North-East Atlantic Commission

NEA(04)3

Report of a Workshop on Gyrodactylus salaris in the Commission Area

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1. The parasite *Gyrodactylus salaris* (*G. salaris*) is a very serious parasite that strikes at the very heart of salmon conservation. In Norway the parasite has infected 44 watercourses and the average decline in parr densities in these rivers has been 86%. The parasite has also been identified in 13 of the 23 rivers on the west coast of Sweden, in the rivers Keret and Kem in Karelia, Russia, and in watercourses in northern Finland, although not the two main Atlantic salmon rivers in the region, the Tenojoki (Tana River) and Naatamojoki (Neiden River). Iceland, the UK and Ireland are free of the parasite but it is known that Scottish stocks are as susceptible to the parasite as those in Norway.

2. The Commission accepted an invitation from the Directorate for Nature Management, Norway, to hold a workshop with the intention of:

   - reviewing information on the monitoring programmes for, and on the distribution of, *G. salaris*;

   - reviewing measures implemented and proposed to minimise the threat posed by *G. salaris*, including details of treatment methods employed;

   - developing recommendations on opportunities to enhance cooperation on monitoring, research and exchange of information;

   - developing recommendations on the need for revisions to international guidelines and other measures and for strengthening of national and regional legislation and measures with the objective of preventing the further spread of the parasite.

3. This Workshop was held in Oslo, Norway, during 11-12 February 2004 under the Chairmanship of Mr Steinar Hermansen (Norway) and the report of the meeting is attached. The Workshop was attended by thirty-five delegates from four of the Commission's Member Parties and an observer from the International Baltic Sea Fishery Commission. It was able to make good progress in a short period of time.

4. The Workshop developed a large number of recommendations and these are contained in sections 7.3-7.5 of the report. In order to take these recommendations forward the Workshop asked the Secretary to convene a sub-group to work by correspondence in order to develop a 'road map' proposing responsibilities and a timeframe for action, and Terms of Reference for the international Working Group proposed by the Workshop. A separate report, NEA(04)4, with the sub-group's recommendations, will be presented.

5. The Commission is asked to consider the recommendations arising from the Workshop, together with the proposed 'road map', and decide on future action.

Secretary
Edinburgh
8 April, 2004

GSW(04)5

Report of the North-East Atlantic Commission Workshop on Gyrodactylus salaris in the Commission Area

Radisson SAS Plaza, Oslo, Norway 11-12 February, 2004

1. Opening of the Meeting

1.1 The Secretary of NASCO, Dr Malcolm Windsor, opened the meeting, welcomed participants to the Workshop and made an introductory statement (Annex 1).

1.2 The State Secretary of the Royal Norwegian Ministry of the Environment, Mr Lars Jacob Hiim, welcomed delegates to Oslo and made an opening address (Annex 2).

1.3 A list of participants is contained in Annex 3.

2. Appointment of a Chairman

2.1 Mr Steinar Hermansen (Norway) was appointed Chairman.

3. Adoption of the Agenda

3.1 The Workshop adopted its agenda, GSW(04)4, (Annex 4).

4. Nomination of a Rapporteur

4.1 Dr Peter Hutchinson, Assistant Secretary of NASCO, was appointed Rapporteur.

5. Status reports by Party on monitoring programmes for, and on distribution of, *G. salaris*

5.1 Reports on the status of monitoring programmes for, and on the distribution of, *Gyrodactylus salaris* were made by EU (Finland), EU (Ireland), EU (Sweden), EU (UK), Norway and Russia. These reports are contained in Annex 5. Iceland reported that it does not have a monitoring programme specifically for *G. salaris* in rivers, although there is a monitoring programme for hatcheries. However, on the basis of the absence of the very severe damage to wild salmon stocks seen elsewhere, the authorities are confident that the parasite is not present in Iceland.

5.2 *G. salaris* has infected 44 watercourses in Norway and the average decline in parr densities in these infected rivers has been 86%. The spread of the parasite in Norway is associated with stocking of rivers, movements of fish between hatcheries and movements through brackish water of wild fish between rivers entering the same fjord. *G. salaris* has also been identified in 13 of the 23 rivers on the west coast of Sweden, and has spread north at the rate of one river a year. The parasite is present in the River Keret and in the watershed of the River Kem (on landlocked salmon in one tributary the River Pista) in Karelia. The parasite is also present in watercourses and fish farms in northern Finland but not in the two main Atlantic salmon rivers in the region, Tenojoki (Tana River) and Naatamojoki (Neiden River). Iceland, the UK and Ireland are free of the parasite. *G. salaris* is not thought to be present in North America, and it is not known if Atlantic salmon stocks there are vulnerable to the parasite.

5.3 Identification of gyrodactylids to species level has, until recently, been on the basis of morphological characteristics and is problematic because of the similarity in shape and size of the attachment hooks used to differentiate the many different species, most of which do not cause serious damage to Atlantic salmon. Recent advances in molecular techniques provide a more robust and reliable objective method of species identification and have cast doubt on the status of *G. salaris* in some EU Member States. Cooperation among scientists in Scotland, Norway, Finland, Germany, the Russian Federation and Sweden has allowed exchange of samples across the North-East Atlantic Commission area. Application of molecular techniques suggests that the reports of *G. salaris* in France, Spain and Portugal may be due to misclassification, although the parasite may be present in Germany. Accurate information on the distribution of *G. salaris* is lacking and is essential in defining infected and free zones designated for trade purposes. This uncertainty is a risk factor in operating zones designed to prevent the spread of the parasite.

5.4 The Workshop discussed the apparent difference in pathogenicity of *G. salaris* to Baltic and Atlantic salmon. Although the same species, Baltic salmon appear to be resistant to the parasite while Atlantic salmon are extremely susceptible. These differences may be due to genetic differences between the two strains of salmon. However, it was noted that there had been limited investigations in the Baltic. Research in one regulated Baltic river, the Indalselven, suggests that the salmon from that river are not resistant. In the rivers on the west coast of Sweden the parasite does not result in the very high parr mortality seen in Norway and in the river Keret in the Russian Federation, possibly because there has been mixing of stocks of Baltic and Atlantic origin. Furthermore, some of these Swedish rivers are acidified and may have high aluminium concentrations (see paragraph 6.2). In Norway, electrofishing data indicates reductions in parr densities ranging from 48% to 99% in different rivers. The reasons for these differences are not known but environmental conditions, particularly water quality, may be a factor. There is no evidence that Norwegian salmon have developed resistance to the parasite. In one river, the Vefsna, which has been infected for more than 25 years, a high incidence of Atlantic salmon/brown trout hybrids, which may have a greater degree of resistance to the parasite than salmon, has been observed in recent years. While it may be possible to develop resistance to the parasite through selective breeding programmes this would alter the genetic make-up, that codes for resistance, of the salmon stock concerned.

6. Status reports by Party on measures implemented and proposed to minimise the threat posed by *G. salaris,* including details of treatment methods employed

6.1 Reports on the status of measures implemented and proposed, to minimise the threat posed by *G. salaris* were presented by EU (Finland), EU (Ireland), EU (Sweden), EU (UK), Iceland, Norway and Russia. A Decision of the European Commission of 21 November 2003 (2003/858/EC) was also tabled. This Decision lays down the animal health and certification requirements for imports of live fish, their eggs and gametes intended for farming, and live fish of aquaculture origin and products thereof intended for human consumption. These reports are contained in Annex 6. It was noted that monitoring at rainbow trout farms in Denmark had indicated a high prevalence of the parasite and the view was expressed that it would have been valuable to have had input to the workshop from Denmark. A risk analysis had indicated that in the future, trade in live salmonids may become an important route of introduction depending on patterns of trade. Trade in carcasses (where the fish have been harvested in freshwater and have not been frozen) and mechanical transmission on fishing equipment and well-boats/lorries had also been identified as potential routes of introduction. The UK and Ireland are developing contingency plans to be implemented in the event of the parasite being introduced.

6.2 Twenty-one rivers in Norway have been successfully treated for *G. salaris* by a combination of construction of barriers and treatment with rotenone, although five remain under close surveillance. During treatment the salmon population is maintained in a living gene bank which is used to supplement the recovery which occurs naturally through salmon from the river returning from the sea. Only disinfected eggs are used to supply the gene bank and to re-stock the river. Research is being carried out into the effectiveness of species-specific chemicals such as aluminium which might be an alternative to rotenone. The cost of the treatment programme in Norway since its inception is approximately NOK 250 million (approximately £20 million, Euro 28 million) excluding the losses associated with the loss of income from the fisheries.

7. Development of recommendations

7.1 The Workshop noted that the Council of NASCO has adopted the "Williamsburg Resolution", CNL(03)57, which contains measures designed to minimise the impacts of diseases and parasites. The Workshop developed the following recommendations for research, monitoring, information exchange and measures to protect the wild Atlantic salmon from the threats posed by *G. salaris.* In doing so the Workshop recognised that there are other factors such as trade rules which will also play a role in determining which of the recommendations will finally be implemented. Nevertheless, the Workshop considers that strong measures, consistent with the Precautionary Approach, are necessary and it urges the North-East Atlantic Commission to seriously consider the following and to take appropriate action.

(a) ***Opportunities to enhance cooperation on monitoring, research and exchange of information***

7.2 Greater cooperation in both research and management is needed among the Parties of NASCO and others. This type of cooperation is crucial with respect to effective measures to prevent further spread of the parasite and to eradicate it in areas where it has been introduced.

7.3 The group has identified that further work or investigation is required in the following areas; immediate priorities are shown in **bold.** Some of the following points may be covered within single projects or monitoring programmes.

7.3.1 Standardized targeted monitoring methods in watercourses, lakes and in aquaculture (anticipated to be based on forthcoming OIE recommendations)

(a) Standards of sample size, frequency of sampling, etc. must be developed

- **Seasonal variation, reproductive rate, etc. of parasite**
- **Annual cycle of infestation in natural watercourses and aquaculture**
- **All year-classes of salmonids, including adults, and any other potential transport hosts, should be sampled**

(b) Taxonomy requires ongoing work

(c) Require laboratory (OIE reference laboratory seems obvious choice) to provide advice, testing, confirmation

(d) Biomonitoring in hatcheries, especially where salmonids other than *S. salar* held.

7.3.2 Mapping the present and natural distribution of *Gyrodactylus salaris* in the North-East Atlantic area and adjacent areas (by individual countries or regions, encouraged by NASCO)

(a) Salmonids from both wild and culture environments should be sampled

(b) Mapping should be carried out in countries that have salmonid fish

7.3.3 NASCO should establish an international working group to:

(a) Develop measures and recommendations, e.g. for contingency plans, methods of eradication in farms

(b) Exchange information, particularly on monitoring and control

(c) Promote international cooperation in generating knowledge on eradication measures, e.g. barriers and chemical treatment

(d) Initiate workshops/seminars to exchange information and present results from monitoring and research activities on *G. salaris*

- Bring academic and applied scientists together with managers
- Potential funding sources need to be identified
- Workshop to develop proposals on applied research programme

(e) Cost benefit analysis to justify research, guarantees, policy decisions, publicity, etc.

7.3.4 NASCO should encourage the Parties to conduct research on:

(a) The natural distribution and genetics of the parasite

- What is the natural distribution and origin of the parasite?
- Can the parasite vary in virulence?

(b) The effects of salmon genetics on sensitivity to *G. salaris*

- Sensitivity of different salmon stocks and heritability of this
- Frequency of resistant traits in salmon populations

(c) General biology and spreading mechanisms of the parasite

- Reproductive rate
- Role of salmon/trout hybrids in spread/maintenance of parasite
- Risk analysis for transport/introduction
- Host-parasite relationships

(d) Effects of environmental parameters and ecology on the distribution of *G. salaris*

- Effects of environmental parameters in rivers
- Effect of environmental parameters on concurrent/secondary infections

- Potential for aluminium tolerance in the parasite and alternative treatments
- Ecological impact of the parasite

7.3.5 Publicity/Information

(a) Target high-risk groups for spread (fish movements, transporters, carcasses, anglers, tourists)

(b) How to disseminate information

Cooperation with other authorities

(b) The need for revisions to international guidelines and other measures with the objective of preventing the further spread of G. salaris

7.4 EU fish health legislation is currently under review. Directive 91/67 will be replaced in the next few years. The Office International des Epizooties (OIE) (also known as the World Organisation for Animal Health) guidelines are reviewed annually. NASCO seeks to contribute recommendations for the control of *G. salaris* to the OIE, the European Community and the Russian Federation.

7.4.1 Article 1 of EC Directive 91/67 provides for measures for conservation of species and this should be retained in any replacement legislation.

7.4.2 *G. salaris* should be placed on list II in the new fish health directive since the parasite can cause severe ecological consequences and it is present in parts of the EU and other areas are free.

7.4.3 Diagnosis of *G. salaris* by morphology should be confirmed by the use of molecular techniques.

7.4.4 The minimum approved zone size should be a river catchment, individual farms should not be given *G. salaris* free status.

7.4.5 Surveillance programmes should include all potential host species. On farms with both salmon and rainbow trout both populations should be tested. Since the expected prevalence is lower in rainbow trout higher samples sizes will be required for this species.

7.4.6 The geographic distribution of *G. salaris* should be established with a view to minimising its spread to uninfected areas.

7.4.7 Criteria for diagnosis and establishing *G. salaris* free zones should be based on international standards laid down by OIE.

7.4.8 Trade in live fish should only take place between zones of equal *G. salaris* status or from a higher to lower status zone.

7.4.9 Guidelines on the transportation of fish in the OIE Aquatic Animal Health Code (2003) should be implemented through national and regional legislation.

7.4.10 Trade in gametes is preferable to trade in live fish.

7.4.11 Countries with shared catchments should cooperate in the control and eradication of *G. salaris* and inter-country working groups for the control of *G. salaris* should be encouraged and strengthened.

(c) The need for strengthened national and regional legislation and measures with the objective of preventing the further spread of G. salaris

7.5 The new EU fish health directive will provide guidance on minimum measures for trade and disease control. The recommendations below are additional measures that countries should consider for the control of *G. salaris*.

7.5.1 The geographic distribution of *G. salaris* should be established with a view to minimising its spread to uninfected areas.

7.5.2 Within a country, criteria for diagnosis and establishing *G. salaris* free zones should be based on international standards.

7.5.3 Trade in live fish should only take place between zones of equal *G. salaris* status or from a higher to lower status zone.

7.5.4 Permission to stock fish into infected river catchments should be based on an assessment of the increased risk of transmission of the parasite to non-infected rivers (e.g. through migration and other routes).

7.5.5 In regions where the introduction of the parasite would lead to the extinction of Atlantic salmon population there should be no movement between river catchments of fish from infected farms.

7.5.6 Guidelines on the transportation of fish in the OIE Aquatic Animal Health Code (2003) should be implemented through national and regional legislation.

7.5.7 Countries should have contingency plans in place for treatment, containment or eradication. A legal base for use of rotenone and other treatment, containment and eradication measures should be put in place.[1]

7.5.8 Where possible, routine breaks in production and disinfection on rainbow trout and salmon freshwater sites should be implemented as part of a control programme in infected areas.

7.5.9 There should be good containment to prevent escapees.

7.5.10 Trade in gametes is preferable to trade in live fish.

7.5.11 Physical barriers to fish migration should be considered as a measure to minimise the risk of spread of *G. salaris* within a catchment and to uninfected catchments.

[1] Contingency plans need to be developed on a case-by-case basis and eradication may not always be possible.

7.5.12 Countries with shared catchments should cooperate in the control and eradication of *G. salaris* and inter-country working groups for the control of *G. salaris* should be encouraged and strengthened.

7.5.13 Appropriate steps should be taken to minimise the spread of *G. salaris* through movement of anglers, boats, etc. by use of approved disinfection methods.

7.5.14 All movements of live fish should be recorded so that movements can be traced in the event of an outbreak of *G. salaris*.

7.5.15 The risk of *G. salaris* introduction through the processing of fish carcasses should be assessed and where appropriate mitigated through control of processing.

7.5.16 Countries should ensure that adequate resources are available for the implementation of measures to contain and eradicate *G. salaris*.

7.6 The Workshop agreed that prior to the next Annual Meeting of the North-East Atlantic Commission, a sub-group convened by the Secretary should be established, to work by correspondence, to develop a "road map" proposing responsibilities and a timeframe for taking forward the recommendations from the Workshop and to develop Terms of Reference for the proposed international Working Group referred to in paragraph 7.3.3 above. The Parties agreed to advise the Secretariat of their participants on the sub-group.

8. Other Business

8.1 The Workshop was advised of the intention to hold a NASCO/ICES Symposium entitled "Interactions between aquaculture and wild stocks of Atlantic salmon and other diadromous fish species: science and management, challenges and solutions." The symposium will be held in Bergen, Norway, in early October 2005. The subject is relevant to the Workshop and a preliminary announcement will be sent to all Workshop participants.

9. Report of the Meeting

9.1 The Workshop agreed a report of its meeting.

10. Close of the Meeting

10.1 The Chairman thanked participants for their contributions and closed the meeting.

List of Annexes

Annex 3 List of Participants

Annex 4 Agenda

Annex 5 Status Reports by Party on Monitoring Programmes for, and on Distribution of, *G. salaris*

Annex 6 Status Reports by Party on Measures Implemented and Proposed to Minimise the Threats posted by *G. salaris*, including Details of Treatment Methods Employed

ANNEX 1

Introductory Statement by the Secretary of NASCO

Welcome to this Workshop of the North-East Atlantic Commission of NASCO. I am glad to see that the State Secretary of the Royal Norwegian Ministry of the Environment is with us today, and he will address us shortly.

Today and tomorrow we face a very important issue: how to eradicate from infected areas, and stop the further spread of, the parasite *Gyrodactylus salaris*. NASCO's essence is the conservation of wild Atlantic salmon stocks and here we have a threat that strikes at the very heart of conservation. It kills young salmon.

We know the parasite has had a lethal effect on salmon in certain Norwegian rivers; over 40 were affected, and it still exists in about 25. We know how intense and costly the efforts have been to remove the parasite from infected rivers.

We know that it has also affected rivers in northern Finland, in the Karelian region of the White Sea in Russia and on the west coast of Sweden.

We know that it is very difficult and very costly to eradicate it and stop its spread.

We know that wild stocks in other countries, such as Scotland, are equally vulnerable to the parasite. We know that for those countries that do not have it, the prospect of its occurrence is a fishery manager's worst nightmare.

We also know that there are international pressures to liberalise trade. I suspect that most of us find this valuable; we all want cheaper goods – cheaper videos and freezers through free trade are good for all. But most of us here do not want free trade in, say, fish if the price is the movement of the parasite into areas where it does not exist. We do not want to risk the remaining wild stocks which are already in a weakened state.

So the challenge before us is to emerge from this meeting tomorrow afternoon with firm ideas on:

- how to enhance our cooperation on monitoring, research and information exchange;

- how to adapt national and regional legislation to prevent the spread of the parasite;

- and to consider if we need to develop international guidelines from this Commission, or to amend the Council's Williamsburg Resolution, or possibly to make representations to other bodies, such as OEI, on guidelines.

So your ideas here will go to the North-East Atlantic Commission in June and it will then be asked to decide whether it wishes to refer the matter on to NASCO Council.

Well, this is one interpretation of why we are here that you may or may not agree with. We will soon get to our business. First, however, I would like to invite the State Secretary, Mr Lars Jacob Hiim, to address us.

ANNEX 2

Opening Address by the State Secretary of the Royal Norwegian Ministry of the Environment

Mr Secretary, Ladies and Gentlemen:

I wish you all welcome to a wintry Oslo and to this NASCO meeting dedicated to international cooperation to minimise the threat to wild salmon from *Gyrodactylus salaris*. This parasite represents one of the most serious threats to the stocks of wild Atlantic salmon, and the effect on Norwegian stocks has been dramatic since the parasite was introduced in 1975. A total of 44 rivers have been infected, and their salmon stocks in most cases have been practically wiped out. In economic terms, estimates show an annual loss of more than 200 million Norwegian Kroner each year, giving a total loss in the range of 3-4 billion Kroner since *Gyrodactylus* was introduced.

