

**Newfoundland and Labrador
Department of Fisheries, Forestry and Agriculture**

Sea Lice Integrated Pest Management Plan

Introduction and Guiding Principles

An Integrated Pest Management Plan (Integrated Pest Management Plan) is a comprehensive approach to effectively manage pests, including sea lice. Integrated Pest Management is used in many different situations including schools, hospitals, restaurants, hotel management, gardens, forestry management, agriculture and aquaculture. Integrated Pest Management is not a single control method but rather a series of control methods. The key components of an Integrated Pest Management Plan include accurate pest identification, understanding pest and host dynamics, preventative strategies, monitoring, decision making, control tactics, implementation, evaluation and research.

The aquaculture industry worldwide has an increased awareness of sea lice in Atlantic salmon farms. Sea lice surveillance, threshold levels and treatment options vary from region to region. Surveillance and treatment (timing and product used) will vary depending on lice species, climate, water parameters and available chemotherapeutants. The goal of any sea lice Integrated Pest Management Plan is to control sea lice by providing a management strategy that is science based and utilizes all available means (prevention, research, monitoring) to control the pest populations. This document should be used as a guideline for sea lice management for the province of Newfoundland and Labrador. The strategy put forward in this document recognizes the importance of both non-chemotherapeutic and chemotherapeutic approaches to sea lice management and control.

Guiding Principles

- The Integrated Pest Management Plan will not rely on a single management regime. A combination of management approaches will be utilized.
- On site monitoring and correct identification of sea lice is a crucial component of any sea lice Integrated Pest Management Plan. The training and tools must be made available to those individuals responsible for onsite monitoring.
- On site evaluation by the attending licensed aquaculture veterinarian, company and the Aquatic Animal Health Division will be conducted as part of an effective monitoring program.
- The use of chemotherapeutants will still be required and are used judiciously to mitigate tolerance/resistance.
- All chemotherapeutants must be under the direction of the attending licensed aquaculture veterinarian and must adhere to requirements dictated by the registration of that product and appropriate regulators.
- Research and development is encouraged.
- All data must be submitted to an agreed upon third party database.
- As new information becomes available, the Newfoundland and Labrador Sea Lice Integrated Pest Management Plan will be updated.

Sea Lice Biology and Life Cycle

- Sea lice are marine copepod crustaceans that belong to the family Caligidae. They are natural parasites of fish and are present in the marine environment. The most common species in Atlantic Canada are *Lepeophtheirus salmonis* and *Caligus elongatus*. *Lepeophtheirus salmonis* is the sea lice species of concern in Newfoundland and Labrador. Sea Lice have a complex life cycle. They have various moults between the egg stage and the adult stage and need a host to survive and to replicate. The speed of the life cycle is water-temperature dependent meaning that reproduction will be faster in the warmer water temperatures.

Monitoring

- Sea Lice Counts
 - Accurate and timely counting are crucial to the successful implementation of any Integrated Pest Management Plan. Important information to be collected includes the species of sea lice found, its life stage (eg. gravid, adult, mobile, or chalimus), and water temperature.
 - Regular counts must be conducted and licensees must meet the department's Minimum Recommendations for Sea Lice Counts.
 - According to the public reporting policy:
 - As of January 1, 2021, Licensees must report Sea Lice abundance numbers to the Aquatic Animal Health Division on a monthly basis and the operator must post sea lice abundance numbers publicly, on a monthly basis, on the industry association or corporate website. Further details as to sea lice reporting parameters will be determined through stakeholder engagement prior to this date.
- Training
 - It is crucial that training occurs for those conducting sea lice counts to ensure congruous counting methods and reliability of the results. The training program should be in line with a recognized standard. It is the responsibility of the aquaculture companies to ensure that their staff is adequately trained in conducting sea lice counts. This will ensure that those conducting the sea lice counts are providing accurate information.
- Sea Lice Bioassays
 - Sea lice bioassays are a necessary component of an effective sea lice Integrated Pest Management Plan. Bioassays are a scientific technique used to evaluate the level of sensitivity that the sea lice have for a particular chemotherapeutant. A bioassay is not readily available for all chemotherapeutants.
 - Licensees are required to participate in the department's sea lice bioassay program.
- Sea Lice Audits and Third Party Assessment
 - Sea lice audits are an essential component of the monitoring program. Independent audits and qualified third party assessments will identify training needs, minimize inaccuracies in the data and provide useful information to better understand the dynamics of sea lice on aquaculture farms.

- Licensees are required to participate in the department's sea lice auditing program.
- Third Party Database
 - A third party database such as FishiTrends is used to collect sea lice data (i.e., lice counts, treatments). This system will serve as a central repository for information. The data will assist veterinarians, companies, and policy makers to make decisions based on evidence-based veterinary medicine. This will enable aquaculture veterinarians and epidemiologists to monitor sea lice trends, determine treatment efficacy, follow tolerance/resistance patterns, observe regional differences and enhance mitigation/treatment strategies.
 - According to the Public reporting policy:
 - As of January 1, 2021, Licensees must report Sea Lice abundance numbers to the Aquatic Animal Health Division on a monthly basis and the operator must post sea lice abundance numbers publicly, on a monthly basis, on the industry association or corporate website. Further details as to sea lice reporting parameters will be determined through stakeholder engagement prior to this date.
 - According to the Integrated Pest Management Plan policy:
 - Licensees must submit sea lice numbers (where applicable) into an agreed upon third party database.

