

# Ferskvannsavlusing i brønnbåt: Oppsummeringsrapport/analyser av tidligere forsøk.

The use of freshwater to control infestations of the sea louse  
*Lepeophtheirus salmonis* K on Atlantic salmon *Salmo salar* L.



**June 2014**

## 1.0 Summary

A series of studies have been undertaken at Gifas to assess the potential for using freshwater to remove attached sea lice from infected Atlantic salmon. The studies started in 2011 and four studies have now been completed.

The first study (report title: **The use of freshwater to control infestations of the sea louse *Lepeophtheirus salmonis* K on Atlantic salmon *Salmo salar* L. September 2011**) initially assessed the potential for using freshwater to remove attached sea lice from infected Atlantic salmon.

The study showed that exposing infected salmon to freshwater resulted in a significant reduction of both mature male and female lice after three hours and results from freshwater bioassays undertaken at the same time during the first study showed that after 1 hour exposure to freshwater, 10% of mature females were found to be dead whilst 90.9% of mature males had died as a result to exposure to freshwater. These initial small-scale studies showed that there is potential in using freshwater to delouse infected Atlantic salmon.

The second and third studies (report title; **Ferskvannsavlusning i brønnbåt. The use of freshwater to control infestations of the sea louse *Lepeophtheirus salmonis* K on Atlantic salmon *Salmo salar* L. April 2013 & October 2013**) were undertaken under more realistic commercial conditions.

These studies showed that a significant biomass of Atlantic salmon (up to 110 T) could be successfully deloused with freshwater. However, the studies also highlighted the need to maintain water quality parameters such as dissolved oxygen and particularly pH in order for the attached sea lice to be exposed to freshwater for sufficient time in order to be affected.

During the studies undertaken in October 2013, it was found that a super oxygenation system can maintain safe levels of dissolved oxygen. Saturation levels decreased from 124.0% at the start of the exposure study to 84.0% at which point oxygen was added and levels increased to 101.0% quickly thereafter. However, pH levels steadily decreased to 6.08 ppt during the exposure period. At this point the fish were showing signs of acute stress and it was decided at this point to start pumping in seawater to safeguard the large biomass of fish and to ensure the welfare of the fish. Carbon dioxide readings on board the well boat (ranging from 19.1 to 68.4ppt) were based on pH levels and were not measured in real time. Readings from hand-held instruments measured CO<sub>2</sub> between 16.0 and 17.0 ppt at the later end of the study.

For carbon dioxide the safe criterion used for the Norwegian production of Atlantic salmon smolts is 15 mg L<sup>-1</sup> (Fivelstad, S. 2013) provided dissolved oxygen concentrations are high. However, constant fish respiration can raise carbon dioxide levels high enough to interfere with oxygen intake by fish, in addition to lowering the pH of the water. If the cause of the stress noted in the fish was attributed to lowering of pH and/or an increased carbon dioxide concentration then some form of buffering agent may alleviate this problem.

A potential option to prevent swings in pH is to add Sodium hydroxide (NaOH), also known as caustic soda, lye/lut solution or Sodium Hydrate solution. It is a highly caustic metallic base and alkali salt which is available as a prepared solution at a number of different concentrations. Sodium hydroxide forms an approximate 50% (by weight) saturated solution with water. It is commonly used at smolt facilities which use recirculation systems to help maintain safe pH levels throughout production.

The fourth study (report title: **Ferskvannsavlusning i brønnbåt: Study 4. Water quality. December 2013**) had the aim of assessing the potential of using a buffering agent (NaOH) to maintain safe levels of pH when treating a large biomass of salmon in freshwater for a defined period of time.

Results from the study show that initially there was a steady but small decrease in pH in both wells once fish transfer had been complete and prior to the addition of NaOH. The addition of NaOH commenced approximately 1 hr. and 30 minutes after the fish had been transferred to

both wells at a rate of 0.25 l/hr. The decline in pH slowed after the addition and in the well containing freshwater even increased slightly after 10 minutes post-addition. The decrease in pH levels continued however, as the rate at which NaOH was increased there were corresponding small increases in pH in both wells. This present study showed that there is potential for NaOH to be used as a buffering agent to control pH in wells filled with freshwater. However, further research is required to elucidate flow rates and how much to add to maintain safe levels throughout a desired treatment period of approximately three hours.