The grave threat to the wild stocks of salmon and the associated economic losses make *Gyrodactylus* a serious challenge for Norwegian salmon management. Many resources have been used to control and eradicate the parasite. Most well known – and indeed also most controversial – has been the use of rotenone in infected rivers. This is a dramatic but necessary treatment that has relieved the stocks in 19 infected rivers from the parasite. As a result the number of infected rivers has been reduced to 25.

During the last few years, new and improved methods of fighting *Gyrodactylus* have been developed. The most promising development in recent years, however, is the use of aluminium for treatment of *Gyrodactylus*-infected rivers. This method was successfully tested in a small river system in Western Norway last autumn, and further tests will be conducted in 2004 to reveal the strengths and weaknesses of this method. Another improvement is the use of barriers to migration of anadromous fish in infected rivers.

Apart from <u>getting rid of</u> *Gyrodactylus* in infected rivers, we have spent considerable resources on measures to <u>avoid</u> spreading of the parasite to new areas. A dedicated surveillance programme keeps the proper authorities updated on the distribution of the parasite. In addition, disinfection facilities have been established in a number of rivers to avoid spreading from infected areas. And just the need to avoid further spreading will, I believe, be at the core of your discussions here in Oslo.

I personally want to stress that we must all do whatever can be done to avoid further spreading of *Gyrodactylus* to uninfected countries or regions of NASCO. To achieve this, we should examine all the potential benefits of strengthened cooperation at the scientific and management levels. The aim, of course, should be to improve the overall efficiency of the measures used against the parasite. Furthermore, we need to examine the potential for strengthened legal tools, nationally as well as internationally. I am aware that this may reveal conflicts with other important objectives, but when the conservation of our wild salmon stocks is on the line, no stone should be left unturned. NASCO has a fine tradition of competent work to conserve Atlantic salmon. The Organization has already established guidelines relevant to the battle against *Gyrodactylus*. I am therefore confident that the issues before this meeting are in good hands.

Last, but not least, I wish you all fruitful discussions and a pleasant stay here in Oslo.

ANNEX 3

List of Participants

EUROPEAN UNION

Ms Carmen Beraldi	Secretaria General de Pesca, Madrid, Spain
Mr Gordon Brown	SEERAD, Edinburgh, UK
Ms Paloma Carballo	Ministerio de Agricultura y Pesca, Madrid, Spain
Dr Carey Cunningham	FRS Marine Laboratory, Aberdeen, UK
Mr Brian Daly	Fisheries Division, Belfast. UK
Dr Paddy Gargan	Central Fisheries Board, Dublin, Ireland
Ms Fiona Geoghegan	Marine Institute, Dublin, Ireland
Dr David Graham	Veterinary Sciences Division, Belfast, UK
Mr Nigel Hewlett	Environment Agency, Huntingdon, UK
Mr Perttu Koski	National Veterinary and Food Research Institute, Oulu, Finland
Mr Pentti Munne	Ministry of Agriculture and Forestry, Helsinki, Finland
Mr Fredrik Nordwall	Swedish National Board of Fisheries, Gothenburg, Sweden
Dr Edmund Peeler	CEFAS, Weymouth, UK
Mr Ole Tougaard	European Commission, Brussels, Belgium
Mr Dave Wyman	SEERAD, Edinburgh, UK

ICELAND

Mr Arni Isaksson	Directorate of Freshwater Fisheries, Reykjavik

NORWAY

Dr Gunnbjørn Bremset	Directorate for Nature Management, Trondheim
Dr Lars Petter Hansen	Norwegian Institute for Nature Research, Oslo
Mr Ivar Hellesnes	Mattilsynet, Steinkjer
Mr Steinar Hermansen	The Royal Ministry of Environment, Oslo
Mr Bjorn Ove Johnsen	Norwegian Institute for Nature Research, Trondheim
Mr Stian Johnsen	The Ministry of Fisheries, Oslo
Mr Finn Erlend Odegaard	Norwegian Salmon Rivers, Oslo
Mr Svein-Harald Salomonsen	Mattilsynet, Sjøvegan
Mr Steinar Sandøy	Directorate for Nature Management, Trondheim
Mr Ketil Skar	VESO Trondheim, Trondheim
Mr Jarle Steinkjer	Directorate for Nature Management, Trondheim
Mr Øyvind Walsø	Directorate for Nature Management, Trondheim

RUSSIAN FEDERATION

Ms Julia Barskaya	Karelian Research Centre of Russian Academy of Sciences, Karelia
Dr Eugeny Ieshko	Karelian Research Centre of Russian Academy of Sciences, Karelia
Ms Natalia Kalinina	Regional Veterinary Service, Murmansk
Dr Svetlana Krylova	Murmanrybvod, Murmansk
Ms Olga Novokhatskaya	Karelian Research Centre of Russian Academy of Sciences, Karelia
Ms Elena Samoylova	PINRO, Murmansk
Dr Alexander Zubchenko	PINRO, Murmansk

OBSERVERS

Dr Walter Ranke	International Baltic Sea Fishery Commission, Warsaw, Poland

SECRETARIAT

Dr Malcolm Windsor	Secretary
Dr Peter Hutchinson	Assistant Secretary

ANNEX 4

GSW(04)4

North-East Atlantic Commission Workshop on *Gyrodactylus salaris* in the Commission Area

Radisson SAS Plaza, Oslo, Norway
11-12 February, 2004

Agenda

1. Opening of the Meeting

2. Appointment of a Chairman

3. Adoption of the Agenda

4. Nomination of a Rapporteur

5. Status reports by Party on monitoring programmes for, and on distribution of, *G. salaris*

6. Status reports by Party on measures implemented and proposed to minimise the threat posed by *G. salaris,* including details of treatment methods employed

7. Development of recommendations on:

    (a) opportunities to enhance cooperation on monitoring, research and exchange of information;
    (b) the need for strengthened national and regional legislation with the objective of preventing the further spread of *G. salaris;*
    (c) the need for revisions to international guidelines with the objective of preventing the further spread of *G. salaris.*

8. Other Business

9. Report of the Meeting

10. Close of the Meeting

ANNEX 5

Status Reports by Party on Monitoring Programmes for, and on Distribution of, G. salaris

European Union

FINLAND

Monitoring of *Gyrodactylus salaris* in Finland

Perttu Koski, National Veterinary and Food Research Institute, Oulu Regional Unit

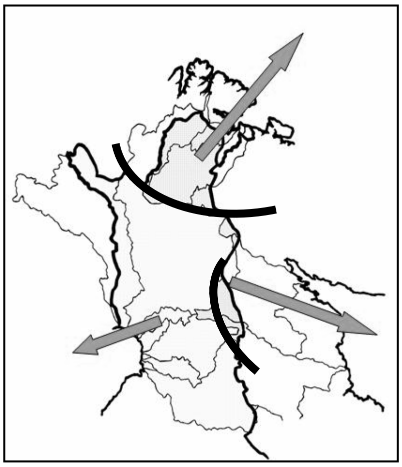

Figure 1:
Three main water catchment areas in northern Finland.

The watersheds between the water catchment areas of the Barents Sea, White Sea and Baltic Sea are partly situated in the territory of Finland (see Fig. 1).

Finland thus forms an important monitoring area for *Gyrodactylus salaris*, which is regarded as an extremely dangerous parasite of the Atlantic form of *Salmo salar*, but harmless to the Baltic form and other fish species.

History

G. salaris was found at approximately 40% of the fish farms in the northern Finland in the period 1990-92 (Koski & Malmberg, 1995). After discovering the widespread and prevalent occurrence of the parasite at fish farms in the Baltic and White Sea catchment areas, monitoring has been less intensive at farms. In the year 2000 the River Tornio wild Baltic salmon was, however, found to be heavily infected, especially in the upper parts of the tributaries in Finland. Since then there has been fairly intensive monitoring in the Finnish parts of this border river between Finland and Sweden.

Koski & Malmberg (1995) also found *G. salaris* at a rainbow trout farm in the River Paats catchment area (Lake Inari), which runs into the Barents Sea. Although this catchment area has no spawning Atlantic salmon population, the farm stock was eradicated. The first attempt to eradicate the infection was in 1992, but its failure was recognised in 1995. The farm was closed in 1996 and has been empty of fish since then. The follow-up of the eradication attempts and *G. salaris* monitoring of the River Paats catchment area is described in Koski & Heinimaa (2001).

Monitoring of the situation in the catchment areas running into the Barents Sea

In accordance with an agreement between Norway and Finland, 150 wild salmon parr per river are sampled from the Rivers Teno (Tana in Norwegian) and Näätämö (Neiden in Norwegian) each year. Examination of the samples from a particular river is performed in

Finland and Norway in alternating years. So far the results have been negative for the presence of *G. salaris*. Monitoring within this framework has been carried out in 1998-2003.

In the River Paats catchment area 60-150 wild salmonids and at least 60 fish at both of the fish farms per year are taken for the monitoring. Usually only the pectoral and dorsal fins are examined as is the general rule applying to fish farm samples in Finland. The results of the monitoring in the period 1993-1999 were reported in Koski & Heinimaa (2001). In 2000-2003 the monitoring has continued but *G. salaris* has not been detected.

The upper parts of the River Tuuloma catchment area are situated in Finland. From one tributary, the River Lutto, pectoral and dorsal fins of 60 wild grayling have been examined annually in the period 1999-2003 but *G. salaris* has not been detected. The small part of the River Uutua in Finland (Munkelva in Norwegian) has not been sampled.

Monitoring of the situation in the catchment areas running into the White Sea

There is no regular official monitoring of *G. salaris* in the two catchment areas, River Kouta and the River Vienan Kem, the upper parts of which are in Finland. Several rainbow trout farms located in these waters in Finland are, however, known to be infected with *G. salaris* (examined irregularly in conjunction with the monitoring of VHS and IHN viruses under the framework of the EU directive 91/67). It is also known that the wild land-locked salmon of Lake Kuittijärvet on the Russian side of the River Vienan Kem are infected with *G. salaris*.

Monitoring of the situation in the catchment areas running into the Baltic Sea

There are at present two wild salmon rivers flowing into the Baltic Sea in Finland, the Rivers Tornio and Simo. *G. salaris* has been found in both these rivers. In the River Tornio catchment area four rapids in different parts of the river system have been monitored. The prevalence and intensity of the *G. salaris* infection in this important Baltic salmon river are monitored by sampling 60 wild salmon parr, every second year, from the rapids. In 2000-2002 the samples were, however, taken annually and no clear time trends were detected.

The fish farms in the Baltic Sea catchment area are monitored for the presence of *G. salaris* only irregularly, as in the White Sea catchment area, or in connection with live fish exportation from Finland. The general situation is not believed to have changed from that reported in Koski & Malmberg (1995).

References

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IRELAND

Distribution and Monitoring of *Gyrodactylus salaris* in Ireland

A monitoring programme for *Gyrodactylus salaris* has been in place in Ireland since the mid 1990s. This programme covers both wild and farmed fish. At least 30 fish are examined from each freshwater aquaculture facility in the country each year, and a number of river catchments (at least five) are electro-fished annually in an attempt to gather wild fish samples. Table 1 gives details of all testing which has been carried out over the past 9 years.

G.salaris has not been detected in Ireland either by the statutory monitoring programme, or by any other means.

Table 1: Breakdown of fish sampled for Gyrodactylids from 1995 - 2003

Year	Farmed salmon	Wild salmon	Farmed Brown Trout	Wild Brown trout	Farmed Rainbow trout	Charr	Carp	Total Number sampled	Positive Samples (*G.truttae* & *G.dergavini*)
1995	633	0	0	0	254	0	0	887	1
1996	580	0	0	0	351	40	0	971	19
1997	1319	0	15	16	340	15	0	1705	19
1998	1242	0	15	4	348	15	0	1624	26
1999	549	0	25	0	203	10	4	791	11
2000	775	60	25	56	133	11	0	1060	21
2001	590	95 fins	38	0	260	11	10	909 + 95 fins	19
2002	612	84 fins	10	0	168	0	0	790 + 84 fins	10
2003	380	40	18	0	8	0	0		

Approximately half of the 2003 samples are yet to be read. There are 446 fish examined from the 2003 sampling with 4 confirmations of *G.dergavini*, all positives are from farmed fish.

SWEDEN

Monitoring of *G. salaris* in Sweden

The basic idea behind the monitoring of the parasite *G. salaris* in Sweden is that only **uninfected** rivers on the Swedish west coast are monitored regularly. The reason for this is that there are regulations for stocking fish in uninfected rivers. The parasite is only monitored in a few infected rivers (Table 1). At present (2003), 13 of 23 salmon rivers on the west coast are infected, mostly the rivers located on the southern part of the coast. In other areas in Sweden, i.e. rivers emptying in to the Baltic, the parasite is considered endemic and is therefore not monitored.

Table 1.

River (Fig. 1)	**No. Fish, time of year, no. of sites**
Gyrodactylus salaris **not found**	
Enningdalsälven	40, June, each year
Strömsån	20, end of May-June, 2 sites, every second year (2003)
Örekilsälven	40, June, 3-4 sites, each year
Bäveån	20, end of May-June, 2 sites, every second year (2002, 2004)
Arödsån	20, end of May-June, 2 sites, every second year (2004)
Bratteforsån	20, end of May-June, 2 sites, every second year (2003)
Anråseån	20, end of May-June, 2 sites, every second year (2003)
Kungsbackaån	40, June, 3-4 sites, each year
Rolfsån	40, June, 3-4 sites, each year
Löftaån	40, June, 3-4 sites, each year
Himleån	40, June, 3-4 sites, each year
Tvååkersån	20, end of May-June, 2 sites, every second year (2002, 2004)
Törlan	20, end of May-June, 2 sites, every second year (2002, 2004)
Gyrodactylus salaris **found**	
Säveån	40, June, 3-4 sites, each year
Ätran	40, 3-4 sites, Högvadsån 40 , 4 sites, total of 80 , autumn, each year
Stensån	40, autumn, 4 sites, each year

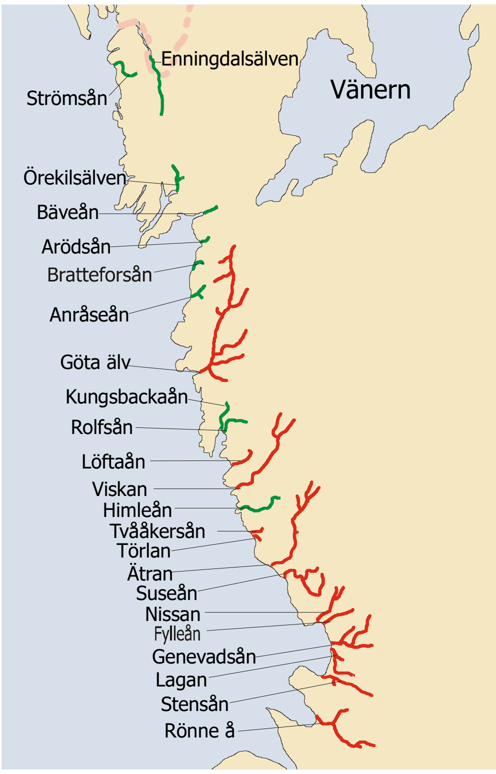

Fig. 1 Rivers monitored on the Swedish West Coast in the programme 2002-2004.

UNITED KINGDOM

Gyrodactylus monitoring and distribution

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Monitoring

The severe effects of *G. salaris* on Atlantic salmon in Norway led to great concern that the same situation might arise in the UK. Scientists from Fisheries Research Services (FRS) Marine Laboratory in Aberdeen transported parr from Scottish populations to Norway and exposed them to *G. salaris*. The Scottish fish were found to be equally susceptible to the parasite and, hence, at risk should it ever be introduced (Bakke *et al.*, 1993). The lack of any mass mortality of salmon parr in Scotland comparable to that experienced in Norway due to gyrodactylosis, combined with the knowledge that Scottish fish were susceptible, supports the hypothesis that Scotland has historically been free from *G. salaris*.

Monitoring programmes to establish that the parasite was indeed absent from the UK were instigated in the early 1990s. Shinn *et al.* carried out extensive initial surveys (Platten *et al.*, 1994; Shinn *et al.*, 1995). Routine monitoring of fish farms by FRS commenced in autumn 1994. Since then, the official service, FRS, has continued to monitor both farmed and wild salmonids. Information from this monitoring was vital to obtain the safeguard measures to prevent the movement of salmonid fish from areas that are, or may be, infected with *G. salaris*, to the UK (Commission Decision 96/490/EC). Sustained surveillance continues to demonstrate the parasite is not present in the UK.

Sampling

Freshwater fish farms are sampled once every two years for the presence of *Gyrodactylus* spp. Thirty fish are sampled from each site. Pectoral fins are cut from sacrificed fish and placed in absolute ethanol for transport back to the laboratory. Ideally, the fish would be examined on site, with all fins, the body and pharynx being examined under a binocular microscope immediately after sacrifice. Another procedure recommended for *Gyrodactylus* spp collection is to transport live fish back to the laboratory in the water they have been sampled from and carry out sacrifice and examination there. However, UK fish health inspectors are required to carry out rigorous examinations of facilities, fish and records when on a farm, and take tissues for virological, bacteriological and histological examinations. They are also often in the field for a week at a time, which precludes the collection and transfer of live fish to the main laboratory. This requires the fish to be sampled on the farm and time constraints on both sampling and examination have led to the decision to sample only pectoral fins. As susceptible species are being sampled and it is known that *G. salaris* infections rapidly increase in intensity on these hosts, it is likely that infections would be sufficiently intense to be detected from fin samples alone. Nevertheless, there is a risk that this sampling might not detect very low levels or intensities of infection.

Aquaculture facilities act as sentinel populations in fresh water. Any *G. salaris* infection in local waters that supply the farm will readily transfer to salmon or trout on the site. In a farm environment, the parasite population will rapidly increase until it is noted by the farmer or detected by the monitoring programme. For watercourses without farms, a programme of sampling wild fish has been carried out.

Since 1994, 135 samples of salmonid fish have been found infected with gyrodactylids. To illustrate the type of samples obtained in Scotland; in 2002, 107 cases were examined, representing a total of 3,010 fish. Sixteen cases, containing 397 fish, were examined from wild fish. Two thousand, six hundred and thirteen farmed fish were sampled. Twenty-four of these samples were infected by *Gyrodactylus* spp. *G. salaris* was not found in 2002 or any of the preceding years. *G. derjavini* and *G. truttae* are the species most commonly found in Scotland. *G. teuchis* was first identified from Scottish samples, but appears to be quite rare, as does *G. caledoniensis* (Shinn, Sommerville & Gibson, 1995).

In England and Wales in 2002, 125 salmonid farm sites were tested and a total of 3,595 fish were examined. Generally 30 fish were sampled at each site. 68 sites (55%) were negative for gyrodactylids. *G. derjavini* was found on 53 sites (43%), *G. truttae* was found at only 10 sites (8%), and both *G. derjavini* and *G. truttae* on 7 of these sites. In a 30-fish sample the number of fish with *G. derjavini* varied between 1 and 9. A total of 25 wild salmonids (Atlantic salmon and grayling) from 2 river catchments were sampled. *G. truttae* and *G.lucii* were found on fish from one catchment.

In Northern Ireland in 2003, 21 salmonid farms were sampled, with 1,107 fish examined. 7 farms had *Gyrodactylus* infection, none of these were *G. salaris* and *G. salaris* has never been found in Northern Ireland.

Species identification

Traditionally, *Gyrodactylus* species are discriminated by microscopic examination of the attachment organ, using differences in the size and shape of the attachment hooks to identify and differentiate species. Over 400 different species have been described within the genus *Gyrodactylus*, from fish and amphibians in fresh, brackish and salt water (Bakke *et al.*, 2002). As is frequently the case in taxonomy and systematics, several of these species descriptions require revision and updating. It was suspected that some descriptions of *Gyrodactylus* from different hosts might in fact be the same species. However, the converse has been shown more recently; specimens identified as one species are actually species groups of several morphologically similar types. *G. salaris* and *G. teuchis* are one such example of this phenomenon and are discussed below. The total number of *Gyrodactylus* species may be far higher than 400.

