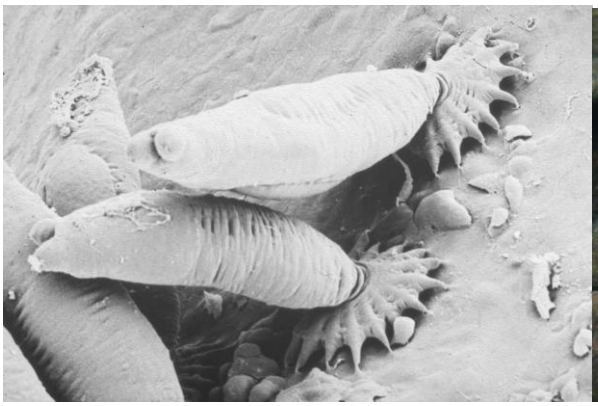
Experts and authorities meeting – Resuming the cooperation on the salmon parasite *Gyrodactylus salaris* in the North Calotte region 26th-27th October, 2010

Svanvik Norway

Abstracts



The County Governor of Finnmark
Department of Environmental Affairs
Report 6 - 2010

Nordkalottrådet
Pohjoiskalotin neuvosto
The North Calotte Council

Mattilsynet

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The REPORTs from the Office of the Finnmark County Governor, Department of Environmental Affairs presents results from different works under the governance of the mentioned department. The main aim is to document and to disseminate information on important environmental issues to a broader audience. We highlight that all authors/ contributors in this report are themselvs responsible for their own conclusions and evaluations.

ISSN 0800-2118

Report no. 6-2010 is mainly published on the internet www.fmfi.no under 'rapporter' and 'miljøvernavdelingas rapportserie'. Hard copies are produced after request.

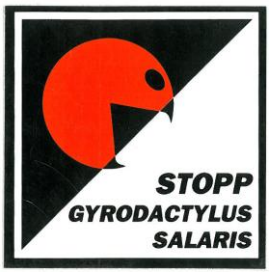
Printing/ layout: Fylkesmannen i Finnmark

For more information concerning this publication contact:

Fylkesmannen i Finnmark
Miljøvernavdelinga
Statens hus
9815 VADSØ

Cover pictures: *Gyrodactylus salaris* (photo: Tor Atle Mo). Salmon parr (photo: Panu Orell)

The seminar was supported financially by the North Calotte Council Environment Group, Norwegian Food Saftey Authority Regional Office of Troms and Finnmark and the Office of the Finnmark County Governor.



Program and agenda

Experts and authorities meeting October 2010 – Resuming the cooperation on the salmon parasite *Gyrodactylus salaris* in the North Calotte region

Venue: Bioforsk Svanhovd, Svanvik Norway
Date: October 26th – 27th
Time: 10:00 – 17:30 and 8:30 – 13:00

Interpreters (Finnish/ Norwegian – Norwegian/ Finnish):
Ms. Taina Aellig and Ms. Leila Väänänen

Agenda – 26th October

10:00 Welcome by Ms Marthe Brundtland, Norwegian Food Safety Authority (Mattilsynet), Region of Troms and Finnmark

G. salaris expert meeting 2010: background and aims of the meeting/ *G. salaris* ekspertmøte 2010: bakgrunn og målsetninger for møtet/ Kokouksen tausta ja tavoiteet

Session 1. The salmon resources in the Norwegian – Finnish transboundary rivers/ Laksebestandene i de norsk-finske grensevassdragene/ Lohiresurssi Suomen ja Norjan rajavesistöissä

Chairman: Mr. Jan Fredriksen

10:15 – 11:00 Mr. Morten Johansen, researcher, Norwegian Institute of Nature Research (NINA) and

Mr. Eero Niemelä, researcher, Finnish Game and Fisheries Research Institute (RKTL)

The salmon resources in the Norwegian - Finnish transboundary rivers/ Laksebestandene i de norsk-finske grensevassdragene/ Lohiresurssi rajavesistössä

Questions, discussion and closing of session 1

Session 2. The salmon parasite *Gyrodactylus salaris*

Chairman: Mr. Morten Johansen

11:05 – 11:40 Mr. Jaakko Lumme, researcher, University of Oulu, Dept. Of Biology

Molecular clone recognition on *Gyrodactylus* helps tracking the infection sources. Examples from Norway, Estonia and Russia/ Sporing av smittekilder ved hjelp av molekylære teknikker. Eksempler fra Norge, Estland og Russland/ Tartunnan paikantaminen molekyylitekniikan avulla. Esimerkkejä

11: 40-12:15 Mr. Tor Andreas Bakke, prof., University of Oslo, NHM

Results from experiments with selective breeding, and on survival of *Gyrodactylus* under experimental conditions/ Resultater fra forsøk med selektiv avl, og parasittens

overlevelse under eksperimentelle forhold/ Koetuloksia: valikoiva lisääntyminen ja loisen eloonjääminen koeolosuhteissa

Lunch

Chairmen: Mr. Morten Johansen and Mr. Eero Niemelä

13:15 -13:50 Mr. Phil Harris, prof., University of Oslo, NMH

Genetic and environmental factors influencing pathogenicity in the interaction between *Gyrodactylus salaris* and its salmonid hosts/ Genetiske faktorer og miljøfaktorers betydning for patologisk virkning i interaksjonen mellom *Gyrodactylus salaris* og parasittens salmonide verter/ Perintö- ja ympäristötekijöiden vuorovaikutus loisen patogenisuuteen

14:00 – 14:45: Mr. Audun Rikardsen, prof., University of Tromsø

Arctic charr as host of *G. salaris* and spreading of the parasite with anadromous fish trough sea water/ Røye som vert for *G. salaris* og spredning av parasitten med anadrom fisk i sjøvann/ Nieriä *G. salariksen* isäntälajina ja loisen leviäminen vaelluskalojen mukana meressä

