

**PLACENTIA BAY ATLANTIC SALMON AQUACULTURE PROJECT
ENVIRONMENTAL EFFECTS MONITORING PLAN (EEMP):
PERFORMANCE OF EUROPEAN-STRAIN TRIPLOID FISH**



GRIEG NL

**Placentia Bay Atlantic Salmon Aquaculture Project
Environmental Effects Monitoring Plan:**

Performance of European-strain Triploid Fish

Prepared by

LGL Limited
Box 13248, Station A
388 Kenmount Road
St. John's, NL
A1B 4A5

Prepared for

Grieg NL Seafarms Ltd.
205 McGettigan Blvd.
Marystow, NL
AOE 2M0

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1.0 Introduction

As part of the environmental assessment (EA) process for the Placentia Bay Atlantic Salmon Aquaculture Project, Grieg NL was required to prepare and submit Environmental Effects Monitoring Plans (EEMPs) subsequent to the completion of the Environmental Impact Statement (EIS) but prior to initiation of hatchery operations (see Minister's release letter of 5 September 2018). Additionally, the release of the Placentia Bay Atlantic Salmon Aquaculture Project from further EA by the Minister of the Department of Municipal Affairs and Environment (DMAE) on 5 September 2018 was subject to Grieg NL meeting a series of terms and conditions including eight components requiring an EEMP. The EEMP for the Performance of European-strain Triploid Fish is presented in this document. As stipulated in the EIS Guidelines, this EEMP is designed to monitor and document how well Grieg NL's farmed Atlantic salmon perform in terms of health, growth, and survival at the sea cage sites. As described in Section 2.4.1.1 of the Grieg NL EIS (LGL 2018), European-strain triploid Atlantic salmon have not previously been farmed in Newfoundland but triploid Atlantic salmon have been successfully farmed for years in Norway, Scotland and Tasmania.

Grieg NL is committed to implementation of this EEMP as a component of its Placentia Bay Atlantic Salmon Aquaculture Project. The organization of this document closely follows the requirements outlined in Section 7.4 of the EIS Guidelines (DMAE 2018). However, a section related to cumulative effects has not been included in this EEMP given that it is not applicable. The EEMP will be reviewed on an annual basis and updated as needed.

2.0 Objectives and Scheduling of Monitoring

The objective of the EEMP for 'Performance of European-strain Triploid Fish' is to monitor the health, growth, and survival of the Atlantic salmon that Grieg NL will grow at its sea cage sites in Placentia Bay. Grieg NL will do this on a continuous basis as part of its normal operational procedures. Results of the monitoring will be documented and summarized in the annual report for EEMPs. Note that this EEMP does not deal with potential effects of the Project on the marine environment. Potential interactions between Grieg NL's farmed Atlantic salmon and the marine environment are addressed in other Project EEMPs, namely the Benthic Habitat Health EEMP and the Genetic and Ecological Interactions of Escaped Farmed Atlantic Salmon with Wild Atlantic Salmon EEMP.

3.0 Monitoring Design/Methodology

There are three primary components of the fish performance EEMP: (1) health; (2) growth; and (3) survival. Monitoring these parameters and employing adaptive measures to improve fish performance is considered essential to the success of Grieg NL's Project. As stated in the EIS Guidelines, the purpose of an EEMP is to verify effects predictions as well as the effectiveness of mitigation measures. There were no effects predictions tied directly to the performance of European-strain triploid salmon. However, based on information available at the time the EIS was prepared (early 2018), Grieg NL did include estimates of fish survival (percent mortality) and growth (Economic Feed Conversion Ratio; EFCR) at its sea cage sites, which can serve as benchmarks for comparative purposes.