Of the Gyrodactylidae described from salmonid hosts in Europe, *G. salaris* is of obvious concern. *G. derjavini* and *G. truttae* are common in Northern Europe and *G. thymalli* is of interest because of the great similarity to *G. salaris*, although *G. thymalli* has a different natural host: grayling, *Thymallus thymallus*. Therefore monitoring for *G. salaris* in the UK has concentrated on identification of these species and especially the discrimination of *G. salaris* from other types.

Improvements have been made to the methods used to analyse gyrodactylids viewed under microscopic magnification. Measurement of the magnified attachment parts and further analysis of this data can provide more objective species identifications (Shinn *et al.*, 1996; 2000; 2001). However, there is a degree of overlap in measurements from species such as *G.*

salaris and *G. thymalli*, and especially *G. salaris* and *G. teuchis*, that results in a degree of uncertainty.

Since the 1990s, developments in molecular biology have enabled examination of genetic differences between *Gyrodactylus* species and the development of tests to differentiate species. Several tests are available to discriminate *G. salaris, G. derjavini* and *G. truttae*. These have been in routine use at FRS since 1995 and validated alongside microscopic examination. They have proven objective, robust and reliable, and as many diagnostic laboratories now have molecular testing facilities, are readily transferable. The traditional taxonomic study of gyrodactylids using microscopic examination requires long training and practice to develop and maintain expertise. As these skills are dwindling in many countries and molecular methods have become commonplace, the DNA-based tests may become more routine, although they will not replace traditional techniques.

Detailed methods for the identification of *Gyrodactylus* species infecting salmonid fish in Northern Europe are described by Collins *et al.* (2002) in an output from an EC-funded project involving workers from Scotland, Norway and Denmark. This handbook provides comprehensive guidance and methodology for microscopic and molecular analysis and is suitable for laboratories carrying out monitoring and surveillance for *G. salaris*.

Morphological Examination

Once samples have been deposited in the laboratory, fins are examined carefully for the presence of *Gyrodactylus*. These are examined immediately or recorded and placed in ethanol for later examination. *Gyrodactylus* specimens are removed from ethanol and placed on a microscope slide, covered with a coverslip. Examination of the anchors, ventral bar and marginal hooks is used to identify the specimen to species-group or species. Photographs are taken in cases of difficulty in identification.

Ammonium-picrate glycerin (Malmberg, 1957), a superior method for preparing whole mounts of monogenea for microscopic examination, is not used as it may interfere with subsequent molecular analysis. For the same reason, and for operator safety, formaldehyde is also not used. Parasites may be dissected to remove the attachment organ from the body, allowing staining of the attachment organ for microscopy while the body can be retained in ethanol for molecular analysis (Cunningham *et al.*, 1995a). However, there is a higher risk of losing one or both parts of the specimen in this procedure, and so it is not performed routinely in monitoring. Similarly, digestion of the specimen to leave the hard parts for microscopy and a lysate for nucleic acid extraction (Mo *et al.*, 1990; Harris *et al.*, 1999) is also not used in case of loss of one part of the sample.

Molecular examination

Several methods for discriminating *Gyrodactylus* species on the basis of DNA differences have been described (Cunningham *et al.*, 1995a; b; Cunningham, 1997; Cunningham *et al.*, 2001). At present, restriction fragment length polymorphism (RFLP) within the internal transcribed spacer (ITS) region of ribosomal RNA (rRNA) genes is the most straightforward and practical for use in surveillance and monitoring programmes. Individual parasites, once examined microscopically, are digested and part of the rRNA genes amplified by polymerase chain reaction (PCR). PCR products are then digested with enzymes and a different pattern of fragments is produced for each species. These results can then be cross-checked with those from microscopic examination.

The greatest level of detail is obtained by sequencing the DNA from specimens. DNA sequences revealed that although *G. teuchis* is almost identical to *G. salaris* in morphology and cross-hybridises with a DNA probe, it is in fact a separate species, as distinct from *G. salaris* as *G. derjavini*. These two species are an excellent example of the species groups of similar types that can be found within the genus *Gyrodactylus*. It is not cost-effective to apply sequencing as a routine diagnostic method. However, it is useful in cases of uncertainty, and in discriminating *G. salaris* and *G. thymalli*. These species are also extremely alike in morphology and in most DNA sequence, but can be separated and analysed using regions of spacer DNA (Sterud *et al.*, 2002; Cunningham *et al.*, 2003).

This spacer DNA and mitochondrial DNA have been used to begin analysis of population variation in *Gyrodactylus* (Cunningham *et al.*, 2003; Hansen *et al.*, 2003). Further information or methods to study population variation in *G. salaris* may provide information on the epidemiology or potential sources of new infections.

Distribution

Defining the current distribution of *G. salaris* in Europe is complicated by a number of factors. Early records of occurrence should be treated with caution. Potential misidentifications of *G. salaris* are listed by McHugh *et al.* (2000) and the more recent finding that specimens from France, Spain and Portugal are *G. teuchis* and not *G. salaris* raises questions over the distribution of the parasite in Southern Europe (Cunningham *et al.*, 2001). It may be the case that *G. salaris* is not present in these countries. To demonstrate this, evidence of absence is difficult to obtain and requires rigorous and thorough monitoring to verify the absence of the pathogenic species.

Conversely, *G. salaris* may be present in countries where no or small-scale investigations are carried out. If the species is present at low prevalence, or does not cause any pathogenic effects such as those in Norway, it may well go unrecorded until large-scale monitoring is established.

The borderlines between species of *Gyrodactylus* are becoming increasingly blurred. *G. salaris* and *G. thymalli* are extremely similar in morphology but can be separated by molecular methods, endorsing the distinction of these two species on grounds that they have different biological effects, as *G. thymalli* is not pathogenic to salmon (Sterud *et al.*, 2002). Analysis of population differences in *G. salaris* and *G. thymalli* support their separation (Cunningham *et al.*, 2003; Hansen *et al.*, 2003).

Within the species *G. salaris*, distinctions can now be made on the basis of genetic data. A variant of *G. salaris* showing preference for rainbow trout and not Atlantic salmon was identified in Denmark (Lindenstrøm *et al.*, 2003) and shows some genetic variation from the Norwegian form of the species that is pathogenic to salmon. Other studies on *G. salaris* from rainbow trout have found morphological variation and suggested that this form might be different to that from salmon. The differentiation of *G. salaris* from rainbow trout and salmon can be demonstrated using genetic data (Cunningham *et al.*, 2003; Hansen *et al.*, 2003), but at present there is no single reliable marker to distinguish pathogenic from harmless forms of the species (Cunningham *et al.*, 2003). However, with future development in molecular ecology, it is possible that types or strains of *G. salaris* might be identified that have different effects on different host fish.

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NORWAY

Monitoring *Gyrodactylus salaris* on Atlantic Salmon and Rainbow Trout in Norway

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The first detection of the salmon parasite *Gyrodactylus salaris* in Norway was on smolts at a Salmon Research Station in Western Norway in 1975. During the next 5 years it was detected on salmon in 5 rivers along the coastline. It was then recognised as a parasite seriously threatening the salmon populations in the country. A comprehensive study to catalogue the occurrence of *G. salaris* in Norwegian rivers and fish farms was launched. From 1980 to 1982 young salmon from several hundred watercourses were collected and examined. These examinations revealed *G. salaris* in 17 more rivers, bringing the total number of infected watercourses up to 21 by the end of 1982. A number of fish farms were also examined. Indications were found that the parasite had primarily spread to the rivers through stocking of infected fish.

As a consequence of these findings, *G. salaris* was placed on the Ministry of Agriculture's list of B diseases under reporting obligations. This intensified the focus on the parasite significantly, and the monitoring of fish farms was organized. Until the end of the 1990s a large number of reports describing this river monitoring were published. In 1987 it was finally determined that the parasite found the previous year on rainbow trout in a fish-farm in Lake Tyrifjorden (the Drammen watercourse near Oslo) was *G. salaris*. During the next three years a comprehensive study of rainbow trout fish farms across South-Eastern Norway was undertaken, the result being that the parasite was found in a total of 26 such fish farms.

Towards the end of the 1990s cooperation was formalised between the Directorate for Nature Management (DN) and the Norwegian Animal Health Authority, which at that time were responsible for the Salmon and Inland Fishing Act and the Fish Diseases Act, respectively. The Animal Health Authority is now incorporated into the Norwegian Food Safety Authority, and the Fish Disease Act is incorporated into the Food Act. The two mentioned acts lay down responsibilities for both agencies with respect to disease problems in wild salmon. In 2000, the DN and the Animal Health Authority drew up a joint Action Plan for measures against *G. salaris* and placed the responsibility for monitoring on the Animal Health Authority. In 2000 the Animal Health Authority, in conjunction with the National Veterinary Institute, implemented the monitoring of salmon and rainbow trout in watercourses and fish farms. From 2001 the monitoring programme for *G. salaris* has been in full operation as far as rivers are concerned, and from 2003 the same has been achieved concerning fish farms.

From 1975 to the end of 2000 *G. salaris* has been found in a total of 41 watercourses. The parasite was found in one and two new rivers, respectively, in 2001 and 2002. In total *G. salaris* has thus been found in 44 Norwegian watercourses.

From 1975 to the end of 2000 *G. salaris* had been found in a total of 37 fish farms. The parasite was found in three new fish farms in 2002, one of which was also infected in 1977. Thus overall, *G. salaris* has been found in 39 Norwegian fish farms, of which 26 are inland facilities producing rainbow trout in South-Eastern Norway and 13 are hatcheries producing smolt along the coast.

At the moment, there are no known existing cases of *G. salaris* in Norwegian fish farms.

There are 23 rivers with known occurrences of *G. salaris*, five rivers are in the process of being declared healthy and 16 rivers have been declared healthy. For tables giving the details about the results from the monitoring programme in 2001 and 2002, see

http://www.vetinst.no/Arkiv/Pdf-filer/NOK-2003/22-2002.pdf
and
http://www.vetinst.no/Arkiv/Pdf-filer/NOK-2001/22_2001_Gyrodactylus.pdf

A more comprehensive description of monitoring and control of *G. salaris* in Norway up to 2003 may be found in the next issue of the Norwegian Veterinary Journal, March 2004. The article will be in Norwegian but with a summary in English.

The results for 2003 are not available, but approximately 12,500 fish have been sampled, of which 8,500 – 9,000 are from fish farms, and the rest from rivers. The testing of all the material from the rivers has not yet been concluded (Tor Atle Mo, *personal communication*, February 2004).

Gyrodactylus salaris in Norwegian rivers

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Introduction

In the period 1975-1979, pre-smolt Atlantic salmon were found to be infected by *Gyrodactylus* in an increasing number of Norwegian rivers. Such a mass infection in natural waters was unique, and investigations were initiated to find out the proportions and causes of the problem.

1. The first observations of G*yrodactylus*

G. salaris was discovered for the first time in Norway in a hatchery at Sunndalsøra in 1975. The same year the parasite was found infecting three out of 128 salmon parr sampled in the river Lakselva, a rather small salmon river situated in the northern part of Norway. One year later, in August 1976, *Gyrodactylus* was found parasitizing 159 (95%) out of 168 salmon parr caught at the same five locations in the river. Fish, which were infected with *Gyrodactylus* and fungus, were found dead and dying in the river. In August 1977, the salmon parr population had decreased catastrophically. Only two parr were found and they were both infected with *Gyrodactylus*.

In 1979, *Gyrodactylus* was discovered in three more rivers and as a result of these findings regional investigations were started in 1980.

2. Regional investigations 1980 – 85

Regional research was initiated on juvenile Atlantic salmon in hatcheries and natural waters and approximately 200 rivers were investigated within a few years. By the end of 1982, *G. salaris* had been found in 23 rivers and in 1983 *G. salaris* was declared a notifiable disease.

3. Evidence of introduction

Regional investigations of about 50,000 salmon parr from a large number of rivers (until 1999) show that *G. salaris* is not naturally distributed in Norway. In 139 of the rivers, more than 90 salmon parr have been investigated without finding the parasite. If the parasite had occurred with a prevalence of 5% or more in one of these rivers, there is a 99% probability that it would have been discovered (Johnsen & Jensen 1999).

The introduction hypothesis was strongly supported by Bakke *et al.* (1990). They examined the susceptibility and resistance of salmon parr from two Norwegian rivers (river Alta and river Lone) and one Russian Baltic river (Neva) against *G. salaris* from Norway. In both the Norwegian salmon stocks, the *G. salaris* infrapopulations steadily increased during the experimental period of 5 weeks, in contrast to a decline in the Neva salmon stock. The Baltic Neva stock demonstrated both an innate and an aquired resistance towards *G. salaris* in contrast to the highly susceptible Norwegian Alta and Lone salmon stocks.

Four anthropogenic introductions of *G. salaris* into Norway (Figure 1) along with infected salmonids from hatcheries around the Baltic Sea have been suggested (Johnsen *et al.* 1999). One of these introductions was to a river (Skibotnelv) and the other three were to hatcheries.

1. *G. salaris* was introduced to the river Skibotnelv probably by "dumping" of smolts from a Swedish smolt transport in 1975.

2. *G. salaris* was discovered for the first time in Norway in 1975 at a hatchery at Sunndalsøra, western Norway. This hatchery had imported salmon smolts from Sweden on several occasions in the 1970's. From this hatchery, the parasite was spread through stocking of fish to several rivers distributed over a large part of the country.

3. A hatchery in the Trondheimsfjord area had imported salmon smolts from Sweden several times in the 1980's.

4. *G. salaris* was discovered in a fish farm in Lake Tyrifjorden in 1986. The same parasite was later found infecting rainbow trout in 8 fish farms and on salmon parr in one fish farm, all situated on rivers draining to the Lake Tyrifjord.

Studies of mitochondrial DNA variation of *G. salaris* populations in Norway and Sweden (Hansen *et al*. 2003) showed that the *G. salaris* populations grouped into 3 phylogenetic clades consisting of 6 haplotypes (A – F). The distribution of the different haplotypes clearly indicate Baltic-Sea strains of *G. salaris* as the source for introduction of the parasite into most Norwegian rivers. The occurrence of haplotype F in the rivers Drammenselva and Lierelva as well as in the rainbow trout farm in Lake Bullaren, Sweden, support the suggestion by Mo (1991) of an independent introduction via rainbow trout to these rivers. Haplotype F was also detected in the river Lærdalselva but the source of its infection is unknown (Hansen *et al.* 2003).

A total of 44 rivers have been or are still infected with *G. salaris*. In 38 of these rivers the occurrence of *G. salaris* can be connected to stocking of fish from infected hatcheries, to infected hatcheries situated by the river or to further spread in brackish water from infected rivers (Johnsen & Jensen 1999).

4. Spreading within rivers

The finding of *G. salaris* in the river Vefsna and its tributaries indicate an upstream spread of the parasite. In 1978 the parasite was found in the main river, and in the tributary Svenningdalselva. In 1979 the parasite was found in lower parts of the tributary Austervefsna. In 1980 it was found in upper parts of the Austervefsna, by which time it had spread throughout the entire watercourse. In Vefsna there are many waterfalls in which salmon ladders have been built. The lengths and heights of the 14 salmon ladders in the watercourse indicate that there is only a small chance of upstream migration of pre-smolt salmon, suggesting therefore that adult salmon carried the parasites. Atlantic salmon have access to 126 km of the river. Within 2 years from the first finding of *G. salaris* (1978 - 1980), the parasite had colonized the entire watercourse (Figure 2).

5. Spreading between neighbouring rivers

Several of the infected rivers are situated so close to each other that the occurrence of *G. salaris* may be explained as the result of spreading with fish through brackish water in the fjord area from a neighbouring river. For example, in Romsdalsfjord, stocking of fish from an infected hatchery in the river Henselva took place in 1978. The river was investigated in 1980 and parasites were found infecting most of the salmon parr. The same year the parasite was found in Rauma, which has its outlet 6 km from the outlet of Henselva. In 1982 the small river Skorga, which is situated 1.5 km across the fjord from Rauma, was found to be infected. In the river Måna, which has its outlet approximately 12 km from the outlet of Rauma, young salmon were checked both in 1981 and in 1983, but no *G. salaris* was found. In September 1985, *G. salaris* was found for the first time. In the river Innfjordelva, which is situated in the innermost part of the 4.5 km long Innfjord with its outlet 10 km from the outlet of Rauma, investigations of the young fish population were started in 1983. Yearly investigations were conducted from 1985, but *G. salaris* was found for the first time in 1991 (Figure 3).

6. Pre-smolt populations in infected rivers

Investigations of young fish populations in infected rivers show that *G. salaris* causes great reductions and near-extermination of populations of young salmon. For example, in the river Vefsna where *G. salaris* was discovered on salmon parr collected in 1978, a drastic decrease in the density of salmon parr was observed from 1978 to 1979. This decrease continued, and since 1982 specimens of salmon parr were only sporadically recorded. The density of brown trout varied in the same period, but with no tendency towards increase or decrease (Figure 4). Data from 14 of the infected rivers indicate that the density of salmon parr has been reduced on average by 86%.

7. Salmon fisheries in infected rivers

While the total catch of Atlantic salmon in all Norwegian rivers was constant (around 300 tons) in the first part of the 1980's, the catch of salmon in *G. salaris* infected rivers dropped dramatically in the same period (Figure 5). In infected rivers the catch of salmon was reduced on average by 87%. The total yearly loss in the river fishery caused by *G. salaris* has been estimated to be about 45 tons. Without any measures the *G. salaris* attacks would have reduced the Norwegian salmon fishery by a minimum of 15%.

8. Long-term effects in the river Vefsna

As mentioned earlier, the density of salmon parr in the river Vefsna was strongly reduced as a consequence of the *Gyrodactylus* attack. In the period 1981 - 1997, densities of more than 5 salmon parr/100 m^2 in one locality were rare in the river Vefsna. However, in 1998 and later years such densities have been found in a few localities every year. In the period 1999 – 2001 the prevalence among one- and two-year old salmon sampled in August has been reduced compared to 1998 and earlier years. Data collected in 2003 showed, however, that the population of "salmon" parr mainly consisted of hybrids between Atlantic salmon and brown trout. Out of a total of 65 "salmon" parr collected in the river in 2003, 63 were hybrids between Atlantic salmon and brown trout. Such hybrids are more resistant against attacks from *G. salaris* than Atlantic salmon (Bakke *et al.* 1999).

Introduction of *G. salaris*

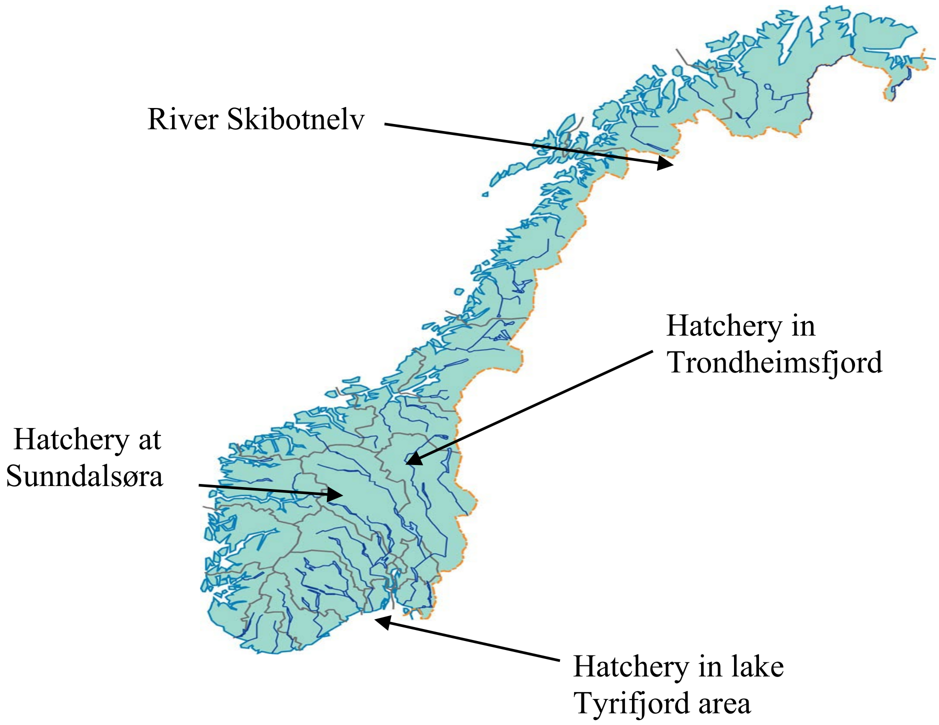

Figure 1. Four suggested introduction routes for *G. salaris* into Norway.