Questions, discussion and closing of session 2

Coffee break

Session 3. Treatment of infected waters: status, methods and results/ Behandling av smitta vassdrag: status, metode og resultater/ Tartunnan torjunta: metodit ja tuloksia

Chairman: Mr. Paul A. Nilsen Lutnæs, Head of section for game and fisheries, Office of the Finnmark County Governor (Fylkesmannen i Finnmark)

15:30 – 16:05 Mr. Asle Moen, National Veterinary Institute (Veterinærinstituttet), Section of environment and infection measures

Infected rivers, treatment and treatment results/ Smitta vassdrag, behandling og behandlingseffekt/ Tartunnan saaneet vesistöt, torjunta ja tuloksia

16:05 -16:40 Mr. Asle Moen, National Veterinary Institute, Section of environment and infection measures

Experience from chemical treatments of the Steinkjer water systems 1994-2009/ Erfaringer fra kjemisk behandling av Steinkjervassdragene mot lakseparasitten *G. salaris* i perioden 1994-2009/ Kokemuksia kemiallisesta torjunnasta Steinkjerin vesistössä vuosina 1994-2009

Questions, discussion and closing of session 3

Session 4. Legislation, management and routines for disinfection/ Regelverk, forvaltning og rutiner for desinfeksjon/ Lainsäädäntö, hallinto ja desinfiointimenetelmät

Chairman: Mr. Paul A. Nilsen Lutnæs

16:50-17:20 Mr. Knut Bach-Gansmo, Senior inspector, Norwegian Food Safety Authority, District Office of North Troms

Legislation and management/ Regelverk og rammer for forvaltningen/ Lainsäädäntö ja hallinto

Sauna

19:30 Dinner at Bioforsk Svanhovd

Agenda – 27th October

8:30-8:40 Summing up Day 1 Mr. Knut Bach-Gansmo. Practical information

Continuation of Session 4.

Chairman: Mr. Paul A. Nilsen Lutnæs

8:40 -9:10 Ms. Kari Norheim, National Veterinary Institute, Regional laboratory/ Harstad

Diagnostics and monitoring programs/ Diagnostikk, overvåkning og kontroll/ Määritys, seurantaohjelmat ja kontrolli

9:10-9:40 Mr. Perttu Koski, Senior Research Officer, Finnish Food Safety Authority (EVIRA)

The river Teno: challenges of the contingency planning/ Utfordringer i arbeidet med beredskapsplaner for Tanaelva/ Tenojoki: haasteet valmiussuunnitelman valmistelussa

9:40 – 10:10 Mr. Sturla Brørs, Advisor, Norwegian Directorate of Nature Management (DN)

Fighting *G.salaris*: plans, roles and international cooperation/ Kampen mot *G. salaris* – planverk, rollefordeling og internasjonalt samarbeid/ *G. salariksen* torjunta – suunnitelmat, roolit ja kansainvälinen yhteistyö

Coffee break

Chairman: Mr. Sturla Brørs

10:30 – 10:45 Mr. Hans-Erik Varsi, Laksebreveiere i Tanavassdraget AL, LBT (interest group for fishing rights holders in the Tana river)

The disinfection of equipment- mandatory or voluntary/ Fra laksebreveiernes (LBT) ståsted – plikt til desinfeksjon eller frivillighet/ Desinfiointi - pakollinen vai vapaaehtoinen, Tenojoen lohenkalastusoikeudellisen järjestö (LBT) näkökulmasta

10:45 – 11:00 Mr. Jussi Kuusela, Centre for Economic Development, Transport and the Environment (ELY-keskus)

Disinfection routines on the Finnish side of the Tana and Neiden rivers/ Praktisk organisering av desinfeksjon i Tana og Neiden på finsk side/ Desinfioinnin järjestely Suomen puolella Näätämö ja Tenojoen vesistöalueilla

11:00 – 11:15 Mr. Erik Sterud, Norske Lakseelver

The landowners view on the *G. salaris* management/ Grunneieres syn på gyroforvaltningen/ Maanomistajien näkemys gyro-ongelma hallinnoinnista

Questions, discussion and closing of session 4

Session 5. Steps towards harmonization of contingency plans for the transboundary rivers/ Skritt mot harmonisering av beredskapsplaner for grensevassdragene/ Askelia kohti valmiussuunnitelmien harmonisointia rajavesistöissä

