



PESTICIDE USE TREATMENT PLAN

Permit Application Number: 877-0013-25-28

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TABLE OF CONTENTS

Table of Contents	2
Integrated Pest Management	3
Prevention	3
<i>Area Based Management</i>	3
<i>Drifters</i>	3
<i>Barriers</i>	3
Pest Identification	4
Monitoring & Thresholds	4
<i>Distribution of Pests</i>	4
<i>Monitoring Methods</i>	5
Treatment Methods	6
Selection of Pesticide	6
Pesticide Use	6
<i>Well Boat</i>	6
<i>Tarp</i>	7
Other IPM Treatment Options	7
<i>In-feed treatment (SLICE®)</i>	7
<i>Mechanical Delousing (SkaMik 1.5)</i>	8
<i>Harvest</i>	8
Choosing a Treatment Method	8
Efficacy Evaluation	9
Environmental Protection Strategies	9
Peroxide Use	9
Wild Fish Interactions	10
Research and Development	10
Handling Peroxide	11
Transport & Storage	11
Mixing & Calibrating	11
Spills	11
Appendix 1 - Area Specific Information	12

INTEGRATED PEST MANAGEMENT

Grieg Seafood BC Ltd. (Grieg) uses an Integrated Pest Management (IPM) approach that involves identification, prevention, setting thresholds, monitoring levels and rotating treatment tools to ensure the continual efficacy with any particular method when mitigation is necessary. Additional information regarding Grieg's IPM principles is described in the Sea Lice Control Group Policy.¹

PREVENTION

Area Based Management

Area Management Zones (AMZ) for all Grieg's active sites are included in the Marine Finfish Aquaculture Licence, issued under the *Fisheries Act* (Page 1, Location and Legal Description)² based on hydro connectivity modelling³ using a 3-day connectivity period. The sites listed in the Appendix 1- Area Specific Information are designated as one zone and are managed as follows:

- only one species cultured at a time
- practice single year-class and all-in, all-out stocking
- coordinated sea lice treatments

There are no other finfish aquaculture companies operating sites in Grieg's AMZ's.

Drifters

Grieg's Environmental Department has custom built 20 cross-vane style current powered drifters equipped with satellite tracking devices. Grieg has deployed these drifters in all the AMZ's to better understand how the sites are connected by ocean currents and the unique hydrodynamics that may influence site level environmental conditions. This information is considered by Grieg's Veterinarians when developing and implementing mitigation strategies.

Barriers

Grieg has been trialling semi-closed systems at suitable sites on the east and west coast of Vancouver Island since 2019⁴. This system utilizes retractable barriers, which are capable of being lowered to 15 metres, fully encapsulating the sides of the farm. This has several benefits, including preventing the lateral interaction of wild and farmed salmon populations and providing protection for farmed populations from harmful algae. During periods when the barriers are down, the system uses an innovative oxygen technology to address low-oxygen levels within the farm system to ensure the welfare of

¹ [Group Policy - Sustainable Farming – Sea lice Control](#)

² [Marine finfish B.C. aquaculture licence and conditions of licence](#)

³ [Hydrodynamic Connectivity between Marine Finfish Aquaculture Facilities in British Columbia](#)

⁴ [Semi-Closed Containment Systems at Grieg BC Farms](#)

the farmed population. To date, trials have shown promising results in the frequency or need to treat farmed populations within the system for sea lice.

PEST IDENTIFICATION

Sea lice are parasitic copepods (Copepoda, Caligidae) found in the marine environment. There are two genera, *Lepeophtheirus* and *Caligus*, which are commonly found on both wild and farmed salmonids. The species regulated by the Department of Fisheries and Oceans (DFO) in BC waters is *Lepeophtheirus salmonis* (and is the species referred to as “lice” throughout the document). *Caligus* is not regulated but required to be monitored as per the conditions of licence.

In a life cycle, the copepod goes through 2 larval stages (nauplii, copepodid) before entering a chalimus stage denoted by a specialized frontal filament that is used to attach to the host. Upon reaching the pre-adult stage the louse becomes motile before finally morphing into reproductive adults. Motile lice can transfer from wild adult returning salmon in early summer and fall.