## 2.0 Conclusions

The present studies have shown clear reductions in all infectious stages of *L. salmonis* from Atlantic salmon. However, the studies have also highlighted the need to fully elucidate the primary causal factors which contribute to these reductions. To this end future studies will be implemented to identify these factors. Acute changes in water quality parameters such as temperature, salinity and pH may play a crucial role in the removal of lice from the salmon. In addition, there is a need for more detailed analysis of water quality parameters before and during treatments. The use of freshwater will be limited due to supply thus studies will be undertaken to assess the potential for reducing the time salmon need to be exposed to this medium without compromising the effects. Reusing freshwater for treating larger biomasses of fish will allow for the method to become more practical commercially. Further elucidation of the mechanical/handling effects will also be undertaken in an attempt to maximise the potential treatment effects when fish are exposed to freshwater.

A series of studies are planned to investigate these factors (appendix 1). These studies will be funded by FHF. Project number: 901006.

## 3.0 Publications

Reynolds *et al* Bruk av ferskvann som en potensiell metode for å bade behandle atlantisk laks infisert med lakselus. (2012). **Norsk fiskeoppdrett Nr 5. May 2012.**

Reynolds *et al* Ferskvannsavlusing i brønnbåt: Test av ferskvannsavlusing av laks i brønnbåt viser meget lovende resultater (May study 2013). **Norsk fiskeoppdrett Nr 4 May 2014.**

Reynolds *et al* Ferskvannsavlusing i brønnbåt: Test av ferskvannsavlusing av laks i brønnbåt viser meget lovende resultater (October study 2013). **Norsk fiskeoppdrett Nr 4 May 2014.**

Reynolds *et al* Avlusning med ferskvann i brønnbåt: Vannkvalitet: vedlikehold av oppløst oksygen og pH under behandlingene. **Norsk fiskeoppdrett Nr 5 June 2014.**

### 3.0 Appendix 1

Mål for prosjektet:

1. Vannkvalitet analyse: To elver ligger i nærheten av oppdrettsvirksomheten til GIFAS og analyse av vannet i disse elvene vil bli gjennomført for å bestemme vannkjemien til disse. Dette er for å se om vannet er av god nok kvalitet for å bli brukt som fremtidige ferskvannskilder.
2. Småskala tester: Gjennomføre korte eksponeringstester for å belyse håndteringseffekter. Målet med denne studien er å fullt ut belyse virkningene av fysisk håndtering på lakselus når fisken blir pumpet/overført fra en merd til en brønn som inneholder ferskvann og tilbake til en merd. Hvis nivået av lakselus kan reduseres med opptil 40 % på grunn av effekten av fysisk kontakt før eksponering til ferskvann, kan kortvarig eksponering i ferskvann være tilstrekkelig dersom fisken pumpes tilbake til merden etter eksponering ved hjelp av samme metode. Målet med denne studien er å bestemme effekten av fysisk behandling ved eksponeringstider i ferskvann fra 15 minutter opp til en time. Studien vil bli utført ved GIFAS småskalaanlegg ved hjelp av egenutviklede/fabrikkerte tanker og pumpe-systemer, og vil eksponere små grupper av atlantisk laks for hver test. Nivået av lakselus vil bli telt gjennom hele prosessen: før behandling, umiddelbart etter overføring, etter eksponering og umiddelbart etter overføring tilbake til merden. Vannkjemiske profiler vil bli tatt i løpet av disse studiene, samt at det vil bli tatt blodprøver fra fisken å belyse potensielle velferdsspørsmål.
3. Kortvarige eksponeringstester ved bruk av brønnbåt: Basert på resultatene fra småskalatester, vil vi gjennomføre et forsøk i kommersiell skala ved bruk av brønnbåt (Havtrans). En kommersiell protokoll vil bli utviklet ved å bruke resultatene oppnådd i småskalatesten. Det er tenkt at fisken vil bli pumpet inn i en brønn som inneholder ferskvann, og etter at den ønskede eksponeringstid er oppnådd vil fisken vil bli pumpet inn i den tilstøtende brønnen som inneholder sjøvann uten at ferskvannet blir pumpet ut fra ferskvannsbrønnen. Etter at fisken har blitt overført, vil mer fisk fra merden pumpes inn i ferskvannsbrønnen og fisken som blir holdt i sjøvannsbrønnen vil bli pumpet tilbake til merden. Denne prosessen vil fortsette inntil all fisk i merden har blitt behandlet. Målet med denne studien er å behandle et stort volum av fisk uten å måtte bytte eller erstatte ferskvannet. Vannkjemiske profiler vil bli tatt i løpet av denne studien samt at det vil bli tatt blodprøver fra fisken å belyse potensielle velferdsspørsmål.
4. Ferskvannsavlusing på full kommersiell skala ved hjelp av brønnbåter: Basert på tidligere resultater er målet med denne studien er å gjennomføre ferskvannsavlusinger på full kommersiell skala i løpet av høsten 2014. Resultater fra alle tidligere studier vil bli benyttet for å utvikle og implementere kommersielle protokoller som skal brukes på brønnbåter.