Chairman: Mr. Perttu Koski and Mr. Knut Bach-Gansmo

11:30-12:30 Open discussion and conclusions on joint recommendations

Lunch and departure

The salmon resources in the Norwegian-Finnish Transboundary Rivers

Morten Johansen and Eero Niemelä

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There are two transboundary rivers between Norway and Finland, the Rivers Tana and Neiden. Both river fisheries are managed through bilateral agreements. Atlantic salmon is often described as “a symbol of a healthy ecosystem”, it has a high socio-economic value within these rivers and within the distribution marine migration area both through commercial and subsistent fisheries and recreational fisheries. Healthy salmon stocks, in general with some exceptions, have been allowing until these days salmon fishing in the River Tana with driftnets, gillnets, weirs, seines and rod. In the River Neiden the fishery can take place mainly with rods and also on Finnish side with gillnets and on Norwegian side with traditional throwing seine “käppäla”. The mean annual salmon catch caught in the River Tana is c. 130 tonnes representing the largest river catches within the salmon distribution areas. The long-term declining trend of the numbers of large females in the catches has raised serious concern both among managers, researchers and most of the fishermen. A comparison of estimated spawning stock size and recently established spawning targets indicate that we presently have a negative stock situation with too few spawners left after the fishing season, indicating that the rivers are under pressure. This worry is further attenuated by a comparison to other neighbouring salmon rivers which have had record catches in the last five seasons. A high catch-level has been a guarantee for the long-term use of traditional fishing methods in the river and in the coastal areas. In both rivers the tourist salmon fishery has developed largely and e.g. in Finland the numbers of recreational fishermen has reached the number of 8000-10 000 persons in the latest year in the main stem of Tana and Anarjohka. The Atlantic salmon juvenile production in these transboundary rivers has made it possible to continue the coastal and fjord fishery in Finnmark with poundnets and bendnets. It has been made salmon taggings in the Rivers Tana and Neiden which indicate the high value of the salmon smolt production also for the coastal catches. So the healthy stocks in these rivers guarantee the continuation of the commercial and subsistent as well as recreational fishery. The parasite *Gyrodactylus salaris* most probably could ruin not only the salmon fishing culture, socio-economic values, but also the biological diversity of salmon stocks especially in the River Tana with more than 30 stocks in tributaries and head waters.

Molecular clone recognition on *Gyrodactylus* helps in tracking the infection sources

Heidi Aisala, Sanna Hietala, Bjørn Ove Johnsen, Jussi Kuusela, Jaakko Lumme, Maria Meinilä, Marek Ziętara, Anti Vasemägi, Alexei Veselov

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It is often interesting to try to reconstruct the infection routes of parasites (and other diseases as well). *Gyrodactylus salaris* is not an exception. Not long ago, all attempts were based on just-so-stories: a salmon parr transport some years ago; a helicopter flying from place to place with a wet sack, etc. Real crime scene investigations (CSI) were not possible, due to lack of suitable technology.

The situation changed with the introduction of DNA-based methods. The first attempt by ITS of ribosomal DNA was widely deemed as a failure, because it was not able to separate salmon parasites from those on grayling: so called "thymalli problem". We think differently: it was just showing how closely related they are. ITS is the best barcoding molecule for *Gyrodactylus* worldwide.

The resolution improved significantly when we in Oulu developed the mitochondrial marker cytochrome oxidase 1 (CO1). Immediately, the grayling and salmon parasites were divided into several evolutionary lineages, but most importantly, also the fascinating diversity of salmon and rainbow trout parasites was demonstrated in Norway, Finland and Russia, and later also in Poland and Macedonia. Instead of one stereotypic *G. salaris*, the vulnerable Norwegian salmon populations were invaded by at least three, perhaps five different *G. salaris* strains, presumably having quite different histories as well. No grayling specific lineages have ever been observed on other species, in farms or in wild.

The mitochondrial DNA –- and in particular the CO1 segment –- is still the best overall genetic marker of *G. salaris*, but we have recently developed many more, to make the detective stories even more conclusive and interesting. I will present three case stories. Keret' in Russian Karelia was infected via fish transport from Onega The outbreak in Polula farm in Estonia was local, probably facilitated by immunologically compromized triploid fish. The nuisance in Laerdalselven in Norway seems to be caused by a hybrid swarm of parasites.

Results from experiments with selective breeding, and on survival of *Gyrodactylus* under experimental conditions

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Extensive experimental laboratory and field studies on *G. salaris* biology and ecology have been performed at the Natural History Museum, UiO, and in Lierelva (Buskerud County). The talk presents a summary of the experimental results related to selective breeding of Atlantic salmon for increased *G. salaris* resistance, and results related to *G. salaris* survival and transmission under influence of defined environmental factors. The scientific results are published in the following selected papers:

- Bakke, T.A., Jansen, P.A., Hansen, L.P. 1990. Differences in the host resistance of Atlantic salmon, *Salmo salar,* stocks to the monogenean *Gyrodactylus salaris* Malmberg, 1957. *J. Fish Biol.* 37, 577-587.
- Bakke, T.A., Jansen, P.A., Hansen, L.P. 1990. Forskjeller i resistens mot *Gyrodactylus salaris* mellom østersjølaks og øst-atlantisk laks. *NINA-Oppdragsmelding* 43, 1-10.
- Bakke, T.A., Soleng, A., Harris, P.D. 1999. The susceptibility of Atlantic salmon (*Salmo salar*) X brown trout (*S. trutta*) hybrids to *Gyrodactylus salaris* Malmberg and *G. derjavini* Mikailov. *Parasitology* 119, 467-481.
- Bakke, T.A., Harris, P.D., Cable, J. 2002. Host-specificity dynamics: observations on gyrodactylid monogeneans. *Int. J. Parasitol.* 32, 281-308.
- Bakke, T.A., Cable, J., Harris, P.D. 2007. The biology of gyrodactylid monogeneans: the "Russian Doll-killers". In: *Advances of Parasitology* (Baker, J.R., Muller, R. and Rollinson, D., eds.) 64, 161-376.
- Jansen, P.A., Bakke, T.A. 1991. Temperature-dependent reproduction and survival of *Gyrodactylus salaris* Malmberg, 1957 (Platyhelminthes: Monogenea) on the Atlantic salmon (*Salmo salar* L.). *Parasitology* 102, 105-112.
- Soleng, A., Bakke, T.A. 1997. Salinity tolerance of *Gyrodactylus salaris* (Platyhelminthes, Monogenea): laboratory studies. *Can. J. Fish. Aquat. Sci.* 54, 1837-1845.
- Soleng, A., Jansen, P., Bakke, T.A. 1999. Transmission of the monogenean *Gyrodactylus salaris*. *Folia Parasitol.* 46, 179-184.
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- Soleng, A., Poléo, A.B.S., Bakke, T.A. 2005. Toxicity of aqueous aluminium to the ectoparasitic monogenean *Gyrodactylus salaris*. *Aquaculture* 250, 616-620.
- Olstad, K., Cable, J., Robertsen, G., Bakke, T. A. 2006. Unpredicted transmission strategy of *Gyrodactylus salaris* (Monogenea: Gyrodactylidae): survival and infectivity of parasites on dead hosts. *Parasitology* 133, 33-41.
- Olstad, K., Robertsen, G., Bachmann, L., Bakke, T.A. 2007. Variation in host preference within *Gyrodactylus salaris* (Monogenea): an experimental approach. *Parasitology* 134, 589-597.
- Poléo, A. B. S., Schjolden, J., Hansen, H., Bakke, T. A., Mo, T. A., Rosseland, B. O., Lydersen, E. 2004. The effect of various metals on *Gyrodactylus salaris* (Platyhelminthes, Monogenea) infections in Atlantic salmon (*Salmo salar*). *Parasitology* 128, 169-177.
- Salte, R., Bentsen, H.B., Moen, T., Tripathy, S., Bakke, T.A., Ødegård, J., Omholt, S., Hansen, L.P. 2010. Prospects for a genetic management strategy to control *Gyrodactylus salaris* (Monogenea) infection in wild Atlantic salmon (*Salmo salar*) stocks. *Can. J. Fish. Aquat. Sci.* 67, 121–129.