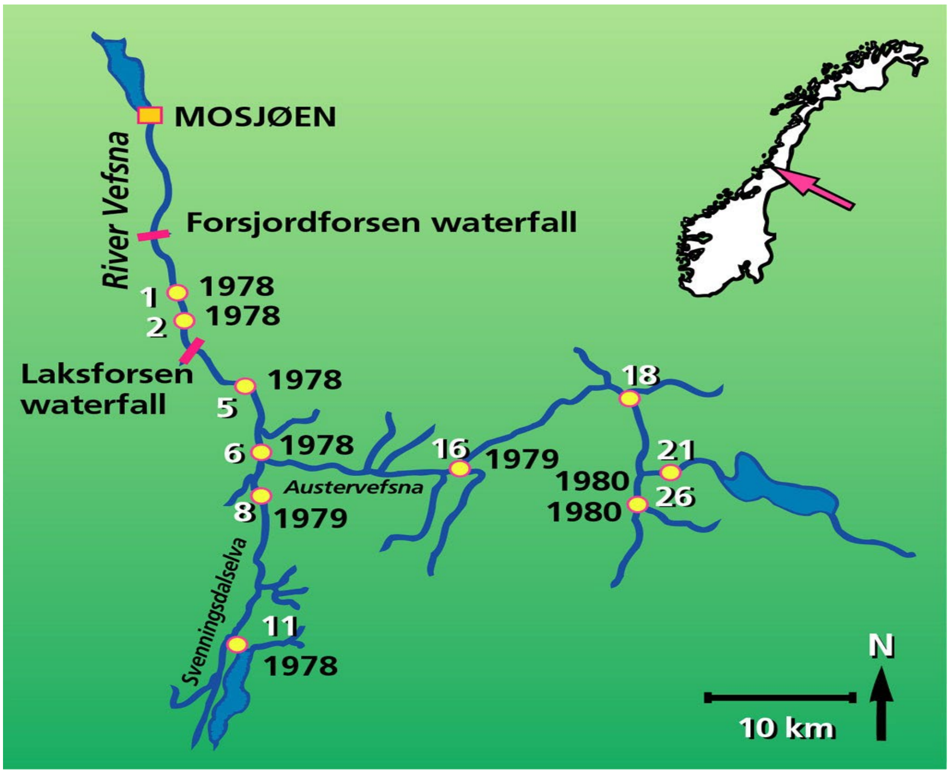

Figure 2. Upstream spread of *G. salaris* in the river Vefsna

Figure 3. Spread of *G. salaris* in the Romsdalsfjord from the river Henselva (1978) to river Rauma (1980) to river Skorga (1982) to river Måna (1985) and to river Innfjordelva (1991).

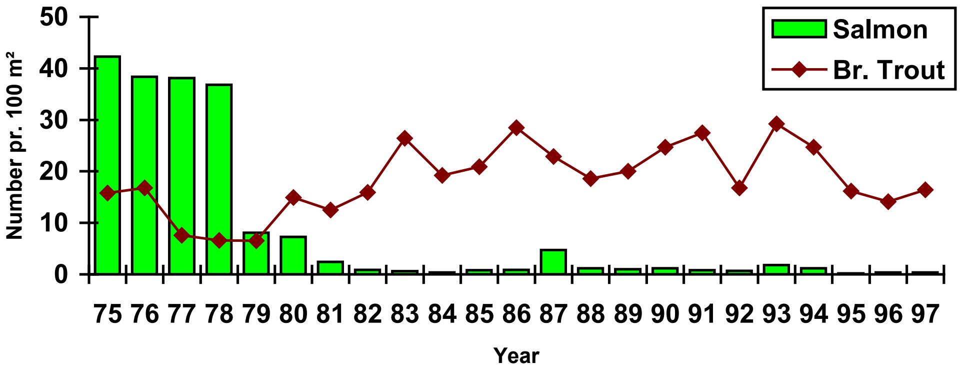

Figure 4. Density of Atlantic salmon and brown trout parr (> 0+) in the river Vefsna in the period 1975 – 1997.

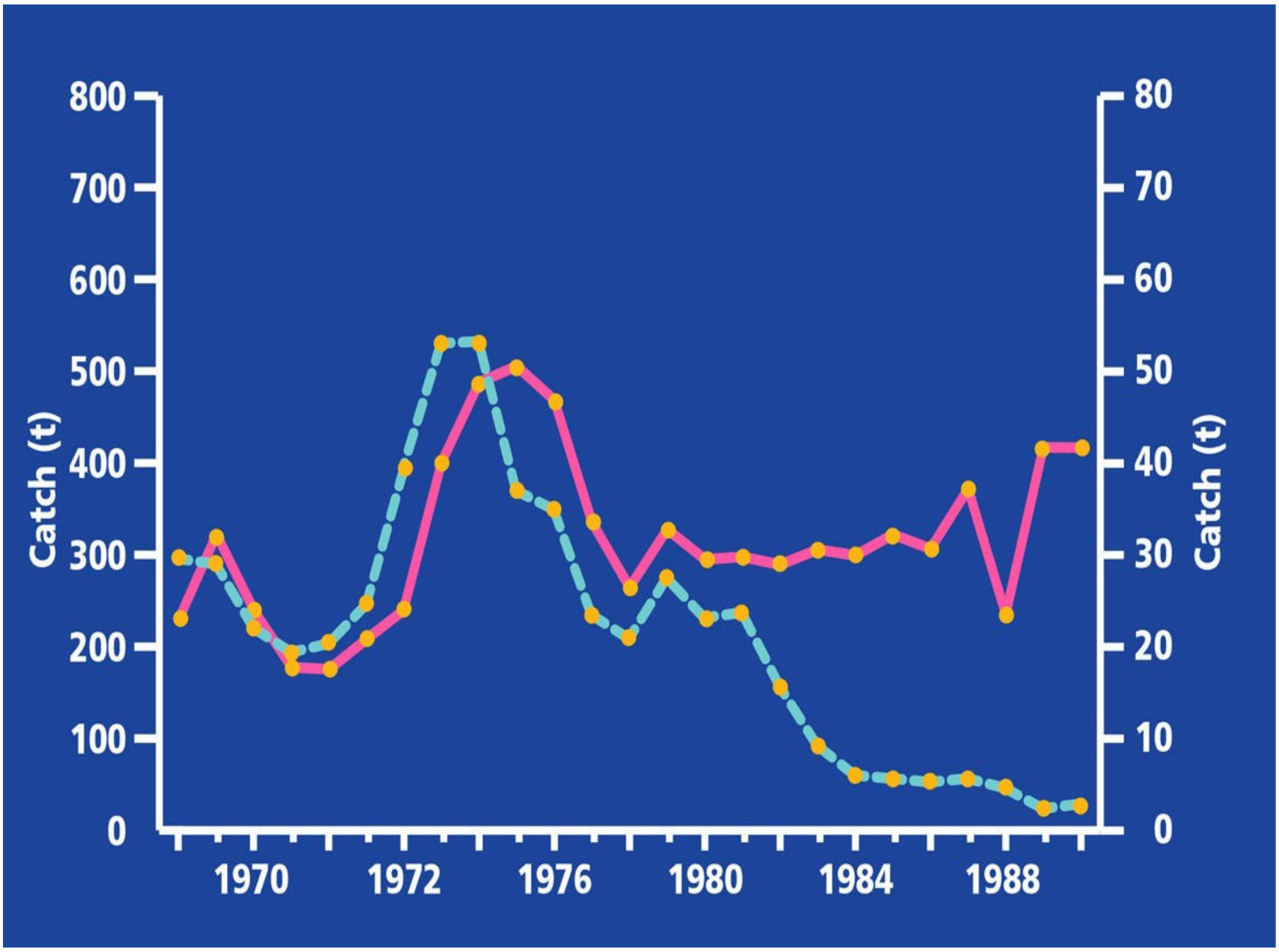

Figure 5. Catch of Atlantic salmon in rivers infected with *G. salaris* (dotted line) compared to total catch of Atlantic salmon in Norwegian rivers.

RUSSIAN FEDERATION

Monitoring Programmes for *G. salaris* in Salmon Rivers of Northwest Russia

Atlantic salmon is found in three regions in northwest Russia: Murmansk and Archangel regions and Karelia. In Russia *G. salaris* was found for the first time in the mid-80s on juvenile freshwater salmon at Petrozavodsk hatchery, Karelia, which had no connection to the sea (E. Rumyantseva, *personal communication*). In 1992 *G. salaris* was found in the Keret river (Karelia), where it caused considerable damage to the salmon population (for instance, parr densities at one of the sites declined from 62 parr/100 m^2 in 1990 to 0.2 parr/m^2 in 1996). The parasite was transmitted into the river during stocking (Ieshko and Shulman, 1994; Shulman *et al.,* 2001), therefore, there is a real risk of its further spread in northwest Russia. The Archangel region and Karelia are connected through a chain of rivers, lakes and canals with the Baltic province, where *G. salaris* is rather widespread. The Murmansk region is bordering Norway, where *G. salaris* caused considerable damage to a number of wild Atlantic salmon populations. Besides, a number of joint Russian-Finnish and Russian-Norwegian projects relating to farming of Atlantic salmon and rainbow trout are currently underway in Karelia and the Murmansk region, which create a potential threat of transmission of *G. salaris* to Russia in the course of their implementation.

For monitoring the distribution of *G. salaris* in Karelia, regular examination of fish from the Keret river for parasites has been carried out annually since 1992. In particular, these studies have shown, that parasite numbers declined sharply in 2002-2003 after peak infestation in 2001. This happened during a period of low abundance of salmon and high summer temperatures. Therefore, it can be presumed that conditions have developed contributing to extinction of the parasite.

In addition, over the same period parasitological research to identify the presence of *G. salaris* was conducted on other rivers in Karelia – the Pulonga and Gridina rivers. However, the parasite was not found. A negative result was also shown by studies to assess the potential role of other salmonids in the spread of *G. salaris* in the Keret river. The parasite was not found in other species, including introduced pink salmon (Dr E. Ieshko could give a more detailed report concerning these studies).

In the Murmansk region targeted parasitological research to identify the presence of *G. salaris* was initiated in 1993 and conducted on a yearly basis thereafter. Over that time period, five White Sea rivers (Kovda, Virma, Kanda, Lubche-Savino and Niva), located near the border with Karelia, were surveyed together with three rivers (Sallajoki, Kuolajoki and Tennijoki) in the basin of the Baltic Sea, the Tuloma river with its upper tributaries beginning in Finland, the Kola river system and the Pasvik river in the basin of Inari lake (Finland), where, according to Finnish researchers, monogenea from *Gyrodactylus* genus – *G. lavareti* and *G. salaris*, were found. *G. salaris* was not found in fish sampled from these rivers.

Since 1996 monitoring programmes for parasites on juvenile Atlantic salmon have been carried out at four hatcheries in the same region on a yearly basis. *G. salaris* was not found. Nor was it found on rainbow trout from farms located in the Tuloma river system. This survey was done in 1996.

In addition to scientific monitoring Murmansk Regional Veterinary Service has been implementing a monitoring programme for *G. salaris* since 1996. In accordance with this programme regular examinations, four times a year, of juvenile salmonids for *G. salaris* are conducted at hatcheries and farms in the Murmansk region. In addition, this programme includes monitoring of wild stocks of various species such as Atlantic salmon, brown trout, smelt, grayling, whitefish, etc. The parasite has not been found.

It is intended to continue scientific and sanitary and veterinary monitoring for *G. salaris* in waters in northwest Russia. However, there are some problems with funding this work which could affect its quality.

Effect of parasites on the status of the natural fauna in inland lakes and watercourses exposed to human impact, 2003 Report

Prof. Evgueni Ieshko, Head, Laboratory for Plant and Animal Parasitology, Institute of Biology, Karelian Research Centre of RAS

Summary

Research was carried out to assess the dynamics of the epizootic related to the anthropogenic spread of the parasite in the River Keret. The monogenean *Gyrodactylus salaris* caused mass death of juvenile salmon. Surveys during the year have demonstrated that with low salmon abundance and high summer temperatures, infestation by the parasite dropped sharply and conditions developed under which extinction of the parasite may be anticipated.

Objective: To study the patterns in the dynamics of parasite abundance and distribution as influenced by the natural succession and anthropogenic pollution of aquatic ecosystems.

Four parasite species specific to the genus Salmo are known from Eurasia. Only 3 of them (*Gyrodactylus salaris*, *Myxidium salmonis* and *Chloromyxum schurovi*) (Shulman, Ieshko; 2003) parasitise *S. trutta* and *S. salar* populations in Fennoscandia. The latter two parasites occur on both hosts. *G. salaris* was previously only reported from salmon, but has also been found on brown trout (Bakke, 1991).

Distinguishing features of the parasite fauna of the Far East salmon – the pink salmon, and the consequences of the parasite range expansion for the native fish fauna of the River Keret (White Sea)

This section deals with a comparative study of the parasite fauna of juvenile Atlantic salmon and the consequences of the spread of the dangerous parasite *Gyrodactylus salaris*. The potential role of other salmon species in the spread of the parasite along the River Keret and to neighbouring rivers was investigated. Data representing the patterns in the formation of the parasite fauna of the pink salmon *Oncorhynchus gorbuscha,* a species introduced in northern rivers, were gathered.

In September 2003, 30 juvenile Atlantic salmon (15 from the River Gridina, 15 from the River Pulonga), 15 pink salmon and 15 whitefish (River Keret) specimens were examined using complete parasitological dissection. During July-October, a further 72 juvenile Atlantic salmon from the River Keret (Sukhoi rapid, rapid by the bridge - 1 specimen, Varatskiy rapid – 11 specimens, Morskoi rapid - 50 specimens) were examined for *Gyrodactylus salaris*. The fish were absent from the upper reaches of the river. In all rapids except for the Morskoi rapid, only young-of-the-year salmon were captured.

The Atlantic salmon *Salmo salar* L.

The parasite fauna of juvenile Atlantic salmon from the River Gridina comprises 4 species (Table 1) belonging to the following taxa: Mastigophora - 1, Ciliophora - 1, Trematoda - 1, Nematoda - 1. The most frequent parasite was *Hexamita truttae* (66%). There were single occurences of the infusorian *Capriniana piscium* (13%/0.002) (here and below the first figure is the infestation intensity, %; and the second figure is the abundance index, ind.), metacercaria of *Diplostomum sp*. flukes (13%/0.1) and the nematode *Capillaria salvelini* (13%/0.1).

Table 1: Parasite fauna of juvenile Atlantic salmon from the River Gridina (September 2003)

	E	min	max	AI
Hexamita truttae	67	+	+	+
Capriniana piscium	13	0.03	0.03	0.002
Diplostomum sp.	13	1	1	0,1
Capillaria salvelini	13	1	1	0,1
No of fish dissected			15	
Total no of species			4	

Examination of juvenile Atlantic salmon from the River Pulonga revealed 5 taxa: Myxosporidia - 1, Ciliophora-1, Trematoda - 2, Nematoda – 1, Acariformes - 1 (Table 2). The greatest prevalence was demonstrated by the infusorian *Capriniana piscium* (93%). The flukes *Ichthyocotylurus erraticus* and *Diplostomum volvens,* which actively invade the host, were represented by single occurences.

Table 2: Parasite fauna of juvenile Atlantic salmon from the River Pulonga (September 2003)

Parasite species	E	Min	max	AI
Chloromyxum schurovi	13	+	+	+
Capriniana piscium	93	2	10	1.7
Diplostomum volvens	7	1	1	0.1
Ichthyocotylurus erraticus	7	1	1	0.1
Hydrachnellae gen. sp.	13	1	8	0.6
No of fish dissected			15	
Total no of species			5	

The parasite fauna of juvenile Atlantic salmon from the rivers Gridina and Pulonga comprises a total of 3 species specific to salmoniforms: *Hexamita truttae, Chloromyxum schurovi, Ichthyocotylurus erraticus*, and 5 generalist species: *Capriniana piscium, Diplostomum sp., Diplostomum volvens, Capillaria salvelini, Hydrachnellae gen. sp.*

Until recently, the largest Atlantic salmon stocks had been recorded from the River Keret. In 1992, the hazardous parasite *Gyrodactylus salaris* was introduced into the river with piscicultural activities, causing mass death of juvenile Atlantic salmon (Ieshko, Shulman 1994; Shulman *et al.* 2001). In the 2003 survey of juvenile Atlantic salmon, *G. salaris* was found only in July in the Morskoi rapid (6% and an abundance index of 0.06 specimens per fish) and in the rapid by the bridge (1 parasite specimen). Analysis of the materials from the last decade reflects the dynamics of juvenile fish infestation with the parasite (Figure 1).

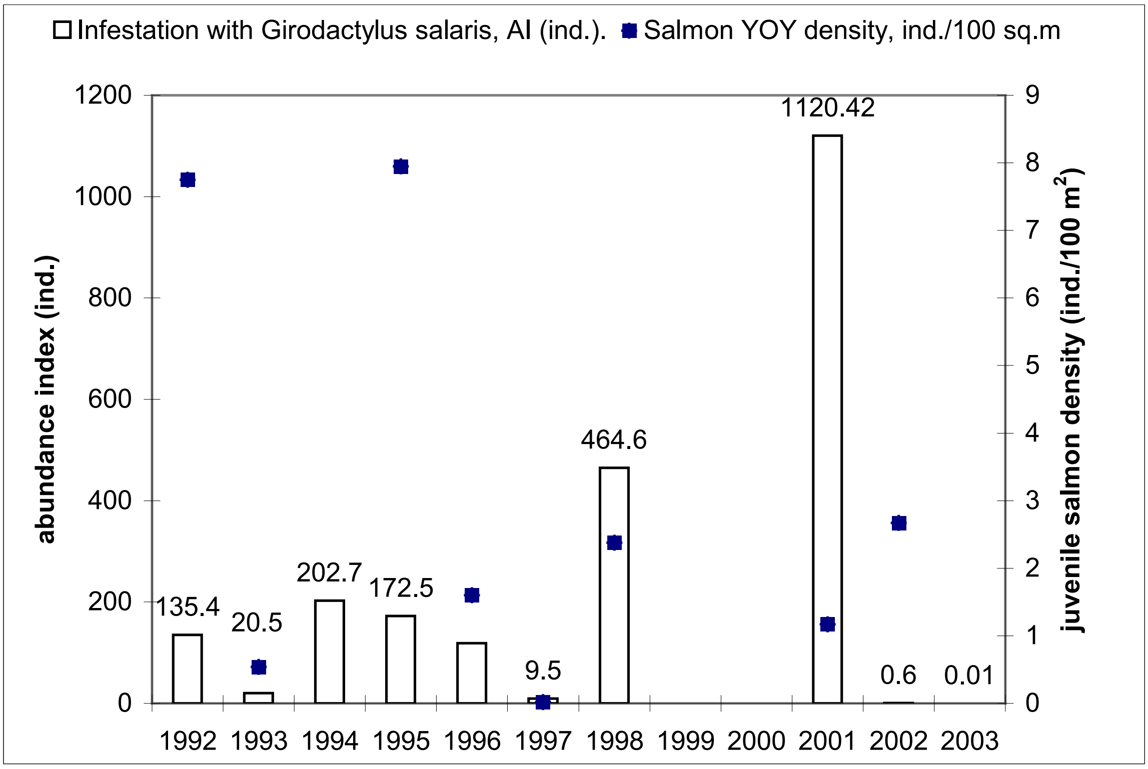

Figure 1: Variations in the infestation and density of the juvenile Atlantic salmon population across years

This and previous years' surveys show an abrupt decline in parasite abundance, which followed peak infestation in 2001. Furthermore, while the survey of July 2003 still yielded several parasite specimens, the surveys repeated in September and October showed a total absence of the parasite from the sections of the River Keret investigated. The density of the juvenile Atlantic salmon population has varied considerably over the past few years, but has been less than 8 individuals/100 sq. m, which is significantly less than the population densities recorded in the pre-infestation period (72 individuals/100 sq. m).