Treatment Timing and Criteria

- The use of chemotherapeutants is a necessary component of an Integrated Pest Management Plan. Prudent usage of authorized treatments is essential to ensure a particular product can be used when necessary. All treatments must be under the direction of a licensed aquaculture veterinarian and only products that are approved for use can be utilized. Coordinating the use of sea lice chemotherapeutants within one region is a crucial tool to disrupt the life cycle of the sea louse. The Bay Management Areas (BMAs) and Production Based Regions for salmon growing areas of Newfoundland and Labrador make this coordination possible.
- The data used to help guide veterinarians in the decision making process of when to treat and what chemotherapeutant to use includes:
 - species of louse
 - life stage of the louse
 - season
 - number of louse present
 - environmental conditions
 - species to be treated
 - any bioassays performed (if available); and
 - withdrawal time
 - government regulated sea lice thresholds

Non-Chemotherapeutant Control Strategies

- Non-chemotherapeutant control strategies are essential in preventing and minimizing the effects of sea lice. These strategies are important in:
 1. Prevention
 2. Mitigation; and
 3. Treatment.
- Fallowing
 - Fallowing of aquaculture sites between production cycles is an important mitigation strategy used throughout the world for sea lice control. Synchronous site fallowing within Bay Management Areas or Production Based Regions for Atlantic salmon marine cages is required.
 - According to the Site Fallowing policy, all finfish sites must be fallowed:
 - following each production cycle or when all cultured fish are removed from the site for any other purpose; and
 - the length of the fallow period will be:
 - in accordance with the minimum period specified by Bay Management Area principles (Bay Management Agreement) for licensed sites producing Atlantic salmon, or
 - 12 months for licensed sites producing finfish other than Atlantic salmon and steelhead trout, or
 - at least 5 months for licensed sites producing steelhead trout in the inner Bay d'Espoir region.
- Siting
 - Siting farms away from known wild salmonid populations such as salmon rivers will help prevent the spread of sea lice from the wild population to the farmed population and vice versa. Siting farms in regions considered to be medium to highly dynamic is desirable over low energy sites.
- Site Separation
 - According to the Site Separation policy:
 - Existing finfish sites (defined as sites approved prior to the enactment of this policy) that are less than 5000 meters apart must meet a minimum requirement of 1000 meters apart.
 - New finfish sites (not Atlantic salmon), not operating under a BMA agreement, (defined as sites not approved) must be a minimum of 5000 meters between site boundaries.
 - New finfish sites growing Atlantic salmon must operate under the BMA principles.
 - Applications that have proposed sites less than the minimum site separation distances will not be accepted by the department.
- Year Class Separation
 - According to the Single Year-Class policy:
 - Licensees must comply with the stocking schedule outlined in the Bay Management Areas Agreement for Atlantic salmon.
 - Multiple year-class stocking of cleaner fish may be permitted on a case-by-case basis, as approved by the Minister.

- Fish Health Management
 - Maintaining a healthy population of fish on an aquaculture farm will minimize the effects of sea lice. Aquatic animal health surveillance, vaccination, proper nutrition, good husbandry practices, proper biosecurity and veterinary oversight will help maintain a healthy population. The Aquatic Animal Health Policies outline several requirements for licensees regarding surveillance, reporting, contingency planning and Integrated Pest Management Plans to optimize aquatic animal health.
- Cleaner Fish
 - Other regions around the world are using cleaner fish, such as wrasse, to consume sea lice off farmed salmon. In Atlantic Canada, cleaner fish used as part of an Integrated Pest Management Plan include Cunners (*Tautoglabrus adspersus*) and Lumpfish (*Cyclopterus lumpus*). Licensees who operate farms with cleaner fish are required to follow the department's policies to ensure the health of these species.
 - Some examples include, but are not limited to:
 - Transfer and Transport Permits
 - Aquatic Animal Health Finfish Surveillance
 - Aquatic Animal Health Reporting
 - Aquatic Animal Disease Contingency Plan
- Other Non-Chemotherapeutant Strategies
 - Other non-chemotherapeutant strategies are being used to control and mitigate sea lice. These can include physical removal, sea lice traps and specially designed cages. There is constant research and development in this area of sea lice control and different options will be available in the future.

Tolerance and Resistance Avoidance

- Coordinated and Timed Treatments
 - Coordinated and timed treatments will decrease the infective pressure within that region and consequently decrease the number of treatments required to maintain sea lice below a threshold. All licensees who are growing salmon are required to adhere to the Bay Management Principles as outlined in the Bay Management Agreement. The use of Bay Management Areas (BMAs) and Production Based Regions allow for this approach to occur in Newfoundland and Labrador.
- Sea Lice Bioassays
 - Sea lice bioassays are a useful tool in not only determining which chemotherapeutant should be used within a region but also in following trends and evaluating effectiveness of a treatment. Bioassays must be performed on a regular basis, in a consistent manner, by qualified individuals. A single bioassay cannot determine tolerance or resistance within a sea lice population.

- Chemotherapeutant Monitoring
 - Monitoring the sea lice population before and after treatment is one of the most important tools in determining the effectiveness of a treatment. Target dose monitoring in the feed, flesh, mucous or the water must be incorporated into any monitoring program.

Research and Development

- Epidemiology Studies
 - Epidemiology studies evaluating risk factors provide additional data to support the lice data and bioassay results. In addition, information from the third party sea lice database would provide researchers and veterinarians the data required to conduct analysis. The information collected will enable aquaculture veterinarians and policy makers to make evidence-based decisions based on science.
- Research and Development
 - Research and development is required in many areas of the Integrated Pest Management Plan.
 - Some examples include:
 - Cleaner fish
 - Vaccines
 - Non-chemotherapeutant approaches
 - Monitoring response to a mitigation strategy
 - Oceanography