Environmental factors and the biology of *Gyrodactylus*

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Gyrodactylus is an almost universal parasite of bony fish, found from polar regions to the tropics, in both marine and freshwater habitats. Most species are entirely without impact upon their hosts. There are a range of reasons why gyrodactylids may become pathogenic, related either to the genetic identity of host or parasite, or to environmental factors which also impact upon both parasites and the fish hosts. *Gyrodactylus* has a unique population growth strategy in which parasites contain in utero a fully grown daughter, which already contains a developing embryo. Total fecundity is relatively low, with a maximum reproductive output in *G. salaris* of c. 5 daughters. This unusual strategy makes the outcome of *Gyrodactylus* infections highly susceptible to stochastic fluctuations in survivorship due to environmental factors. In particular, water temperature, water chemistry and host population density may all play a major role in gyrodactylid-host interactions. An increase in water temperature increases reproductive rate and can therefore lead to epidemic population growth; however equally it can lead to increased mortality, and can stimulate the immune response of the host. Water chemistry is known to have a major impact on gyrodactylid survival, and modification of water chemistry through addition of aluminium salts is being trialled as a control option. However, the impact of natural water chemistry on the distribution and likely pathogenicity of *G. salaris* represents an unstudied field of research. Finally, host density has been known to play the major role in determining the switch from endemic persistence to uncontrolled epidemic growth in gyrodactylid populations. Nevertheless, the role of host density in controlling this switch in *G. salaris* populations, and the interaction between host density and host genetic identity, remains entirely unstudied in this species. Furthermore in natural populations of salmon, local density is controlled by spatial constraints related to the substrate quality of the river bed. The impact of such local factors in triggering epidemic disease is entirely unknown. This talk will focus on the nature of some of these environmental modifiers of the outcome of gyrodactylid infection, and discuss their potential role in the *G. salaris*-salmon interaction.

The risk of *Gyrodactylus salaris* spreading by anadromous fish and their hybrids

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The introduced lethal salmon parasite *G. salaris* is one of the biggest threats to Norwegian Atlantic salmon populations. The parasite was introduced in the early 1970s and spread through anthropogenic stocking of rivers with infected hatchery-reared juvenile salmon. Further spreading to secondary nearby infected watercourses could have happened by "natural" means, e.g. by anadromous fish. New data from the Skibotn region, Troms County, indicate that especially Arctic charr can be an adequate host for the parasite, even without salmon within the river. By use of electronic tracking, it was also shown that it is likely that Arctic charr also can carry the parasite between nearby watercourses through brackish water layers, both during winter (adult fish) and summer (post-smolts). It was also shown that hybrids post-smolts of Atlantic salmon and sea trout can be potential display the same behaviour and carriers of the parasite between nearby watercourses. These results will be important both in order to minimize the risk of spreading, as well as developing mitigating strategies for watercourse management and treatment.

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Infected rivers, treatment and treatment results

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It is until now proven *Gyrodactylus* salaris *(G. salaris)* in 15 regions in Norway. 8 regions are recovered, one region is under surveillance after treatment (Steinkjer region) and 6 regions are still infected. All in all, the parasite has been detected in 47 rivers and 40 fish farms in Norway. Today, 21 rivers have recovered completely, 5 are under surveillance after treatment and 21 rivers are still infected. All fish farms are recovered. Regions infected today are Skibotn region, Vefsna region, Driva region, Rauma region, Lærdal region and Drammen region.

Vikja was treated as the first river in 1981-82. This was followed by several successful treatments of smaller rivers throughout the 80s. In the 90s, treatment took place in several major rivers. This was a period of severe restriction on the use of rotenone, but to what extent this had anything to say is uncertain. With the exception of Beiar River all these treatments were unsuccessful. As a result of this, the following years was dedicated to improvement of distributing rotenone. Still we failed again with a treatment of Steinkjer region in 2001-02. Before *G. salaris* was detected again here, in 2005, we managed to treat Rana region in 2003-04. Rana region was recovered in 2009 and is probably so far the greatest success in combating *G. salaris*.

The failure of the treatments in the 90's caused new methods to be developed. This meant, among other things, more common use of multiple treatments. Furthermore, there was put to use more accurate dosing equipment and several types of pumps. The use of barriers to limit the treatment area was also used to a greater extent. Overall, all aspects of treatment was reviewed to ensure the best possible treatment. This development has been going on, parallel to the treatments in the 2000s. Besides this, acid aluminum solution has been tried out as the main chemical.