These findings suggest that the temperature conditions in the last two years have played a part. The hot summer ensured a prolonged period of high water temperatures in the river lasting into the autumn months. These conditions, which, of late, have recurred year after year, as well as the low densities of juvenile Atlantic salmon, have created a situation of near extinction of the parasite. More thorough research in the winter and spring-summer periods (2004) is necessary to test this hypothesis and analyse the potential fates of the parasite and the salmon in River Keret.

The Pink salmon *Oncorhynchus gorbuscha (Walb.)*

The pink salmon is an acclimated species from the Far East. The pink salmon spawning migration to the rivers of the White Sea watershed is monitored biennially, from July to September. The fish die soon after spawning. Early in September 2003, we examined pink salmon survivors descending from the spawning grounds. The parasite fauna of the pink salmon comprises 14 species: Saprollegnia – 1, Cestoda – 3, Trematoda – 6, Nematoda – 3, Crustacea – 1 (Table 3). Most of the parasites are marine (10), and only 4 are freshwater species.

The previous survey of the parasite fauna of pink salmon from the River Keret took place in August-September 1961-1962 (Malakhova, 1972). The parasite species composition generally remained the same, but infestation indices decreased for all the parasites, apparently due to the long period the fish had spent in the river.

Table 3: Parasite fauna of the pink salmon from the River Keret

Parasite species	E	min	Max	AI
Saprolegnia sp.	100	+	+	+
Eubothrium crassum	26	1	4	0.7
Scolex pleuronectis	67	1	104	12.7
Cestoda l. gen. sp.	87	1	92	5.7
Brachyphallus crenatus	46	1	18	3.9
Derogenes varicus	66	1	55	7.3
Lecithaster gibbosus	46	1	77	3.0
Podocotyle atomon	13	1	1	0.1
Ichthyocotylurus erraticus	20	1	2	0.3
Diplostomum sp.	33	1	6	0.9
Anisakis simplex	26	1	6	0.8
Pseudoterranova decipiens	26	1	1	0.3
Hysterothylacium aduncum	40	1	10	1.3
Ergasillus sielboldi	7	1	1	0.1
No of fish dissected			15	
Total no of species			14	

The pink salmon examined had heavy skin necrosis and a *Saprollegnia sp.* infection. Pink salmon do not forage when ascending to the spawning grounds and, as a result, freshwater species are represented by metacercaria of *Diplostomum sp., Ichthyocotylurus erraticus*, which invade the fish at the free-swimming cercaria stage, and by the crustacean *Ergasillus sielboldi*, which has a one-host life cycle. The infestation levels were quite low. Marine parasites constituted the bulk of the fauna. These species enter the pink salmon as it feeds on marine benthic organisms, zooplankton and fish.

Conclusion

The studies helped gain an insight into the specific fauna of salmonid parasites and patterns of its formation in the salmon rivers of northern Karelia. Analysis of the parasite fauna of the introduced fishes studied has revealed an impoverished species composition of parasites. Scientifically novel data on the analysis of an epizootic and its consequences are provided using juvenile Atlantic salmon infestation by *Gyrodactylus salaris* as the example. A key theoretical and practical issue is identification of the conditions and factors responsible for the stability of host-parasite relations. It was found that the species composition of parasites of the acclimated pink salmon is poorer than that of other fishes owing to minor infestation by freshwater parasites and the lack of specialist parasites. The monogenean *Gyrodactylus salaris* in the River Keret was recorded from juvenile Atlantic salmon only, and surveys have shown that other species cannot contribute to the spread of this hazardous parasite.

Acknowledgement

This research project, supported by the Nordic Council of Ministers, was implemented by groups of parasitologists (B. Shulman, J. Barskaya, O. Novokhatskaya) and ichthyologists (I. Shchurov, V. Shirokov).

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Status Reports by Party on Measures Implemented and Proposed to Minimise the Threats posed by G. salaris, including Details of Treatment Methods Employed

EUROPEAN UNION

COMMISSION

COMMISSION DECISION

of 21 November 2003

laying down the animal health conditions and certification requirements for imports of live fish, their eggs and gametes intended for farming, and live fish of aquaculture origin and products thereof intended for human consumption

(notified under document number C(2003) 4219)

(Text with EEA relevance)

(2003/858/EC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Council Directive 91/67/EEC of 28 January 1991 concerning the animal health conditions governing the placing on the market of aquaculture animals and products (1), as last amended by Council Regulation (EC) No 806/2003 (2), and in particular Article 19(1), Article 20(1) and Article 21(2) thereof,

Whereas:

(1) A list of third countries or parts thereof, from which Member States are authorised to import live fish, their eggs and gametes for farming in the Community, should be established.

(2) It is necessary to lay down specific animal health conditions and model certificates for those third countries, taking into account the animal health situation of the third country concerned and of the fish, eggs or gametes to be imported, in order to prevent the introduction of disease agents that could cause significant impact to the fish stock in the Community.

(3) Attention should be paid to emerging diseases and diseases which are exotic to the Community and which could have serious impact on the fish stocks in the Community. Furthermore, the vaccination policy and the disease situation as regards epizootic haematopoietic necrosis (EHN) and the fish diseases referred to in Annex A to Directive 91/67/EEC, at the place or production and where appropriate at the place of destination should be taken into account.

(4) It is necessary that countries or parts thereof from which Member States are authorised to import live fish, their eggs and gametes for farming, must apply conditions for disease control, and monitoring at least equivalent to Community standards as laid down in Directive 91/67/ EEC and in Council Directive 93/53/EC of 24 June 1993 introducing minimum Community measures for the control of certain fish diseases (3), as last amended by Commission Decision 2001/288/EC (4). The sampling and testing methods used should be at least equivalent to Commission Decision 2001/183/EC (5) of 22 February 2001 laying down the sampling plans and diagnostic methods for the detection and confirmation of certain fish diseases and repealing Decision 92/532/EEC, and Commission Decision 2003/466/EC (6) of 13 June 2003 establishing criteria for zoning and official surveillance following suspicion or confirmation of the presence of Infectious salmon anaemia (ISA). In cases where sampling and testing methods are not laid down in the Community legislation, the sampling and testing methods used should be in accordance with those laid down in the International Office of Epizootics (OIE) Manual of Diagnostic Tests for Aquatic Animals.

(1) OJ L 46, 19.2.1991, p. 1.
(2) OJ L 122, 16.5.2003, p. 1.
(3) OJ L 175, 19.7.1993, p. 23.
(4) OJ L 99, 10.4.2001, p. 11.
(5) OJ L 67, 9.3.2001, p. 65.
(6) OJ L 156, 25.6.2003, p. 61.

(5) It is necessary that the responsible competent authorities of these third countries undertake to notify by fax, telegram or electronic mail, the Commission and the Member States within 24 hours, of any occurrence of epizootic haematopoietic necrosis (EHN), or diseases referred to in Annex A to Directive 91/67/EEC, as well as any other disease outbreaks causing a significant impact to the fish stock within their territory or parts thereof from which imports covered by this Decision are authorised. In such event, the responsible competent authorities of those third countries must take measures to prevent the disease spreading into the Community. Furthermore and as applicable, the Commission and the Member States should be notified of any alteration in the vaccination policy against such diseases.

(6) In addition, when importing live fish of aquaculture origin and products thereof for human consumption, it is necessary to prevent the introduction into the Community of serious diseases affecting aquaculture animals.

(7) Therefore, it is necessary to supplement the certification requirements relating to the importation of live fish of aquaculture origin and products thereof under Council Directive 91/493/EEC of 22 July 1991 laying down the health conditions for the production and the placing on the market of fishery products ([1]), as last amended by Regulation (EC) No 806/2003, with the animal health certification requirements.

(8) It would reduce the possibility to control and eradicate diseases which are exotic to the Community and which could have serious impact on the fish stocks in the Community, if fish that could carry the disease are released into unenclosed waters in the Community. Live fish, eggs and gametes of aquaculture origin, should therefore be imported into the Community only if they are introduced into a farm.

(9) This Decision should not apply to the importation of tropical ornamental fish kept permanently in aquariums.

(10) This Decision should apply without prejudice to the public health conditions established under Directive 91/ 493/EEC.

(11) This Decision should apply without prejudice to Community or national provision on the conservation of species.

(12) Council Directive 96/93/EC of 17 December 1996 on the certification of animals and animal products ([2]) lays down standards of certification. The rules and principles applied by third-country certifying officers should provide guarantees, which are equivalent to those laid down in that Directive.

([1]) OJ L 268, 24.9.1991, p. 15.

([2]) OJ L 13, 16.1.1997, p. 28.

(13) The principles laid down in Council Directive 2002/99/ EC of 16 December 2002 laying down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption ([3]), in particular Article 3 of that Directive should be taken into account.

(14) A transitional period of time should be provided for the implementation of the new import certification requirements.

(15) The list of approved countries referred to in Annex I to this Decision should be reviewed no later than 12 months after the date of application.

(16) The measures provided for in this Decision are in accordance with the opinion of the Standing Committee on the Food Chain and Animal Health,

HAS ADOPTED THIS DECISION:

Article 1

Scope

1. This Decision establishes harmonised animal health rules for the importation of:

(a) live fish, their eggs and gametes, intended for farming in the Community;

(b) live fish of aquaculture origin intended for restocking of put- and take fisheries in the Community;

(c) live fish of aquaculture origin and products thereof, intended for immediate human consumption or further processing before human consumption.

2. This Decision shall not to apply to the importation of tropical ornamental fish kept permanently in aquariums.

Article 2

Definitions

1. For the purpose of this Decision, the definitions in Article 2 of Directives 91/67/EEC and 93/53/EEC shall apply.

2. The following definitions shall also apply:

(a) ‘aquaculture origin’ means fish originating from a farm;

(b) ‘approved import centre’ means any establishment in the Community where special bio-security measures have been put in place, approved by the competent authority of the Member State concerned, for further processing of imported live fish of aquaculture origin and products thereof;

([3]) OJ L 18, 23.1.2003, p. 11.

(c) 'coastal zone' means a zone consisting of a part of the coast or sea water or an estuary:

(i) which has a precise geographical delimitation and consists of a homogeneous hydrological system or a series of such systems, or

(ii) which is situated between the mouths of two water-courses, or

(iii) where there are one or more farms and all farms are surrounded by appropriate buffer zones on both sides of the farm or farms;

(d) 'continental zone' means a zone consisting of either:

(i) a part of the territory comprising an entire catchment area from the sources of the waterways to the estuary or more than one catchment area in which fish is reared, kept or caught, as necessary surrounded by a buffer zone in which a monitoring program is carried out without the necessity of obtaining the status of an approved zone, or

(ii) a part of a catchment area from the sources of the waterways to a natural or artificial barrier preventing fish migrating from downstream of that barrier, as necessary surrounded by a buffer zone in which a monitoring program is carried out without the necessity of obtaining the status of an approved zone.

The size and the geographical situation of the continental zone must be such that the possibilities for recontamination e.g. by migrating fish are reduced to a minimum;

(e) 'designated farm' means either:

(i) a coastal farm in a third country subject to all necessary measures to prevent the introduction of diseases and to which the water is supplied by means of a system which ensures the complete inactivation of the following pathogens: infectious salmon anaemia (ISA), viral heamorrhagic septicaemia (VHS) and infectious haemorrhagic necrosis (IHN), or

(ii) an inland farm in a third country subject to all necessary measures to prevent the introduction of diseases. The farm is, if necessary, protected against flooding and infiltration of water, and there is a natural or artificial barrier situated down stream, which prevents fish from entering the farm. The water is supplied directly to the farm from a borehole, spring, or well, channelled through a pipe, open channel or a natural conduit, which does not constitute a source of infection for the farm and does not allow the introduction of wild fish. The water channel is under the control of the farm or of the competent authorities;

(f) 'establishment' means: any premises approved according to Directive 91/493/EEC, where fishery products are prepared, processed, chilled, frozen, packaged or stored, but excluding auction and wholesale markets in which only display and sale by wholesale takes place;

(g) 'farming' means: the activity that takes place on any farm or, in general, any geographically defined installation in which fish are reared or kept with a view to their being placed on the market;

(h) 'fish products of aquaculture origin' means any products intended for human consumption derived from fish of aquaculture origin, including whole fish (un-eviscerated), eviscerated fish, and filets, and any products thereof;

(i) 'further processing' means preparation and processing before human consumption by any kind of measures and techniques, that produces waste or byproducts which could cause a risk of spreading diseases, including: operations affecting the anatomical wholeness such as bleeding, gutting/evisceration, heading, slicing, filleting;

(j) 'immediate human consumption' means that the fish imported for the purpose of human consumption do not undergo any further processing within the Community before being placed on the retail market for human consumption;

(k) 'put and take fisheries' means ponds, lakes or unenclosed waters that are sustained by the introduction of fish primarily for recreational fishing rather than for conservation or improvement of natural population;

(l) 'territory' means either a whole country, a coastal zone, a continental zone or a designated farm, which is authorised by the central competent authority of the third country concerned for exportation to the Community.

Article 3

Conditions for importation of live fish, their eggs and gametes intended for farming, and of live fish of aquaculture origin for restocking of put-and take fisheries, within the European Community

1. Member States shall authorise the importation into their territory live fish, their eggs and gametes for farming only if:

(a) the fish originate in a territory listed in Annex I;

(b) the consignment complies with the guarantees, including those for packaging and labelling and the appropriate specific additional requirements, as laid down in the animal health certificate, drawn up in conformity with the model in Annex II, taking into account the explanatory notes in Annex III;

(c) the fish have been transported under conditions not altering their health status.

2. Member States shall authorise the importation into their territory live fish of aquaculture origin, their eggs and gametes intended for direct restocking of put-and take fisheries only if:

(a) the consignment comply with the rules laid down in paragraph 1;

(b) the put and take fishery do not represent lakes or unenclosed waters.

3. Member States shall ensure that imported fish of aquaculture origin, their eggs and gametes intended for farming or restocking of put-and take fisheries in Community waters, only are introduced into farms or put-and take fisheries representing ponds, and not introduced into unenclosed waters.

4. Member States shall ensure that imported live fish or aquaculture origin, their eggs and gametes are transported directly to the farm or pond of destination, as stated on the animal health certificate.

Article 4

Conditions related to importation of live fish of aquaculture origin for human consumption

Member States shall authorise the importation into their territory live fish of aquaculture origin intended for immediate human consumption or for further processing before human consumption, only if:

(a) the consignment complies with the conditions laid down in Article 3 paragraph 1 and Article 7 paragraph 1 of this Decision; or

(b) the fish are sent directly to an approved import centre to be slaughtered and eviscerated.

Article 5

Conditions related to importation of fish products of aquaculture origin for further processing before human consumption

1. Member States shall authorise the importation into their territory fish products of aquaculture origin intended for further processing before human consumption only if:

(a) the fish originate in third countries and establishments authorised under Article 11 of Directive 91/493/EEC and comply with the public health certification requirements laid down under that Directive; and

(b) the consignment complies with the guarantees, including those for packaging and labelling and the appropriate specific additional requirements, as laid down in the animal health certificate, drawn up in conformity with the model in Annex IV, taking into account the explanatory notes in Annex III.

2. Member States shall ensure that processing of fish products of aquaculture origin takes place in approved import centres unless:

(a) the fish are eviscerated before dispatch; or

(b) the place of origin has a health status equivalent to the place where they are to be processed in particular as regards epizootic haematopoietic necrosis (EHN) and the diseases referred to in lists I and II, column 1, of Annex A to Directive 91/67/EEC.

Article 6

Conditions related to importation of fish products of aqua culture origin for immediate human consumption

Member States shall authorise the importation into their territory of fish products of aquaculture origin intended for immediate human consumption only if:

(a) the fish originate in third countries and establishments authorised under Article 11 of Directive 91/493/EEC and comply with the public health certification requirements laid down under that Directive;

(b) the consignment complies with the guarantees, including those for packaging and labelling as laid down in the animal health certificate, drawn up in conformity with the model in Annex V, taking into account the explanatory notes in Annex III;

(c) the consignment consists of consumer-ready packages of a size suitable for retail sale directly to the end consumer, like

(i) vacuum packed filets,

(ii) hermetically sealed or other heat-treated products,

(iii) frozen blocks of fish meat,

(iv) eviscerated fish frozen or placed on ice.

Article 7

Certification

1. In the case of live fish, their eggs and gametes, the competent authority at the border inspection post in the Member State of arrival shall complete the document referred to in Annex of Commission Decision 92/527/EEC [1] with one of the statements laid down in Annex VI to this Decision as appropriate.

2. In the case of fish products of aquaculture origin, the competent authority at the border inspection post in the Member State of arrival shall complete the document referred to in Annex B to Commission Decision 93/13/EEC [2] with one of the statements laid down in Annex VI of this Decision as appropriate.

Article 8

Preventing contamination of natural waters

1. Member States shall ensure that imported live fish of aquaculture origin and products thereof intended for human consumption are not introduced into, and do not contaminate any natural waters within their territory.

2. Members States shall ensure that transport water from imported consignments does not lead to contamination of natural waters within their territory.

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[1] OJ L 332, 18.11.1992, p. 22.
[2] OJ L 9, 15.1.1993, p. 33.

Article 9

Approval of import centres

1. The competent authority of the Member States shall approve an establishment as an approved import centre provided that it satisfies the minimum animal health conditions of Annex VII to this Decision.

2. The competent authority of the Member State shall draw up a list of approved import centres, each of which shall be given an official number.

3. The list of approved import centres, and any subsequent amendments thereto, shall be communicated by the competent authority of each Member State to the Commission and to the other Member States.

Article 10

Date of application

This Decision shall apply from 1 May 2004.

Article 11

This Decision is addressed to the Member States.

Done at Brussels, 21 November 2003.

For the Commission

David BYRNE

Member of the Commission

ANNEX I

ANNEX II

Model animal health certificate for the importation of (1) (live fish, eggs and gametes for farming) (1) (live fish of aquaculture origin for the purpose of (1) (human consumption) (1)(restocking of put and take fisheries)) into the European Community (EC)

Note for the importer: This certificate is only for veterinary purposes and has — in its original — to accompany the consignment until it reaches the border inspection post.

Reference Code No ORIGINAL

1. **Exporting country and authorities involved**

1.1. Exporting country: ....

....

1.2. Competent authority: ....

....

1.3. Competent issuing authority: ....

....

2. **Place of origin of the consignment**

2.1. Code of territory of origin (2): ....

....

(1) (2.2. Farm of origin, name: ....

....)

(1) (2.3. Address or location of farm: ....

....

....)

2.4. Name, address and phone number of the Consignor: ....

....

....

....

....

....

3. **Destination of the consignment**

3.1. Member State: ....

....

(1) (3.2. Zone or part (3) of the Member State: ....

....)

(1) (3.3. Farm, name: ....

....)

3.4. Address: ....

....

3.5. Name, address and phone number of the Consignee: ....

....

....

....

4. **Means of transport and consignment identification** (4)

4.1. (1) (Lorry) (1) (Rail wagon) (1) (Ship) (1) (Aircraft): ....

....

4.2. (1) (Registration number(s)) (1) (Ship name) (1) (Flight number): ....

....

4.3. Consignment identification details: ....

....

5. **Description of the consignment**

☐ Farmed stocks ☐ Wild stocks ☐ Live fish ☐ Gametes ☐ Fertilised eggs ☐ Unfertilised eggs ☐ Larvae/fry

Fish specie(s)		Total weight of fish (kg) (Number of fish) (1)	(Volume of eggs) (1) (Volume of gametes) (1)	Age of live fish
Scientific name	Common name			
				☐ >24 months ☐ 12-24 months ☐ 0-11 months ☐ unknown

Annex III

EXPLANATORY NOTES

(a) The certificates shall be produced by the competent authorities of the exporting country, based on the appropriate model appearing in Annex II, IV or V to this Decision taking into account the use to which the fish are to be put after the arrival to the EC.

(b) Considering the status of the place of destination as regards viral haemorrhagic septicaemia (VHS), infectious haematopoietic necrosis (IHN), spring viraemia of carp (SVC) and *Gyrodactylus salaris* (GS) in the EC Member State, the appropriate specific additional requirements shall be incorporated and completed in the certificate.

