factors and environmental conditions. Sea lice numbers are impacted by a variety of factors including salinity and water temperature. In addition to issues impacting access to treatment options, 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.
and in 2012 we saw that these record high water temperatures remained 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.

**SEA LICE CHEMOTHERAPEUTANTS**

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. Extensive research is therefore, available to provide the necessary 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.

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. 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.

Health Canada’s Pest Management Regulatory Agency (PMRA), 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.

Products that have received Emergency Registration in Canada include:

**ALPHAMAX®**

This is the first alternative bath product recommended for use by the National Fish Health Working Group. Monitoring of this product was conducted for ten years in Norway; the results of this monitoring study 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, the NB Department of Agriculture and Aquaculture obtained emergency access to AlpaMax® for trials in an Bay Management Area 2A area where tolerance to SLICE® was most evident. This emergency access 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, 2010 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.

**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 eliminated; lice left in untreated pens can re-infect those already treated. This ultimately means more treatments are required and that low levels of residue chemical remain in the marine environment which can contribute to earlier onset of resistance to Salmosan®. To avoid the risk of resistance the farming industry has for the most part avoided using the product in 2011 and again in 2012.

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 bottlenecks impact IPMP for sea lice.

The application process for full federal licensing of this product is underway. However such an application must be accompanied by scientific and monitoring results which take time to complete and publish. We anticipate that the application process will be completed in 2013.

**INTEROX PARAMOVE®50**

Interox Paramove®50 is hydrogen peroxide - 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.

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 areas with the highest sea lice counts were already 14 plus degrees.

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. Treatments at higher high water temperatures require a lower dose which will also result in lower efficacy.

There is research underway on the efficacy of using Interox Paramove®50 as a neutralizing agent of the active ingredients in other sea lice chemotherapeutants. Lab studies with favourable results have been completed; field trials are pending.

Full product registration of Interox Paramove®50 is in progress with PMRA.

**CALICIDE®**

Calicide® is an in-feed treatment and use has been approved through Health Canada, Veterinary Drug Directorate. However, because Calicide® affects only early life stages of the sea louse, to be effective it must be used in conjunction with bath treatments that affect later stages of the sea louse.

**RESEARCH AND ALTERNATIVE MANAGEMENT OPTIONS**

Beginning in January 2010 the ACFFA has played an active role 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 agenda to deliver effective integrated pest management for sea lice. This research agenda has been focused on five key research 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 salmon farmers to improve 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
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

Over the past three years, significant industry financial and human resources have been invested into ensuring research critical to improving our knowledge and understanding of sea lice dynamics and management. Industry investment has resulted in leveraging investment from federal and provincial governments and the expansion of research collaborations.

Detailed reports of these research workshops are published at [http://www.atlanticfishfarmers.com/research-program-project-reports.html](http://www.atlanticfishfarmers.com/research-program-project-reports.html). Results from all research have been made public through workshops, communication with stakeholder groups at a variety of meetings, industry and DFO websites, etc.

Some significant findings that we can report from this research program include:
To date no sea lice bath treatment 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 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 tarps 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

Local research is continuing. Projects underway include:

- Evaluation on the use of cunner fish as a sea lice cleaner fish
- The effectiveness of mussels as a filter for sea lice nauplii
- The use of hydrogen peroxide as a neutralizing agent for the active ingredients in sea lice therapeutants, with field trials imminent.

Internationally, feed companies have developed formulations using natural herbs as 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, they are not currently on the Canadian Food Inspection Agency’s list of approved ingredients for feed products. Innovations in technology to mechanically remove and/or collect sea lice, also continues.

**NON TARGET SPECIES**

All field research and scientific monitoring conducted on AlpaMax® indicates that this product poses little to no risk to the marine environment or to non-target species when used as prescribed. To date, sediment and water quality testing has also shown little to no impact resulting from the use of Salmosan® treatments. 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 have been 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 over the past 5 years and lobster landings have increased steadily over time (see data below on lobster harvests in LFA 36 located in southwest New Brunswick.)
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.

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 - 2012

SLICE® was used exclusively for sea lice management on salmon farms up until July 2009. Based on an evaluation of sea lice bath treatments available in other countries, a decision was made to begin evaluating alternative treatments with AlphaMax® in July 2009.

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.

It should be noted that water temperatures in BMA 1 Passamaquoddy Bay hit record high temperatures, tolerance to SLICE® was increasing and 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. This factor, combined with the higher than normal lice loads left on the fish because of inadequate treatments 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 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. In addition salmon farmers invested in well boat technology; ultimately 3 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; although the treatment dose was adjusted to accommodate the higher water temperatures, 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, synchronized treatments and product rotations.

This plan 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 to the product. 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 seem to indicate that in 2011 the ability to have timely access to the appropriate treatment options enabled salmon farmers to control this parasite. However; it was also evident that it remains 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 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
The salmon farming companies again prepared a coordinated treatment strategy that included establishing treatment thresholds in each Bay Management Area, synchronized treatments and product rotations.

However; in late 2011 salmon farmers made 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 does not have the ability to implement a fully operational integrated pest management plan due to the lack of a suite of treatment products. Access to in-feed sea lice inhibitors is also not an option because of continued regulatory constraints. This has resulted in lost jobs, lost market access, a significant reduction in provincial tax revenue from this industry, and a critical loss to industry competitiveness.

Thus far in 2012 we have seen 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 are being 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.
TREND ANALYSIS BY BAY MANAGEMENT AREA

In 2010, the Atlantic Canada Fish Farmers Association, on behalf of the New Brunswick salmon farming industry worked with the Atlantic Veterinary College at the University of PEI to develop a data base to house the on farm sea lice data that could be used to support improved sea lice management and to provide regulators with reports on fish health management.

While there has been a significant effort to include data from 2009, not all data entry for that year has been complete. 2009 data are not available for BMA 3A or 3B.

The following charts are provided for each Bay Management Area and 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 on each chart.

Note that the Y-axis scale (numbers of lice) varies from one graph to another.
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 5. 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 2 throughout this monitoring period. A strategic treatment in the fall with of Interox Paramove®50 is scheduled. Water temperatures reach as high as 18 degrees in some areas of this Bay.
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 entered 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 1 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.
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 1 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 2.

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 rate.
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.
Sea Lice Management in New Brunswick October 2012

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 3 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.
The following graph demonstrates that over the past four years New Brunswick’s salmon farming industry has been relatively effective in keeping adult female lice populations at a manageable level. However, effectiveness cannot be maintained without access to a variety of management tools. These tools must include research support to develop non-chemical management options such as the use of cunner fish as cleaner fish, evaluation 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 also offer great promise but require changes to allowable feed ingredients. While the use of medicines and therapeutics is always a last resort, access to these products, approved for use in other countries for over ten years, must also be supported. If New Brunswick’s farming industry continues to rely on a small number of medicines, these products will lose their effectiveness and leave veterinarians with no tools to effectively treat their fish.

The access to a full suite of tools would considerably alter the graph below to provide fewer and smaller peaks. 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. 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.