Currently, activity is taken place in Lærdal region, Vefsna region, Rauma region and Driva region. A new treatment of Steinkjer region was completed in 2009. The development of acidic aluminum solution as an adequate alternative to rotenone has been located to Lærdal region. The trial has now ended and efforts will be followed up with full-scale treatment in 2011. Vefsna region was scheduled to be treated with rotenone this year, but this is postponed due to the detection of *G. salaris* on Arctic charr in the lake Fustvatnet. The work will continue in this region in 2011, but plans for this will not be finished until we have clarified the situation surrounding *G. salaris* on Arctic charr. In the Rauma region we are working with maps and planning for the first treatment in 2012. As a first step in the treatment of Driva region, efforts are now taken to establish a barrier in the river Driva. Only minor activities are going on in the other regions.

Experience from chemical treatments of the Steinkjer water systems 1993-2009

Asle Moen & Anton Rikstad

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Gyrodactylus salaris (*G. salaris)* was detected in the Steinkjer water systems in 1980. As a first step in the treatment of the rivers, a barrier was built in the river Figga in 1988. After five years, in 1993, the first treatment with rotenone took place. Unfortunately the parasite was detected again in 1997. The rivers were treated again in 2001-2002, but despite of improvements of the methods, *G. salaries* was detected once again in 2005. Meanwhile, treatment with acid aluminum solutions as the main chemical had given positive results in other regions. As a result of this, the method was tried out in the Steinkjer water systems in 2006. In 2007 we planned a full-scale treatment, but because of very variable flow of water we were not able to finish this treatment. It was decided that the method was not ready for water systems like this yet. As a result the rivers were treated again with rotenone as the main chemical in 2008-2009. Hopefully, with improvement of the methods and experience from several previously treatments, we have succeeded and can celebrate recovered rivers in 2014.

A treatment of such water systems includes a lot of other kinds of work, before, during and after the treatment. Before the treatment took place the original salmon of the rivers was taken care of by the national gene bank for salmon. Efforts were also made to ensure that see trout should take as little damage as possible from the treatment. Comprehensive surveillance was necessary to discover the full dispersal of the parasite. The main job after the treatment is to reintroduce the salmon in the national gene bank to the rivers. It is also important to continue the surveillance, so any remaining parasites are detected at an early stage, when they are easier to eradicate from the rivers. Although, we hope and believe that this surveillance are unnecessary.

Legislation and management

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In 2008 the Fish health directive was implemented in to the Norwegian legislation. This led to new regulations for trade, prevention and control concerning diseases of aquatic animals.

Diseases of aquatic animals on which there is public intervention are classified on three lists;

1. Exotic diseases in the EU area
2. Non- exotic diseases in the EU area
3. National diseases

G. salaris is on list 3.

Trade
When a receiving country or area has been granted additional guarantee on a specific disease by the EU, the country of origin must have the same guarantee or have the same health status concerning the disease as the receiving country. Most of Norway has an additional guarantee on *G.salaris*. When exporting aquatic animals to a country with additional guarantees, susceptible species must meet the demands in the animal health certificate of EU regulation nr.1251/2008/ EF.

Prevention
The Norwegian Food Safety Authority (NFSA) is to be notified when there is a suspicion of disease on wild aquatic animals. It is prohibited to move aquatic animals from one river to another without permission from the NSFA. All equipment used in one river must either be dry or disinfected before it is moved to another river.

Control
The NSFA can adopt local regulations when listed diseases are detected.

The surveillance and control programme for *Gyrodactylus salaris* in Atlantic salmon and Rainbow trout in Norway

Kari Norheim

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The National Veterinary Institute (NVI) is responsible for the sampling in the rivers. County Environmental Departments and other institutions/ companies are commissioned to do the actual sampling. The Norwegian Food Safety Authority (NFSA) is responsible for the sampling in fish farms.

At least 30 wild atlantic salmon are sampled from rivers every year and 30 salmon or 60 rainbow trout from each farm every second year. From rivers, whole salmon are conserved, from farms the fins are cut off and conserved. All the samples are conserved in 96% ethanol and sent to the NVI regional unit in Harstad for examination under a stereo microscope at 10-15 times magnification.

When *Gyrodactylus* specimens are found, these are sent to the NVI in Oslo (the OIE reference laboratory for the disease) for species determination. The methods used for species identification follows those in the Gyrodactylosis (*Gyrodactylus salaris*) – chapter in the Manual of diagnostic tests for aquatic animals from the World Organisation for Animal Health (OIE), www.oie.int/eng/normes/fmanual/2.3.03_Gyrodactylosis.pdf. A new observation is immediately reported to the NSFA and to the OIE.

The river Tenojoki (Tana elv); challenges of the contingency planning

Perttu Koski

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The large geographical scale and hydrological properties of the Tenojoki river system make the eradication of a *Gyrodactylus salaris* infection from the water course impossible with present methods. The annual migrations of the parr from large river beds to brooks and back would make the building of barriers to brooks rather impractical. Not only eradication, but even the containment of the infection to certain parts of the river system, would be extremely difficult. This underlines the importance of the prevention of the spread of *Gyrodactylus salaris* infection to the Tenojoki river system. For the worst case a contingency plan would, however, be needed.

Identification of the presence of *Gyrodactylus salaris* in the water course would be the beginning of the action against the infection. Early recognition of the infection would need development of the monitoring programme. The empirical data on the epidemiology of the parasite in a river with wild Atlantic salmon population shows that high prevalence of infection is found in the parr quickly after infection. This gives the opportunity of sampling relatively low numbers of fish from each monitoring area. Several annual monitoring areas at strategic portions of the Tenojoki river system would be favourable. Different rivers (river Karasjok, river Inarijoki, river Utsjoki, main river) and main fishing waters (according to the number of fishing efforts and easy accessibility) might be used as selection criteria of these areas.