(c) The original of each certificate shall consist of a single page, double-sided, or, where more than one page is required, it shall be in such a form that all pages form part of an integrated whole and are indivisible.

It shall, on the right hand side of the top of each page, be marked as 'ORIGINAL' and bear a specific code number issued by the competent authority. All pages of the certificate shall be numbered – (page number) of (total number of pages).

(d) The original of the certificate and the labels referred to in the model certificate shall be drawn up in at least one official language of the EC Member State in which the inspection at the border post shall be carried out and of the EC Member State of destination. However, these Member States may allow other languages, if necessary, accompanied by an official translation.

(e) The original of the certificate must be completed on the day of loading the consignment for exportation to the EC with an official stamp and signed by an official inspector designated by the competent authority. In doing so, the competent authority of the exporting country shall ensure that the principles of certification equivalent to those laid down in Council Directive 96/93/EC are followed.

The stamp, unless embossed, and the signature shall be in a colour different to that of the printing.

(f) If for reasons of identification of the items of the consignment, additional pages are attached to the certificate, these pages shall be considered as forming part of the original and be signed and stamped by the certifying official inspector on each page.

(g) The original of the certificate must accompany the consignment until it reaches the EC border inspection post.

(h) The certificate shall be valid for 10 days from the date of issue. In the case of transport by ship, the time of validity is prolonged by the time of journey at sea.

(i) The fish, their eggs and gametes, shall not be transported together with other fish, eggs or gametes that, either are not destined to EC, or are of a lower health status. Furthermore, they must not be transported under any other conditions that alters their health status.

(j) The possible presence of pathogens in the water is relevant for considering the health status of live fish, eggs and gametes. The certifying officer should therefore consider the following:

The 'place of origin' should be the localisation of the farm where the fish, eggs or gametes was reared reaching their commercial size relevant for the consignment covered by this certificate.

ANNEX IV

Model animal health certificate for the importation of fish products of aquaculture origin into the European Community (EC) for further processing before human consumption

Reference Code No ORIGINAL

Note for the importer:

The present consignment must be shipped immediately, without breaking, to be retailed for further processing before human consumption.

Processing of fish products of aquaculture origin must take place in approved import centres unless eviscerated before dispatch, or the place of origin has a health status at least equivalent to the place where they are to be processed, in particular as regards the diseases epizootic haematopoietic necrosis (EHN) as well as the diseases referred to in lists I and II, column 1, of Annex A to Directive 91/67/EEC.

This certificate is only for veterinary purposes and has — in its original — to accompany the consignment until it reaches the border inspection post.

1. Animal health attestation for importation into the European Community of fish products of aquaculture origin for further processing before human consumption

I, the undersigned official inspector, hereby certify that the fish products of aquaculture origin referred to in this certificate:

— originate from fish which showed no clinical signs of disease at the time of (collection) (1) (slaughter) (1) (loading) (1) and

— (1) (are not subject to any prohibitions for animal health reasons, in particular due to clinical signs of disease or suspicion, or confirmation of the presence of the following diseases: (infectious salmon anaemia (ISA);) (1) (epizootic haematopoietic necrosis (EHN);) (1) (viral haemorrhagic septicaemia (VHS) (1) (and) (1) (infectious haematopoietic necrosis (IHN) (1) and)

— (1) (2) (– originate from fish harvested from a farm or a zone which is approved by the central competent authority as having an equivalent health status to those farms and zones with Community approved programmes or status as regards (VHS) (1) (and) (1) (IHN) (1) and);

— (1)(– originate from a designated farm, or a farm that is not connected with coastal or estuarial waters and does not contain any fish of the species considered as susceptible (3) to ISA, EHN, (and) (1) (VHS) (1) (and) (1) (IHN) (1), and that is not subject to any prohibitions for animal health reasons, and)

— (1) (2) (– have been slaughtered and eviscerated, and)

— are transported under conditions that do not alter their health status, and

— have been placed in sealed watertight containers which were cleaned and disinfected beforehand using an authorised disinfectant and which bear on the exterior a legible label with the relevant information (4) of this certificate and with the following statement:

'(Uneviscerated fish) (1) (and) (1) (eviscerated fish) (1) (and) (1) (fish products) (1) of aquaculture origin certified for export to the European Community (including to Community approved zones as regards (VHS) (1) (and) (1) (IHN) (1)) (1), for immediate human consumption, or for further processing (in approved import centres for) (1) before human consumption, and not to be introduced into natural waters of the European Community) (1);

General statement

I, the undersigned official inspector, hereby certify that I am aware of the provisions of Council Directives 91/67/EEC and 93/53/EEC and Commission Decision 2003/858/EC (1).

Done at ...., on ....

(Place) (Date)

....

(Signature of official inspector)

Official stamp

....

(Name in capital letter, qualifications and title)

ANNEX V

Animal health certificate for the importation of fish products of aquaculture origin into the European Community (EC) for immediate human consumption

Reference Code No ORIGINAL

Note for the importer:

The present consignment must be shipped immediately, without breaking, to be retailed for immediate human consumption.

This certificate is only for veterinary purposes and has — in its original — to accompany the consignment until it reaches the border inspection post.

1. Animal health attestation for importation into the European Community of fish products of aquaculture origin for immediate human consumption

I, the undersigned official inspector, hereby certify that the fish products of aquaculture origin referred to in this certificate:

— originate from fish which showed no clinical signs of disease at the time of (collection) (1) (slaughter) (1) (loading) (1),

— have been placed in containers which bear on the exterior a legible label with the relevant information (2) of this certificate and with the following statement:

'Fish products of aquaculture origin certified for export to the European Community for immediate human consumption, and not to be introduced into natural waters of the European Community'

General statement

I, the undersigned official inspector, hereby certify that I am aware of the provisions of Council Directives 91/67/EEC and 93/53/EEC and Commission Decision 2003/858/EC.

Done at ...., on ....

(Place) (Date)

Official stamp

....

(Signature of official inspector)

....

(Name in capital letter, qualifications and title)

Indicative notes

(1) Retain as appropriate.

(2) Country and territory of origin (code) and of destination; name and telephone number of the consignor and consignee.

ANNEX VI

Statements to be issued by the competent authority at the border inspection post to complete the document referred to in the Annex to Decision 92/527/EEC or in the Annex B of Decision 93/13/EEC

The competent authority at the border inspection post in the Member State of arrival shall complete the document referred to in the Annex of Decision 92/527/EEC or of Annex B of Decision 93/13/EEC with one of the following statements as appropriate:

A. **Statements to be added to the document referred to in the Annex of Decision 92/527/EEC as regards live fish, their eggs and gametes intended for farming, and live fish of aquaculture origin for restocking of putand take fisheries, in the European Community**

either:

'(Live fish) ([1]) (and) ([1]) (Eggs) ([1]) (and) ([1]) (Gametes) ([1]) certified for farming in European Community zones and farms except those with a Community approved programme or status, additional guarantees or protective measures with regard to: viral haemorrhagic septicaemia (VHS), and infectious haematopoietic necrosis (IHN), and spring viraemia of carp (SVC), and *Gyrodactylus salaris.'*

or:
'Live fish of aquaculture origin certified for restocking of put-and take fisheries in European Community zones and farms except those with a Community approved programme or status, additional guarantees or protective measures with regard to: viral haemorrhagic septicaemia (VHS), and infectious haematopoietic necrosis (IHN), and spring viraemia of carp (SVC), and *Gyrodactylus salaris.'*

or:

'(Live fish) ([1]) (and) ([1]) (Eggs) ([1]) (and) ([1]) (Gametes) ([1]) certified for farming in European Community zones and farms including those with a Community approved programme or status, additional guarantees or protective measures with regard to: (viral haemorrhagic septicaemia (VHS)) ([1]) (and) ([1]) (infectious haematopoietic necrosis (IHN)) ([1]) (and) ([1]) (spring viraemia of carp (SVC)) ([1]) (and) ([1]) *(Gyrodactylus salaris)* ([1]).'

or:
'Live fish of aquaculture origin certified for restocking of put-and take fisheries in European Community zones and farms including those with a Community approved programme or status, additional guarantees or protective measures with regard to: (viral haemorrhagic septicaemia (VHS)) ([1]) (and) ([1]) (infectious haematopoietic necrosis (IHN)) ([1]) (and) ([1]) (spring viraemia of carp (SVC)) ([1]) (and) ([1]) *(Gyrodactylus salaris)* ([1]).'

B. **Statements to be added to the document referred to in the Annex B of Decision 93/13/EEC as regards fish products of aquaculture origin intended for human consumption**

either:

'Uneviscerated fish products of aquaculture origin certified for export to the European Community (except to zones with Community approved status as regards (VHS) ([1]) (and) ([1]) (IHN) ([1])) ([1]), for further processing (in approved import centres) ([1]) before human consumption.'

or
'Eviscerated fish products of aquaculture origin certified for export to the European Community, for further processing before human consumption.'

or
'Fish products of aquaculture origin certified for export to the European Community for immediate human consumption.'.

([1]) Retain as appropriate.

ANNEX VII

Minimum animal health conditions for the approval of 'approved import centres' for processing of fish of aquaculture origin

A. **General provisions**

1. Member States shall only approve establishments as import centres for further processing of imported live fish of aquaculture origin and products thereof provided that the conditions at the import centre are such that risks of contamination of fish in Community waters, with pathogens capable of causing significant impact to fish stock, via discharges or other waste, or by other means, are avoided.

2. Establishments approved as 'approved import centre', must not be allowed to move live fish out of the establishment.

3. In addition to the appropriate public health provisions laid down under Directive 91/493/EEC for any establishments, as well as health rules laid down by Community legislation concerning animal by-products not intended for human consumption, the minimum animal health conditions as laid down below, shall apply.

B. **Management provisions**

1. Approved import centres must be open to inspection and control by the competent authority at all times.

2. Approved import centres must have an efficient disease control, and monitoring system; in application of Council Directive 93/53/EEC, cases of suspected disease and mortality shall be investigated by the competent authority; the necessary analysis and treatment must be carried out in consultation with and under the control of the competent authority, taking into consideration the requirement in Article 3(1)(a) of Directive 91/67/EEC.

3. Approved import centres must apply a management system, approved by the competent authority, including hygiene and disposal routines for transports, transport containers, facilities, and equipment. The guidelines laid down for disinfection of fish farms in the OIE International Aquatic Animal Health Code, Sixth Edition, 2003, Appendix 5.2.2, should be followed. The disinfectants used must be approved for the purpose by the competent authority and appropriate equipment must be available for cleaning and disinfection. Discharges of by-products and other waste materials including dead fish and their products must be carried out in accordance with Regulation (EC) No 1774/2002 of the European Parliament and of the Council ([1]). The management system at the approved import centre shall be such that risks of contamination of fish in Community waters with pathogens capable of causing significant impact to fish stock, in particular as regards pathogens exotic to the Community and the fish pathogens referred to in list I and II, column 1, of Annex A to Directive 91/67/EEC, are avoided.

4. Approved import centres must keep an updated record of: observed mortality; and of all the live fish, eggs and gametes entering the centre and products leaving the centre including their source, their suppliers and their destination. The record should be open to scrutiny by the competent authority at all times.

5. Approved import centres must be cleaned and disinfected regularly in accordance with the programme described in point 3 above.

6. Only authorised persons may enter approved import centres and must wear protective clothing including appropriate footwear.

FINLAND

Report on measures implemented and proposed to minimise the threat posed by *Gyrodactylus salaris*

Finnish and Norwegian Chief Veterinary Officers made a statement about certain fish health aspects related to the Tenojoki River in 1999. They wrote that "we are not aware of any risk analysis or scientific study to quantify/compare the risk of transmission of *Gyrodactylus salaris* or other serious fish disease with fishing equipment that has been dried and disinfected compared to equipment that has only been dried."

They also wrote that "although there is no evidence of spread of *Gyrodactylus salaris* or other serious fish pathogens with fishing equipment that has not been disinfected, we do acknowledge that the use of a disinfectant could be beneficial to reduce the risk of transmission of pathogenic agents and should be encouraged, particularly if the equipment has been used in a watercourse infected by *Gyrodactylus salaris* or other serious fish disease."

Later they justified that "disinfection of fishing equipment may reduce the risk of transmission of disease-causing agents, like *Gyrodactylus salaris*. Thus disinfection of fishing equipment used in watercourses infected by *Gyrodactylus salaris* or other serious contagious fish disease should be encouraged. This means that the work done concerning disinfection in Norway is highly appreciated, but that, due to the lack of scientific evidence, the benefits of making disinfection of fishing equipment compulsory in Finland too is uncertain. However, we do find it very important that enough information on the possible benefits of disinfection is given and that good possibilities for disinfection are available to encourage disinfection, on a voluntary basis, also in Finland."

After that we have tried to encourage disinfection of fishing equipment and inform the fishermen about the importance of disinfection of fishing equipment, and the possibility for disinfection has been organised in some places.

In the summer of 2001 Norwegians started to require the disinfection of fishing equipment in the case of fishermen who come ashore in Norway even if they do not fish there, and Finland decided to take measures to increase the disinfection facilities. In the summer of 2002 this possibility was available in all locations selling fishing licences to the River Tenojoki (Tana) (15 locations) and to the River Näätämöjoki (Neiden) (2 locations). Disinfection was considered advisable, but it is not obligatory.

In June 2003 the Ministry of Agriculture and Forestry organised a meeting in Rovaniemi in Lapland, on *Gyrodactylus salaris* and invited all the possible stakeholders. At that meeting we made a qualitative risk assessment and planned the tools to reduce the risks. Plans were also made on how to reach all the relevant people who should know about *Gyrodactylus salaris* and we discussed also the need to revise our regulations, for instance concerning disinfection of fishing gears and the use of bait fish.

In autumn 2003 the Food and Health Department and the Department of Fisheries and Game of the Ministry of Agriculture and Forestry started preparation of a new *Gyrodactylus salaris* decree together with the Employment and the Economic Development Centre of Lapland. The plan is to test the procedure next summer and also find out how to reach all fishermen -

also locals. The aim at the moment is that a new national decree will be in force at the end of this year or at the beginning of the year 2005. We do not think that fishing tackle (rods, reels, lines, flies and lures) is a real threat to salmon, as far as *Gyrodactylus salaris* is concerned, but because of the principle of the Precautionary Approach we are ready to implement some measures.

We have first to test the system, because at the moment about 10,000 fishermen visit the River Tenojoki during the summer (from the middle of June to the middle of August) on the Finnish side of the river. We estimate that they have with them about 40,000 rods, 7,000 lifting nets, 8,000 lifting hooks, 20,000 pairs of rubber boots and may be even 1 million flies and 1.5 million lures. Because there are only 15 locations for the purchase of fishing licences and disinfection of fishing equipment, it is impossible to disinfect, wash and dry all that fishing equipment. In summer 2002 about 15% of fishermen disinfected at least part of their fishing equipment. The Ministry of Agriculture and Forestry has the intention to require that fishing equipment is disinfected. This means that, at this time, fishermen must ensure that their fishing equipment is dry / has been dried or they must disinfect their fishing equipment with chemicals. The seller of fishing licences will then give them a certificate of disinfection with chemicals.

Almost all fishermen who come to the Rivers Tenojoki or Näätämöjoki will come through Inari, so we have tried to organise a central disinfection centre there, where fishermen can easily disinfect boats, for example.

We have also prepared some short articles on *Gyrodactylus salaris*, its threats and ways to combat it. These articles have been sent to all sport fishing magazines. We have also developed some press releases, which are distributed by the sellers of fishing licenses for the rivers Tenojoki and to the River Näätämöjoki. We have also prepared big posters for display at the roadside about *Gyrodactylus salaris* and disinfection of fishing equipment.

We have been drafting a bilateral agreement with the Russian authorities concerning prevention of fish diseases in water catchment areas common to Finland and Russia. *Gyrodactylus salaris* is also included. The Ministry of Agriculture and Forestry funds a research project on *Gyrodactylus salaris* (Perttu Koski, Pasi Anttila, Jaakko Lumme *et al.*): Virulence and epidemiological distribution of pathogenic strains of *Gyrodactylus salaris* in Finland.

IRELAND

Measures Implemented and Proposed to Minimise the Threat Posed by *Gyrodactylus salaris*

Prior to the implementation of EU Directive 91/67, the importation of live fish to Ireland was very strictly controlled. Subsequent to this, when it was obvious that Additional Guarantees were not to be granted in relation to List 3 diseases, a Safeguard Measure was sought and obtained from the EU Commission in relation to *G.salaris*. This measure was granted under Commission Decision 96/490/EEC. For the sake of clarity, this Decision has been repealed recently, and replaced by Commission Decision 2003/513/EEC. This measure ensures that live fish may only be imported from Great Britain, Northern Ireland, Isle of Man, Guernsey and certain parts of Finland, all of which are free of *G.salaris*. Ova may be imported from other geographical locations if they have been disinfected to ensure the destruction of the parasite, should it be present.

Within the past two months, Ireland has made a new application to the EU Commission for Additional Guarantees in relation to *G.salaris.* If the application is accepted, the temporary Safeguard Measure (2003/513/EC), will be repealed and a more permanent legal base will be available with which to control imports of live fish and gametes.

In addition to the legislative moves outlined above, a publicity campaign has also been launched, aimed at the angling community. This leaflet is widely available and is used as a tool with which to educate the angling public about the risks associated with the movement of live fish and fishing gear from infected to non-infected zones.

SWEDEN

Status report from Sweden concerning measures implemented to minimise the spread and threat of *G. salaris*

Veterinary management of *G. salaris* in Sweden

Region	Acts and regulations	Delivery	Management authority
West coast (Skagerrak and Kattegatt)	Annual control of *G. salaris* in fish farms by the National Veterinary Institute (NVI) using OIE standards (60 fish)	Reports to County Administrations, Swedish Board of Agriculture, Swedish National Board of Fisheries	County Administrations, Swedish National Board of Fisheries, Swedish Board of Agriculture
East coast	No restrictions concerning *G. salaris*		

Stocking practices with special emphasis on *G. salaris* in Sweden

Region	Acts and regulations	Management authority
West coast (Skagerrak and Kattegatt)	No permission for stocking salmonids in rivers emptying into the Skagerrak and Kattegatt with naturally reproducing salmon, in which *G. salaris* has not been found or the river being declared free from the parasite by the National Board of Fisheries	County Administrations
West coast (Skagerrak and Kattegatt)	Stocking of salmonids may be permitted above the second strict migration barrier.	County Administrations
West coast (Skagerrak and Kattegatt)	In the area above the second strict migration barrier, stocking only permitted if the fish are declared free from *G. salaris* (according to OIE standard) or coming from a fish farm in the same watershed	County Administrations
East coast	No restrictions concerning *G. salaris*	
All areas	No transfer of living fish from the sea to freshwater above the first strict migration barrier	County Administrations
All areas	Stocked fish from farms free from proliferative diseases and holding status of stocking farm	County Administrations
All areas	Permission holder follow special regulations when proliferative disease are registered	National Board of Fisheries, Swedish Board of Agriculture
All areas	Fish tanks disinfected	County Administrations
All areas	Alteration of water only at approved establishments when transporting living fish	County Administrations

Aquaculture practices concerning *G. salaris* and other fish diseases in Sweden

Region	Acts and regulations	Delivery	Management authority
West coast (Skagerrak and Kattegatt)	Stocking of salmonids into fish farms from the outlet to the second migration barrier. Stocked fish must be declared free from *G. salaris* (according to OIE standards)		County Administrations at every single event
All areas	No permission for new fish farm establishments in freshwaters holding salmon stocks		County Administrations
All areas	Status of farm for stocking of fish	3 years of compulsory health control	Swedish Board of Agriculture
All areas	Status of farm for stocking of fish	3 annual controls at different seasons	Swedish Board of Agriculture
All areas	Status of farm for stocking of fish	Recruitment of fish into farms shall minimise transfer of fish diseases (parental stock, eggs, disinfection, risk analysis)	Swedish Board of Agriculture

Border crossing of living fish in Sweden

No regulations concerning *G. salaris*	Swedish Board of Agriculture

ACTUAL SITUATION – STATUS OF *G. salaris* 2003

- New regulations concerning *G.s.* in year 2003, in order to reduce the risk of spreading the parasite on the Swedish West coast. The new legislation is strengthened since stocking restrictions now are higher in rivers free from the parasite (from previous first to second barrier) and there are no possibilities of bathing fish before stocking in rivers free from *G.s*.