All Grieg staff monitoring sea lice are trained on how to identify, record, and report the following:

1. *Lepeophtheirus* counted by the following life stages
 - Chalimus
 - Pre-adult
 - Adult male
 - Adult female (non-gravid)
 - Adult female (with egg-strings)
2. *Caligus* (all stages)

Additionally, staff have access to sea lice identification and count sheets to assist in identification and recording. Grieg’s Fish Health staff also assist in training and routinely observe site staff to ensure that lice are correctly identified. The DFO completes quarterly audits⁵ to ensure compliance in our sea lice identification.

MONITORING & THRESHOLDS

Distribution of Pests

Sea lice levels, survival and fecundity are influenced by a number of factors including adult wild returns (more adult wild returning salmon = more lice), salinity (lower salinity = fewer lice as sea lice do not tolerate lower salinity), temperature (higher temperatures = fast reproduction, high viability, lower fecundity during summer months), oceanographic factors impacting distribution, and presence of filter feeders such as mussels that feed on lice and other natural zooplankton.

⁵ [DFO marine finfish aquaculture audit activities in British Columbia](#)

To limit the interaction between out-migrating smolts and the fish on the site, lice levels are monitored as required in the conditions of the Marine Finfish Aquaculture Licence (Section 6, Appendix 13)⁶ If at any time the lice levels rise above the specified average of motile lice (pre-adults and adults) per fish sampled, mitigation measures must be implemented to reduce the lice levels, which routinely increase late summer, early fall and winter with returning adult wild Pacific salmon.

The distribution and abundance of sea lice is tracked by the counting events completed on each site (described below in the section [Monitoring Methods](#)). The information collected is made available to Grieg's Licenced Veterinarians to determine or prescribe treatment mitigation, as required.

Monitoring Methods

Sea lice sampling is required on all sites as per the Conditions of Licence, and the sector's Integrated Pest Management Memorandum of Understanding (MOU).

All active sites complete weekly counting events from March 1- June 30 (outmigration period) and monthly counting events during the rest of the year (at a minimum). Sampling is completed as set out in the Conditions of Licence (Section 6, Appendix 13).

When a count is required, there are two types of counting events.

- "counting event" - the physical counting and recording of sea lice on farmed salmon from a minimum of three stocked pens. For sites with fewer than three stocked pens, all pens must be counted. Counts must be completed within a five-day period. These are routine counts that include a reference pen (i.e., sampled during each event) to give a representation of the average sea lice population at the site.
- "all pen counting event" - the physical counting and recording of sea lice on farmed salmon from all stocked pens. Counts must be completed within a seven-day period. These counts are conducted before and after a treatment is conducted and during the first week of March (start of the outmigration period).

When counting a pen, the following steps below are taken. These steps are usually performed by two to three people, depending on staff availability:

- Adequate netting is placed under sampling area to ensure escapes cannot occur.
- A netted seine is used to capture the fish within the pen.
- Fish are removed from the seine using a dip net and placed into an anaesthetic bath before examination. Only a few fish are placed in the bath at a time to ensure adequate oxygen.
- The bath consists of a tricaine methanesulfonate (TMS) solution used to sedate the fish prior to handling to reduce stress. TMS use is prescribed by the Veterinarian.
- Fish are handled carefully in the water as they are examined while identifying the presence of *Lepeophtheirus sp.* and *Caligus sp.*

⁶ [Marine finfish B.C. aquaculture licence and conditions of licence](#)

- Staff count and categorize any lice observed on the fish being sampled.
- Once the fish have been thoroughly examined for sea lice, they are carefully returned to the pen to recover.
- The process is repeated for twenty fish in every sampled pen.
- When sampling is complete, water in the anaesthetic tote is examined for detached sea lice. These lice are categorized, counted, and included when calculating the average sea lice population at the site.

The recorded results are entered into a database called FishTalk. FishTalk is available to the Veterinarians, Fish Health Team and Managers for the continual review and assessment of sea lice populations on the sites.

Sea lice counting events are reported to the DFO monthly or more frequently, as required, under the Conditions of Licence (e.g., pre and post treatment counts).