The contingency planning has a long-term task to face the legislation problems. The bodies responsible for the action would need a legal basis for their work, which might include measures like ban of fishing. From the Finnish side, changes to the law concerning the Agreement on joint fishing regulations for the river Tenojoki fishing district require similar reading as the constitution in Finland. Changes to the regulations of the fishing of the local people in the main river of Tenojoki require action by the Government of Finland. Changes to several other regulations in different decision-making levels would also be needed to make quick actions in the event of *Gyrodactylus salaris* infection. Probably situation is complex in Norway, too. In addition to the legislation, voluntary commitment to the rescue of the river Tenojoki salmon would be needed. In spite of the different views of the fishing, in the event of *Gyrodactylus salaris* infection, there would probably be general willingness to act in an efficient way to combat the infection.

A plan to efficiently and quickly collect eggs and milt from the wild broodfish after the establishment of the *Gyrodactylus salaris* infection would be needed. Also the use of the gene bank material has to be prearranged. The order of the magnitude and the possibilities of the realisation of a stocking programme would also need consideration. Not all the Atlantic salmon populations are equally susceptible to *Gyrodactylus salaris*. Tenojoki river system is so large that there may be considerable variation in this within the salmon stock of the river. The use of such subpopulations and the possibilities of selective breeding for the enhancement of the resistance of the material to be stocked would be needed to study.

Fighting *Gyrodactylus salaris*; plans, roles and international co-operation

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Since the parasite was first documented in Norway in 1975, it has been found in 47 rivers. In 21 rivers the parasite is combated, in addition five rivers are treated against *G. salaris* in 2008-2009 and must be monitored until appr 2014 before they can be registered as healthy. 21 rivers are infected at present.

The first action plan to eradicate *G. salaris* was carried out in 1986. The goal then was to eradicate the parasite in every river where possible within 10 years. Since then there have been several actions plans, the latest one was released in 2008 after having an expert group evaluating the methods being used in eradication programs. The authorities' conclusion from the expert group's report was that rotenone at present is the only chemical suitable to eradicate the parasite, eventually together with barriers (long term or short term) in the rivers. The method of AIS must be developed further to be proven suitable for eradication programs, and River Lærdalselva is the location chosen for this work, with an eradication program probably implemented in 2011-2012.

The Vefsn-region of Nordland County, with the huge River Vefsna and several smaller rivers, are object of eradication programs within 3-4 years. The overall plan is, however, substantially affected by *G. salaris* found on Arctic char in a lake nearby River Vefsna in late 2009, making the implementation of the program uncertain until distribution, diagnostics and economical/ political matters are dealt with in more detail.

In Norway, The Food Safety Authority (NFSA) is responsible for monitoring, diagnostics of the parasite, and for preventive measures regarding spread of the parasite, including information. The Directorate for Nature Management (DN) is responsible for eradication measures. When it comes to eradication programs, The Office of the County Governor is responsible for planning, surveying, and eradication of the parasite in the rivers of interest. The National Veterinary Institute serves as a competence centre concerning diagnostics and professional/practical running of eradication programs in near contact with national and regional authorities as well as local stakeholders and property owners.

Experience shows that *G. salaris* spreads, and unpredicted episodes and relapses happen during eradication programs. This focuses on the need for effective contingency plans, so that eradication measures eventually can take place immediately if needed. This indeed also demands international co-operation when it comes to border rivers, and in regions where the parasite threatens salmon stocks of neighboring countries. Such international co-operation has been carried out in different connections from the mid 1990s between researchers and authorities from Norway, Finland and Russia, in NASCO, and between authorities and stakeholders in several projects under the North calotte-umbrella. It is reasonable to conclude that the fatal influence of *G. salaris* on salmon stocks only can be solved through international co-operation.

Disinfection of fishing tackle in the Tana River basin - Mandatory or voluntary disinfection?

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Tana River basin
Tana River is the most important and the largest salmon river in Norway and Finland and one of the most productive salmon rivers. With a catchment area of 16.386 km ² is the comparison ¼ - part of Finnmark county area.1[1] About 70% of the catchment are in Norway (Tana, Karasjok, Kautokeino and Alta municipalities), while 30% are located in Finland (Utsjok and Inari Municipalities).

After input from locals with net fishing rights (LBT) has recorded with Finnmarkseiendommen questions about the procedures for the disinfection of fishing equipment on sale of freshwater fishing card in the Tana River basin. Summary of meetings in 2008/09 is that we have different views on sales link responsible for the disinfection of fishing equipment. We agree that the threat is in the border areas, that include proven gyro in tributaries of the Torne River that has outlets from areas that are close Karasjohka basin.

Disinfection in Tana
Disinfection of fishing tackle on the Norwegian side in Tana River carried out in all outlets for fishing permits, a total of 5 stations in 2010. The license purchased by physical attendance. Fishing equipment will be disinfected, if the fisherman come from areas outside of Finnmark.

Over the years the system for disinfection has improved. In the period 2003-06 had veterinary authorities focus on disinfection, the information and distribution of equipment. Today, stations satisfactorily equipped to disinfect equipment for salmon fishing.

Disinfection in Finland has until last year been on a voluntary basis. At visit 3 of the stations that sell most permits in Finland in the Tana River in 2008-09, it emerged that the stations were not equipped to disinfect quantities of salmon fishing gear.

Different standards for disinfecting
Different standards for disinfecting fishing equipment in the same catchment area may have weaknesses. As a result, the distribution of salmon in the Tana river and in the side over a significant geographical area, we are of the opinion that the area should be the same standards and procedures for what can be considered good disinfection.