- Two new infections in 2003 on the Swedish West Coast. Now more than half of the salmon rivers are considered to hold the parasite. At present, 13 of 23 salmon rivers are infected, mostly the rivers in the southern part of the coast.

UNITED KINGDOM

Measures to reduce the risk of introducing *Gyrodactylus salaris* into the UK

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Introduction

Gyrodactylus salaris is a viviparous, monogenean freshwater parasite of salmon that naturally infects Baltic stocks of Atlantic salmon (*Salmo salar*) without causing clinical disease. However, in Atlantic stocks *G. salaris* is a serious pathogen of pre-smolts. It multiplies unchecked by an immune response and death normally results (Bakke *et al.*, 1990b). The parasite is listed by the Office International des Epizooties (O.I.E.) in the Aquatic Animal Health code (O.I.E., 2003). It is a notifiable disease in the UK (Fish Disease Act, 1983), where it has never been recorded despite widespread surveillance. In this paper an assessment is made of the most likely routes of introduction into the UK and the measures in place to minimise the risk of introduction.

Geographic distribution of *G. salaris*

G. salaris has its natural origin in Atlantic salmon in western Sweden, northern Finland and northern Russia. It was first introduced into Norway in the early 1970's with the importation of Atlantic salmon smolts from Sweden (Johnsen and Jensen, 1991). The parasite has been introduced into 44 Norwegian rivers (currently 23 remain infected – Mo, T.A. *personal communication*). The parasite has also been found in Denmark (Buchmann and Bresciani, 1997; Nielsen and Buchmann, 2001) and it is thought to be in Germany (Cunningham *et al.*, 2003). Reports of *G. salaris* in France (Johnston *et al.*, 1996) have been disputed and it is generally agreed that the parasite found was a different species, *G. teuchis* (Lautraite *et al.*, 1999). Similarly, it is possible that reports of *G. salaris* in Spain and Portugal (Johnston *et al.*, 1996) may also have been due to misidentification. Surveys to substantiate freedom from *G. salaris* have been conducted only in the UK, Ireland, some river catchments in Finland, and France (Lautraite *et al.*, 1999). Its spread throughout Europe has been attributed to the movement of infected rainbow trout (Bakke and Harris, 1998). There are no published data on the prevalence of *G. salaris* in Swedish fish farms; however, in Finland, where Baltic salmon are also farmed, *G. salaris* was found in 39% of all salmon farms (Haenninen *et al.*, 1995). A survey of 11 Danish rainbow trout farms found seven infected with *G. salaris*; however, only 15 fish were sampled from each farm (Nielsen and Buchmann, 2001). The distribution of the parasite in Europe is not comprehensively known.

Biological factors

The importance of different routes of introduction will be influenced largely by biological and biophysical properties of *G. salaris*. The parasite has a short, direct life-cycle (no free-living dispersal stage), produces live young and is highly fecund (Harris *et al.*, 1994; Jansen and Bakke, 1991). Although phylogenetically, *G. salaris* is a macroparasite, its life-cycle is similar to that of a micro-parasite's (e.g. viruses or bacteria). It reproduces and survives permanently only on Atlantic salmon and rainbow trout (Bakke *et al.*, 1991), but can live for periods of 7-50 days on other salmonid and non-salmonid species without causing clinical disease (Bakke *et al.*, 1992a; Bakke *et al.*, 1990a; Bakke *et al.*, 1992b; Bakke and Sharp, 1990; Jansen and Bakke, 1995; Soleng and Bakke, 2001) including eels (maximum duration of infection 8 days) (Bakke and Jansen, 1991). The parasite survives longest (up to 50 days) on grayling (*Thymallus thymallus)* (Soleng and Bakke, 2001) on which limited reproduction takes place. *G. salaris* rapidly detaches from a dead host and is highly efficient at finding a new host (Soleng *et al.*, 1999a). It can survive for 6-7 days off the host in low water temperatures (Mo, 1997). The reproductive potential of *G. salaris* means that a single individual can start an epidemic. It cannot survive desiccation, freezing or elevated temperatures. Soleng and Bakke (1997) transferred hatchery Atlantic salmon smolts infected with *G. salaris* from freshwater to seawater varying in salinity from 5 to 33 parts per thousand (ppt) (33 ppt = full strength salinity) at different temperatures. At 5 ppt *G. salaris* continued to reproduce and increased in number. The rate of population growth was positively correlated with temperature. For salinities between 7.5 and 20 ppt survival time declined from 38 days to 16 hours, respectively (at 6ºC), and was negatively correlated with temperature. At 33% salinity at 6.0ºC the parasites ceased moving within 17 minutes and turned opaque (Soleng and Bakke, 1997). However, other work has shown that whilst the parasites are immobile within a few minutes, 30 minutes exposure to seawater (33ppt) will not kill all the parasites (Soleng and Bakke, 1997). The parasite is killed by aluminium sulphate at 202 $\mu g\ l^{-1}$ (Poleo *et al.*, 2004; Soleng *et al.*, 1999b), and most disinfectants (e.g. 0.5% Virkon ® S, Antec International, Sudbury, Suffolk, UK; Mo, T.A., *personal communication*).

Pathways of introduction and protective measures

The pathways of introduction fall into three main categories: importation of live fish and gametes, importation of eviscerated fish carcasses and mechanical transmission. All identified pathways are listed by the three main categories in Table 1 and the main protective measures in Table 2.

<u>Importation of live fish and gametes</u>

Under Council Directive 91/67 the movement of live fish can only take place between zones of the same health status for VHS and IHN or from a higher to a lower status zone. The UK is an approved zone for VHS and IHN (i.e. these diseases are absent). Therefore, importation of live salmonids into the UK can only take place from other zones approved as free from VHS and IHN. Furthermore, Council Decision 2003/513/EC (which replaces Council Decision 96/490) further restricts trade in live salmonids between regions that have recognised *G. salaris* free status. Member States of the EU can present a case for *G. salaris* freedom based on Article 13 of Commission Directive 91/67 for its territory or part of its territory. Areas within the EU that have recognised *G. salaris* free status are the UK, Eire and two river catchments in Finland. The UK apply the same criteria to trade in live salmonids from 3rd countries. Currently there are no importations of live salmonids into the UK with the exception of limited trade with Eire. Additionally, there is no evidence of illegal importation of live salmonids into the UK.

Salmonid eggs can be imported from farms outside of regions recognised as free of *G. salaris* provided they are disinfected (Commission Decision 2003/513/EC). *G. salaris* could be mechanically transmitted with eggs imported from an infected farm. It has been shown that viable *G. salaris* can stay attached to salmon eggs for some time, probably up to 6 days under damp, cool conditions. Atlantic salmon eggs are currently imported from Norway (hatcheries in Norway are free of *G. salaris* – Mo, T.A. *personal communication*) and rainbow trout eggs from Denmark (where some rainbow trout farms are known to be infected with *G. salaris*).

A risk of introduction from Denmark only exists if disinfection is not carried out. It is recommended by DEFRA that eggs are also disinfected before being taken into the hatchery in the UK, which will further reduce the risk of introduction. The short transit time (typically 24 hours) and cool, moist conditions of transport of rainbow trout eggs are likely to favour survival of the parasite.

Under EU legislation (Council Directive 91/67) live non-salmonid fish, including eels, can only be imported into Great Britain from zones with approved status for viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN). In recent years, live eels have been imported into the UK from France, Ireland, New Zealand, Spain and China. Currently, all eel imports for consumption originate from closed recirculation systems in the Netherlands (environmental contact is minimal and therefore risk of *G. salaris* infection is negligible) and legal imports of live non-salmonids originate from sites with no salmonid species. Wild caught elvers from mainland Europe are held in transit on one site in England under quarantine conditions. Hence the risk of infection with *G. salaris* associated with these imports is negligible. However, there is evidence that significant numbers of coarse fish, notably carp, are illegally imported from mainland Europe for recreational fisheries (Hudson, E.B., *personal communication*). There is a low probability that some of these fish originate from sites where salmonids are present.

It is almost certain that *G. salaris* would establish if introduced via the importation of live infected rainbow trout or Atlantic salmon. The importation of other species of fish, on which the parasite may survive for short periods, presents a considerably lower exposure risk because fewer parasites will be introduced and the probability that the parasite will find a suitable host (i.e. rainbow trout or Atlantic salmon) is considerably lower. There exists a risk that containers and residual water used to transport eggs and live fish may contain viable parasites and DEFRA recommend disinfection or burning for all equipment which has been in contact with the ova or live fish.

<u>Importation of eviscerated fish carcasses</u>

Annual imports of eviscerated salmon and trout carcasses by exporting country are summarised in Table 3. Considerable volumes of chilled or fresh salmon are imported from Norway and Sweden. However, harvested salmon originate exclusively from seawater, in which *G. salaris* survival will depend on salinity (Soleng and Bakke, 1997). In addition, the parasite dies rapidly if not covered with water and often leaves the host soon after death. It will not survive freezing or cooking. Significant volumes of fresh or chilled salmon have been imported from Norway in recent years (Table 3) without a *G. salaris* outbreak, which further suggests that this route presents an extremely low or negligible risk. On average, 49 metric tonnes of fresh or chilled rainbow trout were imported annually from Denmark into the UK between 1995 and 2000 (Table 3). In 2000, 80% of Danish rainbow trout production was in freshwater (Ariel *et al.*, 2002), thus it can be estimated that approximately 40 metric tonnes of imported rainbow trout per year were from freshwater farms, some of which were infected with *G. salaris*. A survey of five freshwater rainbow trout farms in Denmark found *G. salaris* in four farms (Buchmann and Bresciani, 1997) and, more recently, *G. salaris* was reported in seven of 11 Danish rainbow trout farms surveyed; however, only 15 fish were sampled from each farm (Nielsen and Buchmann, 2001). Research from Denmark found that the prevalence of *G. salaris* declined with the size of the fish and no *G. salaris* parasites were found on fish greater than 15 cm in length (Buchmann and Bresciani, 1997), indicating that the prevalence in market-size fish for export is probably low. Since *G. salaris* rapidly detaches from a dead host, many parasites are likely to be removed during harvesting and processing. The duration (typically 48 hours) and moist, cool conditions of transport from Denmark to the UK are likely to be reasonably conducive for survival.

G. salaris parasites on rainbow trout carcasses imported into the UK from Denmark would need to gain access to the aquatic environment and find a suitable host within 5-7 days in order for infection to become established. The parasite detaches rapidly from a dead host, thus the carcasses of fish infected at harvest may be free of *G. salaris* when sold. Effluent and waste from fish processing plants may contain *G. salaris* parasites. At most sites solid waste goes mainly for further processing and effluent enters the mains drainage untreated but viable parasites are extremely unlikely to enter the aquatic environment. However, some processing plants are sited on rainbow trout farms. The importation of fish carcasses directly to these farms creates a significant risk of contact between the introduced parasite and susceptible species in the aquatic environment. *G. salaris* present on uncooked scraps disposed of through the usual refuse disposal system will almost certainly die before entering the aquatic environment (via runoff, seepage or scavenging by piscivorous birds from a landfill site). There exists a theoretical possibility that viable parasites may enter a river or stream through picnickers' discard of uncooked scraps into a river or stream or used as bait. These routes account for only an extremely small volume of imported rainbow trout.

<u>Mechanical transmission</u>

There exists the possibility that *G. salaris* may be introduced by movement of animate or inanimate materials that carry fresh or brackish water, which have recently been in contact with infected fish, and have been kept in cool conditions. *G. salaris* can survive off the host for 5-7 days at ambient river temperatures (Mo, 1994). Items that may contain water and may move rapidly between freshwater areas include lorries moving live fish, canoes and angling tackle, especially keep nets.

A number of live fish hauliers use the same vehicles in mainland Europe and the UK. It is possible that one of these vehicles, travelling from an infected farm in Europe directly to a UK farm, could introduce *G. salaris* if appropriate cleaning and disinfection procedures were not followed. Pools of water within the vehicle may allow *G. salaris* to survive the journey back to the UK. The risk of introduction will be particularly high if live, dead or dying fish accidentally remained in the vehicle.

Gyrodactylids are not free-swimming and prefer to be in contact with a substrate and hence may preferentially attach to equipment. The risk presented by canoes and angling equipment (e.g. which have been in direct contact with infected fish) is low because the volume of water transported is low, and thus is unlikely to contain a parasite. It is likely that the parasite will become desiccated during transit. Canoes, boats, angling equipment, etc., have not been implicated in the transmission of the parasite between rivers in Norway (T.A. Mo, *personal communication*). This provides further evidence that these routes do not present a high risk for transmission over much longer distances (i.e. from mainland Europe to the UK). Nevertheless, angling equipment which has been used in *G. salaris* infected waters and re-used in the UK within a few days is a potential route for introduction. Anglers are advised to disinfect equipment before returning to the UK, where government fisheries departments have recently launched a campaign to raise awareness amongst the angling community of the risk of introduction.

Small leisure craft sail between the UK and Scandinavia. The boats contain freshwater tanks that will be replenished at remote anchorages when cruising in Scandinavia. It is possible that this water could be deposited in UK rivers or estuaries on their return, but the volume of water is low and hence the risk that parasites may be introduced is negligible. Ballast water taken on by a boat from an estuary of a *G. salaris* infected river presents a higher risk due to the high volume of water. Discharge of infected ballast water in an estuary in the UK, in contravention of the International Maritime Organisation's (IMO) guidelines, could introduce the parasite under certain circumstances. A few well-boat operators work in both Norway and Scotland and some boats are used in both countries. The movement of a well-boat which had transported *G. salaris* infected smolts in Norway before travelling to the UK presents a potential route of transmission if recommended cleaning and disinfection procedures are not carried out (Anon, 2000a).

The importation of aquatic plants and lumber from infected countries are potential routes of introduction; however, the risk posed by these routes can be considered as negligible because contact with potentially infected stocks will be almost non-existent.

Discussion

Live salmonid imports inevitably present the most serious threat of introduction since the parasite will survive transport and the fish will be introduced into a farmed aquatic environment where the parasite can quickly establish. The spread of fish diseases is generally through the movement of live fish. The importation of live salmonids, even from European countries or zones of equivalent *G. salaris* free status, would present a potentially serious route of introduction. Since *G. salaris* exists sub-clinically on rainbow trout, it could be introduced into a free zone and be undetected for a considerable time. This will depend on the surveillance and biosecurity systems in place and is a particular danger for zones with no significant Atlantic salmon populations. A high level of targeted active surveillance and biosecurity would be required to ensure that the risk of *G. salaris* introduction via these imports was reduced to an acceptable level.

Currently only a small number of sites on mainland Europe are legally supplying live non-salmonids to Great Britain for release into fisheries, none of which holds salmonids. Imports of non-salmonids from sites holding salmonids species could pose a significant threat of *G. salaris* introduction.

There are few well validated examples of the importation of eviscerated carcasses for human consumption resulting in the introduction of exotic fish pathogens. A number of risk analyses (LaPatra *et al.*, 2001; MacDiarmid, undated; Stone *et al.*, 2001) have shown that in general this route is of low risk because both the quantity of pathogen that may be introduced is low and the risk of entering the aquatic environment is extremely low or negligible. Undoubtedly, it is possible that fresh rainbow trout carcasses from infected farms in Denmark could introduce small numbers of parasites to the UK. However, the probability that viable parasites will enter the aquatic environment is negligible, with the possible exception of carcasses that are processed on fish farms. Currently in England and Wales, a few rainbow trout farms process carcasses and may, on occasion, buy in fish for processing from abroad. This pathway requires further investigation.

Mechanical transmission, e.g. via angling equipment, boats or lorries, has to be considered since the introduction of a single parasite could result in an outbreak. It is worth noting that lorries used to transport eels in Europe probably introduced the parasite *Anguillicola crassus* into Great Britain (Kennedy, 1990). It has been suggested that well-boats could have introduced infectious salmon anaemia (ISA) to Scotland from Norway (Anon, 2000b). Empty animal transports returning to Denmark after delivering pigs to Germany have been identified as a major route of introduction of classical swine fever into Denmark (Horst *et al.*, 1999). Boats and lorries used to transport live fish moving between mainland Europe and the UK probably present the most serious threat of mechanical transmission and merit further investigation.

The World Trade Organisation's (WTO) Agreement of Sanitary and Phytosanitary measures recommend that the acceptable measures are those that reduce the assessed risk to the acceptable level. The acceptable level of risk is based on the potential consequences of introduction, which in the case of *G. salaris* are severe. Further research is required to determine whether the current measures reduce the risk of introduction to an acceptable level. Work in the following areas is required: *G. salaris* contamination of imported salmonid carcasses, risk of exposure from on-farm processing of imported carcasses and the movement of fish transporters (lorries and well-boats).

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Table 1. Pathways of *G. salaris* introduction

Category	**Pathway**
Live fish and gametes	Importation live salmonids[1]
	Importation of eels[2]
	Importation of coarse fish
	Importation of rainbow trout eggs
Fish carcasses	Fresh or chilled Atlantic salmon from Norway/Finland/ Sweden
	Fresh or chilled rainbow trout from freshwater production in Denmark
Mechanical transmission	Lorries moving live fish
	Ships' ballast water
	Freshwater tanks of leisure craft
	Angling equipment (esp. keep nets)
	Importation of lumber from
	Importation of aquatic plants

[1] currently no live salmonids are imported into the UK with the exception of Eire
[2] currently all eel imports originate from closed recirculation system

Table 2. Measures to prevent the introduction of *G. salaris* into the UK

Route	Measure	Legislation / Reference
importation of live salmonids	from G. salaris free approved zones	Commission Decision 96/490/EC as amended by 98/24/EC
importation of live non-salmonids	from VHS and IHN free zones or farms	Council Directive 91/67
importation of salmonids eggs	disinfection	Commission Decision 96/490/EC as amended by 98/24/EC
live fish/eggs containers & residual water	disinfection or disposal	guidelines in import certificate (DoF8c)
live fish transporters	cleaning and disinfection recommended before re-entry to the UK	disinfection guidelines in the ISA code of practice (Anon, 2000a)
angling equipment	disinfection recommended	G. salaris awareness leaflet
boat traffic	ballast water discharge outside UK coastal water	IMO discharge of ballast water recommendations (http://globallast.imo.org/index.asp?page=resolution.htm&menu=true)

VHS = viral haemorrhagic septicaemia, IHN = infectious haematopoietic necrosis, ISA = infect**ious salmon anaemia, IMO = International Maritime Organisation**

Table 3. Average annual imports of whole eviscerated Atlantic salmon and rainbow trout carcasses for 1995- 2000 (metric tonnes)

	Fresh or chilled		Frozen	
	Salmon	Trout	Salmon	Trout
Belgium-Luxembourg	4	0	2	11
Canada	11	0	91	0
Chile	11	0	97	28
China	3	0	97	0
Denmark	150	49	77	185
Eire	822	175	36	45
Faroe Islands	3421	11	8	1
France	47	104	12	75
Japan	0	0	18	2
Germany	70	1	242	2
Iceland	277	3	20	4
Netherlands	13	29	131	27
New Zealand	0	0	3	0
Norway	6102	23	41	1
Portugal	0	0	0	16
S. Korea	0	0	3	0
Spain	10	3	1	204
Sweden	871	0	1	154
Thailand	0	0	3	4
U.S.A.	182	0	1057	<1
Total	11994	398	1940	760

Source : HM Customs and Excise

ICELAND

Disease Risk from *G. salaris* - Status Report for Iceland

Until late 2003 Iceland had a ban on the importation of live salmonids and only disinfected fertilized ova could be imported into the country subject to any exception granted by the Minister of Agriculture.

In November 2003 the Icelandic parliament passed some amendments to the Icelandic "Salmonid Fisheries Act", the "Laws on Importation of Animals" and the "Laws on Fish Diseases" to adapt Icelandic legislation to Council Directive 91/67/EEC, which Iceland had been temporarily exempted from since the creation of the European Economic Area.