TREATMENT METHODS

When sea lice counts are approaching or have exceeded the threshold on the sites, mitigation measures are implemented to reduce the sea lice population levels at the site and in the area.

SELECTION OF PESTICIDE

The only pest control product registered in Canada under the *Pest Control Products Act* (PMRA) for the topical removal of sea lice from aquaculture fish in the marine environment is Interlox Paramove® 50 (active ingredient Hydrogen Peroxide, registration number: 31393). Paramove 50 is only used as directed by Grieg's Veterinarian in accordance with the directions in the product label or as otherwise permitted by the PRMA. Directions on the label that are followed include but are not limited to: water sampling, environmental conditions, PPE, starve timing, site restrictions and frequency of application.

PESTICIDE USE

Paramove 50 treatments will take place in either a well boat or a tarp designed specifically for this purpose. This method is generally used on fish that are larger (i.e., smoltified/ >200g) and have healthy gills, during good environmental conditions, when ocean temperatures are below 14°C.

Grieg has been successfully conducting Paramove 50 treatments in tarps and well boats since 2017. The availability of this treatment method is important to maintain an effective IPM.

Well Boat

- Grieg's 70-metre well boat, the Ronja Islander, is equipment to treat fish with hydrogen peroxide.

- Fish are seined into a shallowed net pen. Oxygen is added, using dispersion and diffusion equipment utilized as needed.
- Fish are pumped from one pen into the holds for the Veterinarian's prescribed treatment time at the prescribed dosage.
- During treatments, staff monitor fish behaviour, the concentration/circulation of peroxide and environmental conditions in the holds.
- After the dosing time, the vessel holds are flushed with sea water to dilute the peroxide. Staff monitor the dilution rate to ensure there is adequate dilution before releasing the treatment water from the vessel.
- The vessel is equipped with 2 systems that recapture dislodged sea lice. Eight krone filters (150 micron) and a back flushing filter (100 micron). Sea lice are disposed of on land.
- To improve fish welfare and minimize time spent in the well boat, where possible, the well boat remains adjacent to the system during treatment and flushing.
- Fish are then pumped back into the pens on the site.

Tarp

- Tarpaulin treatment requires fish remain in a shallowed net pen.
- A tarp encompasses the net pen and is securely tied in place.
- Oxygen is added, with dispersion and diffusion equipment utilized as needed.
- Once fish are settled and water is circulating within the tarp, Paramove 50 is added, and water monitored to ensure prescribed concentration within the tarp.
- During treatments, staff monitor fish behaviour. A sea lice recapture system must be in place, according to the pesticide use permit requirements.
- After maximum contact time, tarp is removed, and air circulation continues to run, to help neutralize peroxide.

OTHER IPM TREATMENT OPTIONS

In-feed treatment (SLICE®)

- Feed is blended with emamectin benzoate (a parasiticide) and fed to the fish at a veterinarian-prescribed rate for a prescribed number of days. Feed is sampled to ensure the correct dosage has been milled.
- Generally used with smaller sized fish prior to the outmigration period to provide extended protection. Infeed treatments are generally not utilized on harvest size fish due to the regulatory withdrawal periods.
- Fish must be actively eating (i.e., good environmental conditions) to achieve the best results.

Mechanical Delousing (SkaMik 1.5)

- The Coastal Server work vessel is equipped with the SkaMik 1.5 system that has six delousing lines. Each line has 18 large spray nozzles and 12 rotating soft brushes that remove lice from the fish.
- Fish are pumped from one pen, through the mechanical treatment lines and then out to an adjacent empty pen.
- It is equipped with a sea lice recapture system. Dislodged lice will be collected via a 200µm drum filter and 150µm belt filter (at a minimum) and a 700 µm filter on the outflow pipe. Sea lice are disposed of on land.
- This system is generally used on fish that are between 1 kg and 5.6 kg during good environmental conditions and when sea lice counts are approaching or have exceeded the threshold on the sites.

Through a sector MOU, Grieg has access to other mechanical tools including the Cermaq Canada's Hydrolicer or SFI vessels and MOWI Canada West's well boat, the Aqua Tromøy, which administers freshwater baths.