As described in the EIS, Grieg NL has numerous procedures in place to maintain the health of its farmed salmon. These procedures are included in Grieg NL's Fish Health Management Plan and relevant Standard Operating Procedures (SOPs). Fish health, including instances of disease and parasitic sea lice, will be routinely monitored at active sea cage sites. The frequency of routine disease sampling will be determined through consultation with veterinarians. The frequency of parasite sampling will depend on time of year and water temperature. During June to November, parasite sampling will be conducted weekly when water temperatures $\geq 5^{\circ}\text{C}$, and biweekly when water temperatures $< 5^{\circ}\text{C}$. During December to May, parasite sampling will be conducted monthly to bimonthly. Fish growth and survival will be carefully monitored as part of routine operational procedures.

3.1 Fish Health

Fish health at the sea cage sites will be monitored by Grieg NL personnel following the procedures prescribed by the Aquatic Animal Health Division (AAHD) of the Department of Fisheries and Land Resources (DFLR). Fish health monitoring procedures are clearly outlined in the Grieg NL Fish Health Management Plan. Fish are routinely monitored by staff for not only physical changes such as signs of fin erosion, lesions, pigmentation problems and parasites, but also for changes in fish behaviour. Active (in response to health issues) and passive (routine checks) surveillance programs will be implemented in consultation with a private veterinarian and the provincial veterinarian. A designated veterinarian will oversee a surveillance visit on each active sea cage site at a minimum of every 30-45 days (see AP 29 in DFLR 2019a). The frequency of surveillance visits may increase if the fish mortality rate increases. Fish health sampling will occur as part of a routine assessment of fish health status whenever there is an increase in unexpected mortalities, and prior to fish harvesting at a sea cage. These data will be summarized as part of this EEMP.

3.1.1 Pathogens

Three of the most common types of pathogens that can compromise the health of salmon at the sea cage sites are viruses, bacteria and parasitic sea lice. Key steps in minimizing the susceptibility of farmed salmon in sea cages to these naturally occurring pathogens include vaccination and health screening, both of which will occur in the RAS Hatchery prior to fish being transferred to the sea cages. After smolt have been transferred to the Post-Smolt Facility but prior to their transfer to sea cages, they will be vaccinated as per the specific recommendations of the provincial veterinarian in consultation with Grieg NL's private veterinarian. A health check by a provincial veterinarian will be conducted within the 45-day period preceding transfer to sea. This check will sample a number of fish from each tank holding fish set for transfer to sea. The number of fish sampled will depend upon input received from the private and provincial veterinarians. Fish will not be transported if there are any health concerns, and not until appropriate transfer permits are issued by the regulatory authorities, which may include: Fisheries and Oceans Canada (DFO), DFLR, and the Canadian Food Inspection Agency (CFIA).

As outlined below, personnel will routinely monitor for behavioural changes and changes in physical appearance in the farmed salmon in sea cages, serving as early warning indicators for issues with fish health.

3.1.1.1 Disease and Other Health Issues (Non-parasitic)

Fish must be routinely monitored for signs of disease and other health issues. As such, all Grieg NL sea cage personnel will be trained to recognize normal fish appearance and behaviour. Visual observations which may indicate a health problem in farmed salmon include but are not limited to the following.

- **Physical appearance changes** - colour change, scale loss, external lesions, increased respiration (opercular movements), deformities, and protruding eyes.
- **Behavioural changes** - loss of normal swimming and schooling behaviour, flashing, failure to elude capture, easily disturbed, panicked, erratic swimming, diminished response to feeding, and gasping at the surface.

Grieg NL will routinely (even in the absence of visual signs of potential health issues) sample salmon at each sea cage. The frequency and number of samples associated with this routine sampling will be determined in consultation with the private and provincial veterinarians. It is advantageous to couple these sampling events with parasite checks and efforts will be made to coordinate routine health checks for changes in physical appearance at the same time salmon are checked for parasites (see Section 3.1.1.2 below). Additionally, Grieg NL will routinely collect tissue samples from farmed salmon to check for health issues. The type of tissue sample and frequency of sampling will depend upon input received from the private and provincial veterinarians.