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1 Rune Muladal 2007, Biologisk delplan for Tanavassdraget s.6

Disinfection routines on the Finnish side of the Tana and Neiden rivers

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Information about ELY Centre:

ELY Centre established on 1 January 2010, the Centres for Economic Development, Transport and the Environment (ELY Centres) form part of the government's reform project for regional administration. The tasks and services of the former Employment and Economic Centres (TE Centre), Regional Environmental Centres, Road Districts, and State Provincial Offices' departments for transport and communications and for education and culture have been pooled in the Centres for Economic Development, Transport and the Environment.

The legislative base about disinfection routines on The Finnish side of the Teno (Tana) and Näätämö (Neiden) rivers:

Ministry of Agriculture and Forestry/regulation 1376/2004:
"Boats and canoes together with fishing equipment like reels, rods, lures, nets, boots, padding trousers, fish cleaning equipment, transferred from other parts of Finland must be dry or disinfected before their use in River Teno, Näätämö, Paats, Tuuloma and Uutuan watercources."

Disinfection certificates are available at all the locations selling Teno and Näätämö River fishing licences on the Finnish side.

There are 18 decontamination stations around Inari and Utsjoki muncipalities. Decontamination is also available in airports (hydroplane and helicopter ports) in Enontekiö municipality. Disinfection is free in Inari Fishing harbor (mid June – mid August). The other decontamination stations may charge max 5 € per disinfection. If all fishing equipment are dry disinfection is not needed.

Before fishing season starts ELY Centre gives instruction, education and all needed disinfection equipment for every decontamination stations.
About 2500 - 3000 disinfection certificates are written every year of which 300 in Inari Fishing harbor.

Information about *Gyrodactylus salaris* and disinfection are given in "Teno info" leaflets, Internet, roadside flats and other information leaflets.

The landowners view on the *G. salaris* management

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The association of Norwegian Salmon Rivers (NRS) represents landowners and holders of fishing rights in 70 rivers with anadromous salmonid populations. A total of 7000 individual land owners are represented and approximately 70% of salmonids caught in Norwegian rivers are caught in the association's rivers.

The annual losses due to *Gyrodactylus salaris* are considerable and represent a threat to local communities where the salmon fishing business is an important part of the annual income. NRS support the eradication of *G. salaris* in infected rivers, but encourage measures to support fishing activities and conservation of sea trout and char (if possible) in infected rivers.

The eradication plans involving chemical treatment of infected rivers should be more aggressive. 35 years after the introduction the parasite is still spreading and too many rivers are still infected. The fear for failing should not be a reason for not implementing the eradication plans. NRS regret that disinfection of fishing equipment, and other equipment intended for use in or on water, for all visitors to salmon rivers in Norway is no longer mandatory. The possibility for using dry, but not disinfected equipment, increase the risk for transfer of potential pathogens between rivers. With respect to this all potential pathogens should be treated similarly. Disinfection should therefore be mandatory.

RECOMMENDATION on action against the spead of *Gyrodactylus salaris*

The risk of spreading the parasite is still present; therefore, preventive measures should actively be taken. The transboundary rivers Tana and Neiden have so far been spared from infection with the salmon parasite *Gyrodactylus salaris*. The goal for NASCO (Norh Atlantic Salmon Conservation Organisation) and its Parties is to prevent further spread of the parasite and to eradicate it from infected areas.

The following recommendations are put forward by the experts and authorities dealing with these issues in the North Calotte region – October 2010;

- Both countries should follow up the recommendations by NASCO
- Responsible authorities in Norway (Mattilsynet, Directorate of Nature Management) and Finland (Ministry of Agriculture and Forestry Department of Food and Health, Finnish Food Safety Authority Evira and ELY-centre) should work towards joint policies concerning threats and preventive measures including mutual long term information strategies
- Responsible authorities in Norway and Finland are recommended to work towards a harmonised contingency plan and to a joint plan for the transboundary rivers, which has to be made available to the general public
- Concerning preventive measures: both countries should agree on active implementation of mandatory disinfection practices. Education and increase of awareness of the risks and control of disinfection practices is nesessary
- Article on preventive measures to be included in the fishing agreements between Finland and Norway for the rivers Tana and Neiden
- Responsible authorities in both countries to agree on a cost efficient and long term screening of fish for the occurence of *G. salaris* infection in the rivers of Neiden and Tana
- A request to responsible authorities to organise continual exchange of information on the relevant actions proposed in this recommendation
- All parties agree on future international experts and authorities meetings. The Food Safety Authorities take responsibility to arrange annual meetings

VAROKAA! VARNING! ADVARSEL! FUOMÁŠ! WARNING!

GYRODACTYLUS SALARIS

Lohiloinen *Gyrodactylus salaris* (koko ~0,5 mm)
Laxparasiten *Gyrodactylus salaris* (storlek ~ 0,5 mm).
Lakseparasitten *Gyrodactylus salaris* (størrelse ~ 0,5 mm).
Luossaparasihtta *Gyrodactylus salaris* (sturrodat 0,5 mm)
The salmon parasite *Gyrodactylus salaris* (size ~ 0,5 mm).

ÄLÄ LEVITÄ LOHILOISTA!

Tämän vesistön kalat saattavat olla *Gyrodactylus salaris* –lohiloisen kantajia. Lohiloinen on suuri uhka villille merilohelle Tenossa ja muissa Atlanttiin virtaavissa lohijoissa. Et levitä lohiloista, kun noudatat yksinkertaisia varotoimia:

- Kuivaa tai desinfioi kaikki kalastusvälineesi, jalkineesi, veneesi j moottorisi ennen kuin käytät niitä toisissa vesistöissä. *G. salaris* – lohiloinen ei voi levitä kuivien välineiden mukana.
- Älä siirrä kaloja tai vettä toisiin vesistöihin.
- Perkaa kala siinä vesistössä, josta olet sen saanut.