Harvest

When fish are at harvestable weight, harvesting is also used as a mitigation option.

CHOOSING A TREATMENT METHOD

When choosing a treatment method, the Veterinarian considers the following:

- Availability of resources
- Timing of the wild salmon outmigration and in migration
- Environmental conditions
- Fish size and harvest plan
- Fish condition
- Previous treatments completed at the site
- Treatment efficacies and treatment related fish mortalities
- Results of sea lice bioassays

Tarpaulin treatments will only be conducted if fish size limitations are exceeded, or if sea lice outbreaks exceed the treatment capability of well-boat assets. Under the permit, a maximum of 2 tarpaulin treatments per pen per year can be completed.

When determining which treatment mitigation to utilize, the Veterinarian considers previous treatment mitigation methods used, the environmental conditions (e.g., dissolved oxygen, water temperature, carbon dioxide, pH, turbidity, plankton) and fish health conditions (e.g., recent handling events, gill health and fish size).

Grieg and Scoot Science launched an innovative ocean analytics and data management platform, the SeaState Dashboard, that provides real-time data on ocean environmental

conditions to Grieg and the Veterinarian.⁷ This platform integrates over a million data points a day and, using AI technology, predicts the environmental conditions expected on the farm in the next 5 days. Treatment will not be carried out if unfavourable environmental conditions are present as described in the Paramove 50 label.

Detailed matrices have been developed to assist in determining how water quality conditions interact with fish behaviour during mechanical and hydrogen peroxide bath treatments and recommend treatment guidelines to ensure the health and welfare of the treated fish.

EFFICACY EVALUATION

All pen counting events are completed pre and post treatment for all treatment methods (excluding harvest) to determine the efficacy of the treatment.

The efficacy of each treatment must be measured and made available to the DFO if less than 60% for in-feed therapeutant and bath sea lice mitigations or upon request for mechanical treatments.

All mortalities (including any wild catch) after treatment must be classified, removed, and disposed of at a licenced facility on land. The mortalities related to the treatment activities are reported into FishTalk and reviewed by the Veterinarian and fish health team.

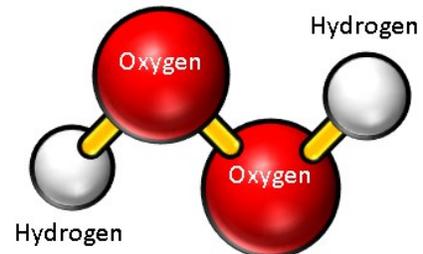
ENVIRONMENTAL PROTECTION STRATEGIES

PEROXIDE USE

During peroxide treatments, the holds of the Ronja Islander are filled with ocean water and Paramove 50 is slowly added until the prescribed concentration is reached as directed by the label. This is closely monitored by water sampling and titrations to ensure concentration is matched. These water sampling and titration events are taken at the frequency described on the Paramove 50 label.

Hydrogen peroxide is unstable and quickly breaks down into its two elements of oxygen and water and is considered non-persistent in the environment.⁸

This aligns with a recent study on hydrogen peroxide dispersion, which found that only low concentrations of hydrogen peroxide were detected at the point of discharge on the Ronja Islander and not further into the environment.⁹



⁷ [Sea State Dashboard and Grieg Seafood BC.](#)

⁸ [DFO Science Advisory Report 2021/013](#)

⁹ Report available from Grieg upon request

The use of hydrogen peroxide on non-target species is not expected to pose risks of concern to non-target marine organisms such as mammals, crustaceans, birds, adult lobsters, lobster larvae, copepods or fish.¹⁰

As a requirement of the pesticide use permit, the environment is visually observed during and after treatment for any effects on non-target organisms. Since 2017, there have been no visually observed effects on non-target organisms.

“No Trespassing” “Keep Back 15m” and “Warning Pesticide Use Notice” signs are posted on the farm and treatment vessel when treatment is occurring to restrict access by the public.