If changes in either physical appearance or behaviour are noted by Grieg NL personnel monitoring the sea cages and/or if there is a noteworthy increase in mortality (i.e., higher than the predicted normal rate), fish will be sampled from the sea cage and closely inspected for specific changes in physical appearance. Sampling numbers will depend upon input received by the private and provincial veterinarians. Changes in physical appearance will be documented and the advice of veterinarians will be acquired.

In some cases, specific combinations of changes to physical appearance and behaviour can be used to identify the type of disease in Atlantic salmon. However, in many cases, symptoms are similar across diseases. Ultimately, the presence of a disease will require confirmation through analysis of blood and/or tissue samples as determined by the private and provincial veterinarians.

During fish health sampling, the gill scoring system may also be employed. The advantage of gill scoring is that it is simple and consistent, thereby allowing for tracking of fish health at each sea cage site throughout the Project. These data are expected to assist with managing potential gill maladies in the farmed salmon. Emergent gill diseases and disorders among Atlantic salmon reared in sea cages, such as amoebic gill disease (AGD), cause significant losses in aquaculture. Although not currently a concern in Newfoundland, AGD has been detected in Atlantic salmon in British Columbia.

3.1.1.2 Parasites

The DFLR has stipulated in their Aquaculture Policy and Procedures Manual (DFLR 2019a) that all aquaculture operators must implement an Integrated Pest Management Plan (IPMP). This Aquaculture Policy and Procedures Manual (see AP 40; revised on 4 November 2019) stipulates that the IPMP must be approved by the AAHD during the site licensing process. Grieg NL has developed and received approval of its IPMP. Grieg NL's IPMP for sea lice is considered an integral part of its overall Fish Health

Management Plan and is designed to meet or exceed the guidelines established by the province in the NL Sea Lice Integrated Pest Management Plan (DFLR 2019b).

The schedule and number of fish samples associated with parasite monitoring will be determined in consultation with the provincial veterinarian and Grieg NL's private veterinarian. Monitoring will either meet or exceed DFLR's minimum requirements for sea lice counts (Appendix A as provided by AAHD and subject to change). Sea lice levels on salmon in sea cages during December to May period will be monitored monthly to bimonthly (anaesthetizing a sample of fish and counting the various life stages of sea lice). Sea lice counts will be more frequent during June to November period, weekly when water temperatures are $\geq 5^{\circ}\text{C}$, and biweekly when water temperatures are $< 5^{\circ}\text{C}$.

3.1.2 Fitness

Grieg NL will use Fulton's Condition Factor K, the ratio of fish weight to fish length, as its primary measure of salmon fitness. The formula for this condition index is as follows:

$$K = 100 \times (\text{whole weight (g)}/\text{fork length}^3 (\text{cm}^3))$$

Typically, the greater the K value, the better the fitness of the fish. Weights and lengths of fish will be measured during parasite sampling and fish grading.

3.2 Fish Growth

Once full production begins, the semi-annual sea cage sites (i.e., Red Island, Merasheen and Rushoon BMAs) will receive fish from the RAS Hatchery between May and October. The weights of these smolt will range from ~ 350 – 800 g. These fish will remain in the sea cages for 14–18 months for continued grow-out, and will be harvested at an approximate weight of 5 kg.

The seasonal sea cage sites (Long Harbour BMA) will receive fish from the RAS Hatchery in May of each year. These fish, whose weights will range from $\sim 1,200$ – $1,400$ g, will remain in the sea cages for eight to nine months for continued grow-out and harvest at an approximate weight of 4.5 kg.