Ei päästetä *Gyrodactylus salaris* –lohiloista leviämään!

VARNING! SMITTSAM LAXPARASIT

Fisken i detta vattendrag kan vara bärare av laxparasiten *Gyrodactylus salaris*. Denna kan utgöra ett hot för stammarna av atlantisk lax i älvar som rinner ut i Atlanten och Norra Ishavet, till exempel Tanaälven. Dessa enkla försiktighetsåtgärder kan stoppa vidare spridning av smittan..

- *G. salaris* sprids inte med torra föremål. TORKA eller DESINFICERA all fiskeutrustning, skor, båtar, utombordsmotorer och liknande innan användning i ett annat vattendrag (sjö, å, älv).
- Flytta inte vatten eller fisk till annat vattenområde.
- Rensa och rengör inte fisken någon annanstans än där den är fångad.

Hjälp oss förhindra vidare spridning av *Gyrodactylus salaris*!

ADVARSEL! SMITTSOM LAKSEPARASITT

Fisken i denne elva/innsjøen kan bære lakseparasitten *Gyrodactylus salaris*. Denne parasitten er en trussel mot bestander av atlanterhavslaks i mange norske elver. Disse enkle forhåndsreglene kan stoppe spredningen av parasitten:

- *G. salaris* spres ikke med tørre gjenstander. TØRK eller DESINFISER alt fiskeutstyr, støvler, båter, motorer osv. før de brukes i en annen elv eller innsjø.
- Ikke flytt vann eller fisk til andre innsjøer eller elver.
- Ikke rens fisken andre steder enn der den er fanget.

Hjelp oss å unngå spredning av *Gyrodactylus salaris*!

VÁRREHUS! NJOAMMU LUOSSAPARASIHTTA

Dán jogas/jávrris sáhttá leat *Gyrodactylus salaris* luossaparasihtta. Dát luossadávda áitá atlanterábi luossanáli Deanujogas ja eara jogain mat golget Atlanterábpai dahje Jeangaábpai. Čuovvovaš álkis várrehusat ja njuolggadusat sáhttet hehttet parasihta viidánami:

- *G.salaris* ii čuovo goike dinggaid miekde. GOIKAT dahje DESINFISERE buot guollebivdinbiergasiid, stevvellid, fatnasiid, mohtoriid jna. ovdal dat geavahuvvojit jogas dahje jávrris.
- Ale fievrret čázi dahje guliid eará jávrriide dahje jogaide.
- Ale čolle guoli eará báikkiin go das gos leat guoli goddán.

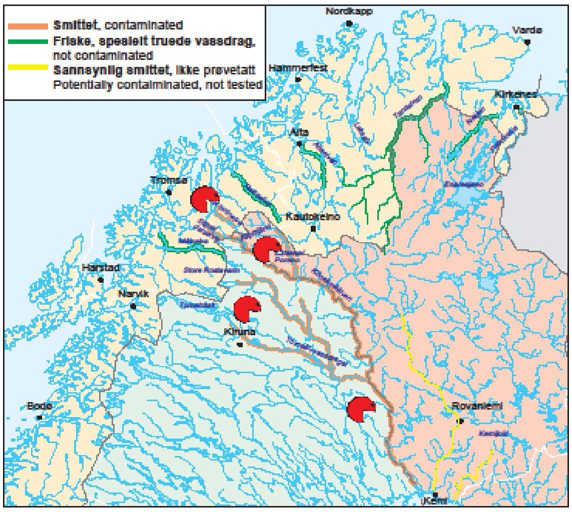
Veahket min eastadit *Gyrodactylus salaris* viidáneami!

WARNING! CONTAGIOUS SALMON PARASITE

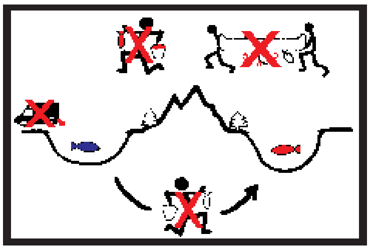
The fish in this river/lake might carry the salmon parasite *Gyrodactylus salaris*. This parasite is a major threath for the salmon in River Tana and in other rivers flowing into the Atlantic. These simple precautions can stop spreading the parasite:

- *G. salaris* is not carried on dry objects. So DRY or DISINFECT all fishing equipment, shoes, boats, outboards e.g. before using them in another river or lake.
- Do not move water or fish to other rivers or lakes.
- Do not clean the fish anywhere else but where it is caught.

Help us to prevent spreading af *Gyrodactylus salaris*!



Gyrodactylus salaris lohiloisen levinneisyys Pohjoiskalotilla.
Forekomst av *Gyrodactylus salaris* på Nordkalotten.
Utbredelsen av *Gyrodactylus salaris* i nordlige deler av Norge, Sverige og Finland.
Gyrodactylus salaris viidá neapmi Norgga davimus oasis, Ruotas ja Suomas.
The occurence of *Gyrodactylus salaris* in the nothern parts of Norway, Sweden and Finland.



Välttäkää veden ja kalan siirtoa vesistöjen välillä.
Inte transportera vatten och/eller fisk mellan vattendrag.
Unngå transport av vann og/eller fisk mellom vassdrag.
Ale fievrrit čázi ja guliid čázádagaid gaskka.
Prevent transport of water and/or fish between watercourses.

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Norkalottrådet
Pohjoiskalotin Neuvosto
The North Calotte Council

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