WILD FISH INTERACTIONS

Measures regarding fish incidentally caught during treatments are prescribed in the aquaculture Conditions of Licence (Appendix 11, Part 6)¹¹. Grieg has procedures in place to observe, assess and communicate the presence of wild fish in the pens prior to and during treatments. Where there is an abundance of wild fish entering the pens, the treatment is stopped, and alternate measures are employed.

RESEARCH AND DEVELOPMENT

As a requirement in the pesticide use permit, a summary of the ongoing research efforts by Grieg to investigate the feasibility of additional non-chemical sea lice control methods (including, but not limited to, the use of mechanical removal technology, cleaner fish, and freshwater treatments) is submitted annually.

As a requirement of the pesticide use permit, dosing requirements listed on the label must be adhered to. The label specifies a dosage higher than required to effectively treat lice on the BC coast. As such, Solvay Chemicals Ltd. has been issued an experimental permit for the use of Interlox Paramove 50 (Hydrogen Peroxide) to assess if lower concentrations of Paramove 50 can be used to effectively remove lice, while preventing lice resistance to Hydrogen Peroxide. This permit was given by Health Canada Pest Management Regulatory Agency.

Grieg is completing the research on behalf of Solvay Chemicals Ltd, to meet the requirements of the experimental design (i.e., a control and 3 reduction studies). This research will be used to amend the label on Interlox Paramove 50 so that lower concentrations could be used for the entire BC aquaculture industry. This would lead to an overall reduction of the amount hydrogen peroxide that would enter the environment.

The experimental permit and its limits will only be used when valid.

¹⁰ [PMRA Registration Decision RD2016-18](#)

¹¹ [Marine finfish B.C. aquaculture licence and conditions of licence](#)

HANDLING PEROXIDE

TRANSPORT & STORAGE

Workers involved in transport and storage must wear appropriate PPE as described in the Paramove 50 label.

Paramove 50 is transported safely and securely during transport in appropriate containers (i.e., IBCs) by authorized 3rd party transport contractors.

Paramove 50 is stored off-site in a fenced and secure location prior to application at sites. Only trained employees handle the peroxide IBC's according to standard operating procedures.

Empty containers are returned to the distributor when new IBC's are delivered.

MIXING & CALIBRATING

Workers involved in mixing and calibration must wear appropriate PPE as described in the Paramove 50 label.

Mixing on the well boat is completed automatically by entering the time and dosage on the specific panel. When it is time to treat, the inject button on the panel is pushed and the dosage is delivered to the wells. Volumes of peroxide used are maintained to ensure that system is calibrated and dosing correctly.

For tarp treatments, the dosage is calculated by using the volume of the pen and an injector system is used to distribute the peroxide into the pen.

For either the well boat or tarp treatments, a person with a valid Pesticide Applicator (Aquaculture-Marine-Hydrogen Peroxide Only) certificate supervises the treatment.

SPILLS

In the event of an incident involving hydrogen peroxide the guidance in the product Safety Data Sheet and Grieg Seafood Emergency Response procedures will be used.

Appropriate PPE as described in the Paramove 50 label will be used whenever in contact with hydrogen peroxide.

The following steps must be immediately considered in the event of a spill.

1. Eliminate all ignition sources if safe to do so.
2. Remain outside the zone of influence of the leak/spill until appropriate PPE is put on.
3. Do not begin working alone and cleaning up a hydrogen peroxide leak or spill without first notifying someone and establishing a check-in process.
4. If someone has been affected by vapours, evacuate personnel to safe areas.
5. Keep people away from and upwind of spill/leak. See first aid guidance in the product Safety Data Sheet.