As part of its normal operating procedures and detailed in the Fish Health Management Plan, Grieg NL will collect data on fish growth. The monitoring of these growth parameters will allow Grieg NL to improve inefficiencies in production. For the purposes of this EEMP, the primary metric for fish growth at the sea cage sites will be the Economic Feed Conversion Ratio (EFCR). As stated in the EIS, Grieg NL estimates an EFCR of 1.35 for the sterile triploid salmon at the sea cage sites in Placentia Bay, primarily due to favorable environmental conditions in Placentia Bay and the weight of the smolt (i.e., > 350 g) entering the sea cages from the RAS Hatchery. Upon entering the sea cages, several factors, including water temperature, daylight length, oxygen level, and weather conditions, influence the Feed Conversion Ratio (FCR) and the feed schedules. In simple terms, FCR is the ratio of feed provided the animal to the animal's weight gain. Note that rapid changes in environmental conditions can reduce the feeding rate.

Grieg NL will periodically sample its farmed salmon to collect data on weight of the whole fish, weight of gutted fish, and fork length. These data will be used to monitor FCR during the period the fish are in sea cages. Fish weights and fork lengths will be measured during parasite checks (see Section 3.1.1.2). A final

EFCR will be calculated once the salmon are processed, and mortalities and total feed use are tallied. Grieg NL will assess the effectiveness of its feed strategy over time by comparing the measured EFCR to the initial EFCR estimate of 1.35.

3.3 Fish Survival

Mortalities of European-strain triploid Atlantic salmon are estimated to be 20% over the maximum 18 months that fish will be at sea (see Table 2.18 in the EIS, LGL 2018). Within the first month that salmon are transferred to the sea cages, a 5% mortality rate is predicted. It is anticipated that subsequent monthly mortality rates will decrease to ~0.5–1.5% during non-winter months, and ~2–2.5% during winter months.

As detailed in the Fish Health Management Plan, the number of fish mortalities will be recorded daily at each sea cage. Dead fish typically accumulate at the bottom of the sea cages. Grieg NL will use a centralized system (LiftUp) which will remove accumulated dead fish at the bottom of the net on a daily basis. The LiftUp system has dedicated video monitoring focused on the bottom of the net. The dead fish will be pumped from the bottom of the sea cage nets through a pipe, which at the surface connects to a fully enclosed pipe grid and ends at the main deck of the feed barge in an ensilage tank. Any visibly moribund fish or surface mortalities will be retrieved, and moribund fish will be euthanized, if required. Records of all dead and culled fish will be maintained. Also, records of any fish culled for sampling purposes alone will also be maintained. Of note, procedures are in place to collect and record fish in the event of a mass mortality (see Grieg NL's Emergency Response Plan).

4.0 Frequency, Duration and Geographic Extent of Monitoring

The frequency, duration, and geographic extent of farmed salmon performance monitoring are summarized in Table 4.1. Grieg NL will implement this EEMP for the first three years that sea cages are operational. After three years of implementing the EEMP, Grieg NL will consult with DMAE regarding changes to monitoring.

Table 4.1. Summary of frequency, duration, and geographic extent of monitoring the health, growth and survival of farmed salmon in sea cages.

Monitoring Parameter	Frequency	Duration ¹	Geographic Extent
Disease	To be determined through consultation with veterinarians When possible coupled with sampling events for parasite checks	Entire period during which fish are in sea cages	Each operating sea cage
Parasites	Weekly during June to November period when water temperature $\geq 5^{\circ}\text{C}$ Bi-weekly during June to November period when water temperature $< 5^{\circ}\text{C}$ Monthly to bi-monthly during December to May period	Entire period during which fish are in sea cages	Each operating sea cage

Monitoring Parameter	Frequency	Duration ¹	Geographic Extent
Fitness	Weights and fork lengths will be collected from fish samples during parasite monitoring and harvesting	Entire period during which fish are in sea cages	Each operating sea cage
Growth	Weights and fork lengths will be collected from fish samples during parasite monitoring and harvesting	Entire period during which fish are in sea cages	Each operating sea cage
Survival	Daily recording of fish mortalities	Entire period during which fish are in sea cages	Each operating sea cage

¹ This EEMP will be implemented during the first three years of marine operations.

5.0 Reporting and Response Mechanisms

Grieg NL will present the findings of this EEMP in its annual EEMP report as per Condition ‘c’ of the EIS release letter. Grieg NL will also adhere to all reporting requirements as stipulated in the DFLR Aquaculture Policy and Procedure Manual (DFLR 2019a). All public reporting will be via public communication acceptable to the DFLR. As stipulated in AP 17, as of 1 January 2021, Grieg NL will report sea lice abundance numbers to the AAHD on a monthly basis and will post sea lice abundance numbers publicly, on a monthly basis, on its corporate website. Further details as to sea lice reporting parameters will be determined through stakeholder engagement prior to 1 January 2021. Furthermore, as per the IPMP policy, Grieg NL will submit sea lice numbers (where applicable) into an agreed upon third party database.

In addition, as per AP 32, Grieg NL will immediately report to the CAV any suspicion or knowledge of a Reportable Disease or zoonotic disease. A written report will be submitted no later than 24 hours after the telephone report. Any Reportable Diseases listed by the CFIA will be reported to both the Federal and Provincial authorities.

Given that this EEMP is not intended to monitor effects of the Project on the environment, response mechanisms are not applicable.

6.0 Procedures to Assess Effectiveness of Monitoring Programs, Mitigation Measures, and Recovery Programs

As discussed in Sections 2 and 3, this EEMP does not deal with potential effects of the Project on the marine environment. Potential interactions between Grieg NL’s farmed Atlantic salmon and the marine environment are addressed in other Project EEMPs, namely the Benthic Habitat Health EEMP and the Genetic and Ecological Interactions of Escaped Farmed Atlantic Salmon with Wild Atlantic Salmon EEMP. Recovery programs and procedures to assess the effectiveness of monitoring and mitigation (for effects on the environment) are not applicable to the Performance of European-strain Triploid Fish EEMP.

7.0 Communication Plan to Describe the Results

As per ‘Condition c’ in the Government of Newfoundland and Labrador’s Project release letter, Grieg NL will include the results of the Performance of European-strain Triploid Fish monitoring program within its annual report on EEMPs. This report will be publicly available on the Grieg NL website.

8.0 Literature Cited

DFLR (Department of Fisheries and Land Resources). 2019a. Aquaculture Policy and Procedures Manual. Report by the Government of Newfoundland and Labrador, DFLR, September 2019. 131 p. Available at https://www.fishaq.gov.nl.ca/licensing/pdf/Aquaculture_Policy_Procedures_Manual.pdf

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Appendix A: DFLR's Minimum Requirements for Sea Lice Counts

Sea Lice Counts

*note these are minimum requirements.

5 fish per cage for all lice counts (low, moderate and full)

- i) ***Low partial lice count*** (less than 30 lice in a sample of first 15 fish from the site)
*Sample **3 cages** (minimum) per site
- ii) ***Moderate partial lice count*** (greater than 30 but less than 60 lice in a sample of first 15 fish from the site)
*Sample **6 cages** (minimum) per site
- iii) ***Full lice count*** (greater than 60 lice in a sample of first 30 fish from the site)
*Sample **12 cages or 50% of all cages** at the site, whichever is greater

Frequency

Regular counts in the absence of any required treatments:

- a) Monthly to bimonthly (every 2 months) counts during December to end of May, whenever possible.
- b) Biweekly (every 2 weeks) counts at other times of the year but when water temperature is below 5 °C.
- c) Weekly counts when water temperature is above 5 °C.

Counts pre- and post- treatment:

- a) A ***full lice count*** (as outlined previously) must be done **within 2 weeks (preferably within 1 week) of the start of the treatment**.
- b) A ***full lice count*** must be repeated on the same cages as pre-treatment **within 1 week (but not in the first week) after the treatment** has been completed (except for EMB (SLICE®) treatments which should be done weekly for a total of three post treatment counts).

Information is collected at the individual fish level and broken down by life stage of the sea lice.