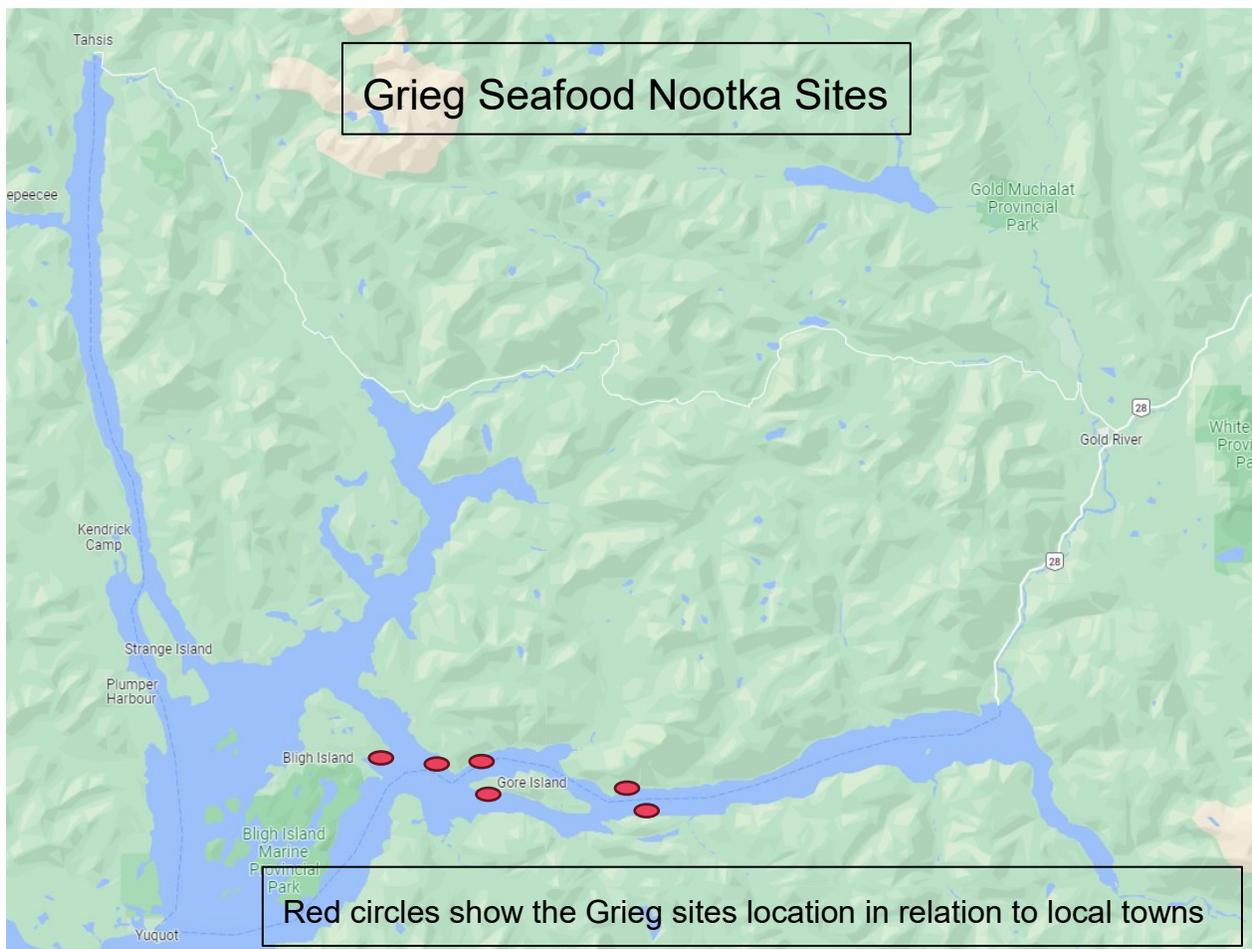
6. Contain the spill/leak and dilute with fresh water.

Pesticide spills that result in impacts not authorized by or consistent with the permit, will be immediately reported to Emergency Management BC at 1-800-663-3456.

APPENDIX 1 - AREA SPECIFIC INFORMATION

The treatment locations are Crown land leases located in Nootka Sound. The Crown land leases file numbers 14111084 (Atrevida), 1405634 (Concepcion), 1411100 (Gore), 1411168 (Muchalat North), 1411064 (Muchalat South), and 1411068 (Williamson). The treatment area for the 6 sites in the application are as follows, Atrevida 4.05ha, Concepcion 4.05ha, Gore 4.05ha, Muchalat North 1.49/1.70ha, Muchalat South 1.49/1.70ha, and Williamson 1.49/1.70ha for a total treatment area of 16.62/17.25 hectares.

The nearest community is Gold River BC.



The light blue box in each of the operational maps below represent the pesticide use area.