Parasites of the species *Gyrodactylus salaris* have not been observed in Iceland and no systematic monitoring has been carried out in Icelandic rivers. Icelandic fish farms, however, are closely monitored by the Veterinary Officer for Fish Diseases, working under the office of the Chief Veterinarian.

It is of vital importance that international trade and health regulations consider the unique status of *Gyrodactylus salaris* free areas as this disease agent is unique in creating an epidemic in wild populations of Atlantic salmon with the threat of extinction of individual stocks.

NORWAY

Status report on measures against and managing of *Gyrodactylus salaris* in Norway

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1. Introduction

Infection by *G. salaris* is a category B disease and the responsibility for combating it comes under the Norwegian Food Safety Authority's remit. In a pollution context *G. salaris* is characterized as an alien and unwanted species in Norwegian fauna, so that this parasite problem requires the attention of the Ministry of Environmental Affairs and the Directorate for Nature Management as laid down in the Norwegian Salmon Act.

Rotenone is used for extermination in watercourses, and any release of rotenone requires a permit pursuant to the Norwegian Pollution Act, which is administered by the Norwegian Pollution Control Authority.

<u>History and regulations</u>

G. salaris has no natural occurrence in Norway but was introduced into the country on one or more occasions. The parasite was found for the first time in 1975. During those first years it was not acknowledged by the authorities that *G. salaris* was a pest that needed to be incorporated into the regulations for combating diseases. Only after the *Gyrodactylus Board* submitted their report in April 1982 was it clearly stated that the salmon stocks in the infected watercourses had been virtually exterminated and that "all possible measures must therefore be implemented to prevent this from spreading". On this occasion attention was also drawn to the fact that the matter had been raised with what was then the Veterinary Department of the Ministry for Agriculture. It was urged that the parasite should be included on the list of diseases the Fish Diseases Act would apply to, and that the necessary measures should be implemented to prevent further spreading.

The Veterinary Department announced in Circular M-79/83 of 6 June 1983 that the Fish Diseases Act would apply to *G. salaris* with immediate effect. The disease is now listed as a B disease on the disease list, which today comes under the Food Act. As of 1 January 2004 the Ministry of Fisheries is responsible for regulations relating to the health and welfare of aquatic animals, while all administration and all inspections authorized by this Act will be undertaken by the various offices of the Norwegian Food Safety Authority that were established on the same date.

A special regulation relating to the prevention, containment and extermination of *G. salaris* was established by the Fish Diseases Act and adopted on 28 February 1997. It authorizes the regional offices of the Norwegian Food Safety Authority to make diagnoses based on laboratory diagnoses from the Veterinary Institute. The Regional Director may also decide that aquatic organisms in all or parts of the watercourses where *G. salaris* has been found must be treated or killed, while also drawing attention to the fact that measures causing intervention in fish stocks or other fauna require permits pursuant to general legislation, the Salmon Act and the Pollution Act. The Ministry of Environmental Affairs administers the two latter Acts.

2. Administration plans

Cooperation and the division of work when combating the *G. salaris* have regularly been resolved through agreements between the agencies involved. The Directorate for Nature Management drew up the first Action Plan for measures against the parasite in 1986. The latest Action Plan was completed in 2000. In 1999 the Wild Salmon Committee designated *G. salaris* as the most comprehensive loss factor caused by human activity that has impacted the Norwegian salmon stock in recent years. The Committee proposed active measures by building salmon barriers and rotenone treatments. These recommendations were followed up in White Paper no.8 (1999-2000) "Regjeringens miljøvernpolitikk og rikets miljøtilstand" [The Government's Environmental Protection Policy and the State of the Environment in the Realm] where it was pointed out that activities to combat *G. salaris* would be given special priority in the coming years, and that the proposed Action Plan in general would be used as the basis for future activities to combat the parasite.

The division of responsibilities between the Ministries involved and their subordinate agencies was determined as follows:

Ministry of Environmental Affairs and its subordinate agencies are responsible for:

- studying and reporting on strategies for combating the disease in affected watercourses;
- a national resource centre for implementing measures against *G. salaris;*
- carrying out measures against *G. salaris;*
- studying and reporting on alternative measures;
- research.

The Ministry of Fisheries with its subordinate agency (Norwegian Food Safety Authority) is responsible for:

- monitoring programmes;
- measures to contain infection;
- epidemiological surveys;
- hygiene measures when treating infection;
- information on the status of infection and measures to prevent infection;
- research.

The Action Plan confirms the division of the involved watercourses into contamination regions based on the possibility of the parasite spreading via infected fish travelling in brackish water in the fjord systems. Of a total of 15 contaminated regions, in 2000 the parasite had been exterminated from seven of them. Of the remaining eight the Action Plan calls for the extermination of the parasite from seven regions using current knowledge. For the final region which comprises Drammenselva and Lierelva, the Action Plan states "Within the framework of this Action Plan, measures will not be introduced to exterminate the parasite. More experience with chemical treatment and the development of alternative methods for combating the disease are necessary before measures may be introduced in the future."

In December 2000 the Norwegian Parliament instructed the Government to draw up a multi-year plan of measures against *G. salaris*. The Measures Plan is the outcome of this assignment and is a direct follow-up with detailed specifications of the Action Plan from 2000, and emphasizes socio-economic costs more than the previous plan, estimated to be around NOK 200-250 million yearly. With a horizon of 10 years into the future, the plan aims for the removal of the parasite from all infected watercourses except the Drammen region within this period, claiming that this aim is realistic and viable. Up to the present Norway has incurred costs in the order of NOK 3 - 4 billion, and expenses under this plan will be approximately NOK 340-370 million for the ten-year period.

3. Research and development

The administration's choice of strategies for preventing and combating the disease have been based on research. Advice has been heard from the Advisory Group (proposals for choice of strategy and the order of treatment), the STOPP group (development of barrier solutions both generally and for specific watercourses) and the Method group (group with expertise on chemical treatment).

4. Prevention of infection

The most important preventive measure is to reduce the number of infection sources, i.e. infected fish farms and watercourses. Prevention of infection from contaminated fish farms is also in part effected by placing them under restrictions.

One important measure in watercourses is to prevent the migration of infected smolts by reducing the cultivation activity and by catching spawning fish. This leads to a major conflict of interests for the persons and communities that have fishing rights in the river, and in practice such measures have only been implemented when there have been specific plans for treatment.

As laid down by the Gyrodactylus Regulation, it is prohibited to take tackle used in an infected watercourse out of an infected zone without first having it disinfected. Comprehensive efforts have, therefore, been expended on establishing disinfection stations in various locations along the watercourses, in total 350 along all the watercourses. Moreover, regionally focused leaflets have been produced to inform and instruct users of the watercourses on the different procedures to be complied with. Information posters with a regional focus have been produced for a number of years and have been placed in strategic locations along watercourses. Employees in the various administration bodies also carry out substantial information activities through discussions, conversations, meetings and conferences.

Significant activities have also been implemented along non-infected watercourses to prevent infection. These include a system, voluntarily established by the owners of fishing rights, for the compulsory disinfection of fishing tackle before a fishing permit can be purchased.

5. Eradication measures

Fish farms

Any finding of *G. salaris* in aquaculture farms will immediately bring restrictions and ordinances into effect, which will be imposed by the regional offices of the Norwegian Food Safety Authority. Up to this point in time a total of about 40 fish farms have been infected, but presently no fish farms are infected or under restriction.

Rivers

Two main extermination measures have been used in Norwegian rivers: physical barriers and the chemical treatment of rivers. During an early phase of the measures, rotenone treatment was the only extermination measure used. Physical barriers have nevertheless been used as an important element in the extermination measures in all the contaminated regions.

Barriers

Long-term barriers

The principle of long-term fish barriers is to prevent the salmon from entering spawning areas in upper parts of rivers. After five to seven years the areas upstream of the fish barrier will be free of salmon, thus also free of parasites, as these die rapidly without a host. The young salmon will either be dead due to the parasitic infection or have migrated as smolts. Thus the existence of the parasite will have been contained to the areas downstream of the fish barrier, simplifying the work to combat the parasite.

This type of barrier is only used in complex watercourses, particularly where big lakes are located in the section where salmon are found, rivers with a long anadromous distance or rivers that are difficult to treat, i.e. because of the cost of a barrier, the long period from the start to the end of the eradication, the influence on other anadromous fish species such as sea trout, and technical possibilities to build a barrier in the lower parts of the river.

An example of the successful use of a fish barrier is in the River Figga, in the central part of Norway. The River Figga was infected by *G. salaris* in 1980. There is a large lake in the section inhabited by salmon. The distance from the sea to the lake is 16 km (10 miles). The size of the lake is 20 km^2 (7.8 $miles^2$). There are also many tributaries. A main focus of eradicating the parasite from this part of the watercourse was to prevent the salmon from swimming up into the lake. Therefore, a fish barrier was built approximately 1 km (0.6 mile) from the estuary. The length of the barrier is 40 metres (131 feet). The river water is filtered through a 4-metre (13 feet) wide iron grating with 50 millimetre (2 inches) openings. After five years all Atlantic salmon and thus also all parasites were removed from the area upstream of the barrier. The rotenone treatment was contained to the areas below the barrier.

According to the Action Plan, three other rivers (River Driva, River Skibotnelva and River Signaldalelva) are included in the planning of long-term barriers. The River Driva is a rather large river. The anadromous stretch is about 90 km long and the mean discharge is 70 m^3/sec. Both the River Skibotnelva and the River Signaldalselva are considered as hydrologically complex rivers, and consequently challenging for effective chemical treatment.

Short-term barriers

Short-term barriers in tributaries are often used to section the river during chemical treatments, as sectioning of the river simplifies the treatment. Short-term barriers are built the year before, or the same year as, the main treatment. The barriers make it possible to perform the treatment of the tributaries at any time before the main treatment. In this manner it is possible to accomplish the treatment when the condition is most favourable.

Chemical treatment

In principal, there are two ways of eradicating the parasite by chemicals: 1) Species-specific biocides that kill only parasites, and 2) non-specific chemicals removing the hosts.

<u>Non-specific chemicals</u>

No species-specific chemicals have so far been developed that will eradicate only the parasite. Currently, the only available method of eradicating *G. salaris* is to remove its hosts from the watercourse for a short period of time. We know, of course, that the parasite can only live in those sections of a watercourse where fish species that are susceptible to the parasite are present. The parasite, moreover, gives birth to live offspring, meaning that there are no eggs or other resting stages where it can survive without the host fish. The chemical used to remove fish from infected rivers is rotenone.

Rotenone treatment has been carried out in a total of 28 infected rivers in Norway. In 21 of the treated rivers, the parasite has been removed. In seven rivers the parasite has been registered again after rotenone treatment. In three of these rivers, the rotenone treatment has failed; in the other four rivers the parasite has re-established from neighbouring rivers. Norwegian rivers with previous or current infection of *G. salaris* are shown in Appendix 1.

Bearing in mind that three rotenone treatments have failed, considerable efforts have been put into improving the treatment techniques and equipment. These improvements have increased the probability of successfully eradicating the parasite in the future.

One of the latest rotenone treatment projects in Norway was accomplished in 2002 (Appendix 2). The salmon can migrate 3 miles up River Byaelva to Lake Reinsvatnet, but not into the lake created by a hydroelectric power station. In River Ogna the salmon can migrate 21 km (13 miles) up to a high water fall. In addition, there are two smaller rivers in the same area (River Figga and River Lundselva). The project started in the autumn of 2001 with a limited rotenone treatment concentrated to the main rivers (River Byaelva and River Ogna). The purpose was to eliminate all spawners from the river, to reduce the number of fry during the main treatment. Six short-term barriers were constructed in the most complex tributaries. The next step was rotenone treatment above the short-term barriers. The main rotenone treatment, which was accomplished at the end of August 2002, was simplified because most of the complex tributaries were already treated.

The plan for eradication of *G. salaris* this year is a large rotenone treatment project in the northern part of Norway (Appendix 3). In this project a total of six infected rivers in the same fjord system will be treated with rotenone. Two rivers (River Ranaelva and River Røssåga) are quite large; the others are considerably smaller.

<u>Species-specific chemicals</u>

In recent years there has been a very one-sided and negative focus on the use of rotenone in rivers, making the development of alternative chemical measures that kill the parasite, but not the host, a high priority. The most promising results have been obtained using aluminium solutions.

Several years of research have shown that aluminium has a clear negative effect on ectoparasites such as *G. salaris*. The effect is dependent on concentration, water pH and temperature. Experiments in the laboratory, as well as in the field, show that the parasite is substantially more sensitive to aluminium than the salmon. In nearly all experiments that have been performed, aluminium eliminates *G. salaris* from the fish, but the salmon apparently does not seem to be affected by the treatment. Based on this, it is possible that aluminium can be used as the main agent in the future treatments of *G. salaris* infected rivers.

With only a single dosing point with aluminium sulphate (AlS) it was possible to eliminate the *G. salaris* infection on Atlantic salmon 4 – 5 km downstream from the dosing point in the River Batnfjordelva, Møre and Romsdal County. The total salmon habitat in the river is 11 km. At station 1, located 2.2 km downstream from the dosing source, all *G. salaris* were eliminated after 4 days of treatment. There are several important reasons why the researcher did not manage to eliminate the parasite further down in the main river. The water from 15-20 tributaries entering into the river contributes to a significant dilution of the "parasite killing" Al-forms. In addition these tributaries have high pH, causing a pH increase in the main river, which *per se* also reduces the amount of reactive Al-forms. The biological reactive forms are highly pH-dependent. The AlS added is a mixture of aluminium sulphate and sulphuric acid, which cause both increase in aluminium and a decrease in pH when added. In a future full-scale treatment of the river system, AlS will also be added into the tributaries.

6. Conservation measures

In all infected watercourses where individuals from the indigenous salmon stock are still to be found, these stocks have been preserved in the so-called Salmon Gene Bank. The gene bank was established in 1986, being the first fish gene bank of its kind anywhere in the world. Originally it was a semen bank, where salmon milt was frozen and conserved in liquid nitrogen. At the start of the 1990s specialized fish farms were established for the safekeeping of brood stock (the Living Gene Bank), and at present family groups from more than 30 salmon stocks have been preserved, of which 17 are from rivers infected by *Gyrodactylus salaris*.

The eradication measures against the parasite require suitable conservation measures for anadromous populations of trout and char. Without such measures, local fish stocks will be rapidly depleted, because these stocks spend almost their entire life-cycle in freshwater habitats. Without special protection measures, eradication measures using piscicides during the winter period would kill virtually all anadromous trout and char. Similarly, fish barriers close to the river mouth would prevent these species from reaching their spawning grounds upstream of the barrier. The most suitable protection measures for sea trout include temporary penning in fish cages at sea during chemical treatment, and controlled access through established fish barriers (after genetic identification of species). The same protection measures are also being considered for anadromous char, in addition to long-term safekeeping in the Living Gene Bank.

Recovery of depleted salmonid populations is highly dependent on adequate conservation measures and restocking procedures. In recently infected rivers with viable populations of anadromous salmonids, the recovery period after chemical treatment has been shown to be very short. In these rivers there is no urgent need for restocking, as large proportions of the stocks are at sea during the chemical treatment. In rivers with a long infection history, the recovery of salmon stocks needs to be augmented by large-scale stocking immediately after treatment. Successful restoration of previously infected salmon stocks has been performed in several salmon rivers in western Norway during the 1990s, resulting in viable salmon stocks that have given substantial river catches during recent years. In rivers with no stocking programme, however, the recovery of the salmon stocks is very slow, and even after 10-15 years the salmon yield is considerably less than prior to the introduction of *Gyrodactylus salaris*.

7. Summary

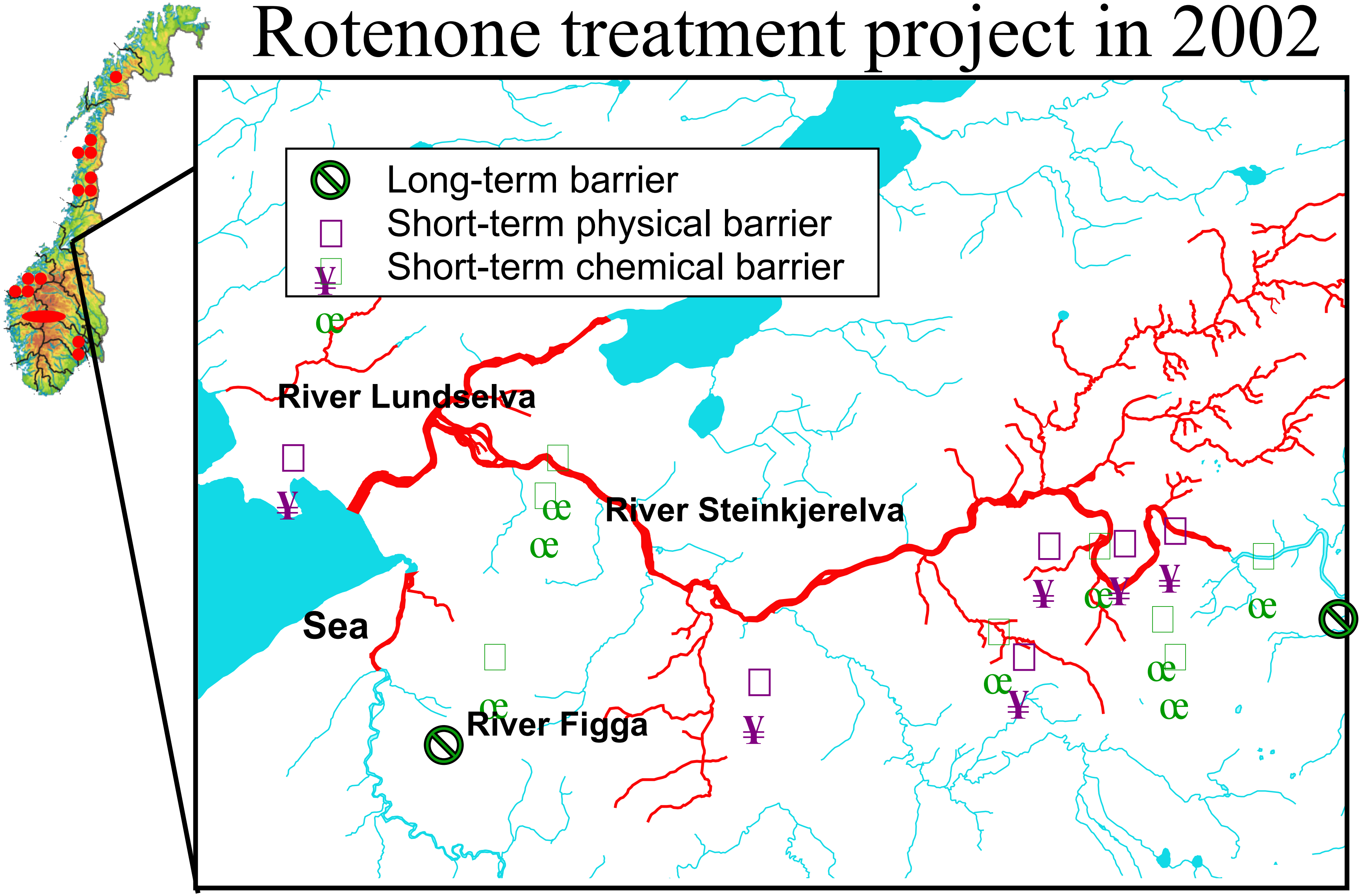
The Ministry of Fisheries is tasked with dealing with the outbreak of disease and the occurrence of the salmon parasite *Gyrodactylus salaris* through the regional and local agencies of the National Food Safety Authority, while the Ministry of Environmental Affairs is responsible for protecting salmon stocks, specific measures in rivers and matters that concern the use of chemicals in rivers through the Directorate for Nature Management and the Norwegian Pollution Control Authority. The Action Plan from 2000 and the Measures Plan from 2002 provide comprehensive plans for the prevention and extermination of the parasite in seven of the eight remaining contaminated regions. Locally run information and prevention activities are being undertaken to prevent further spreading of the parasite.

APPENDIX 1

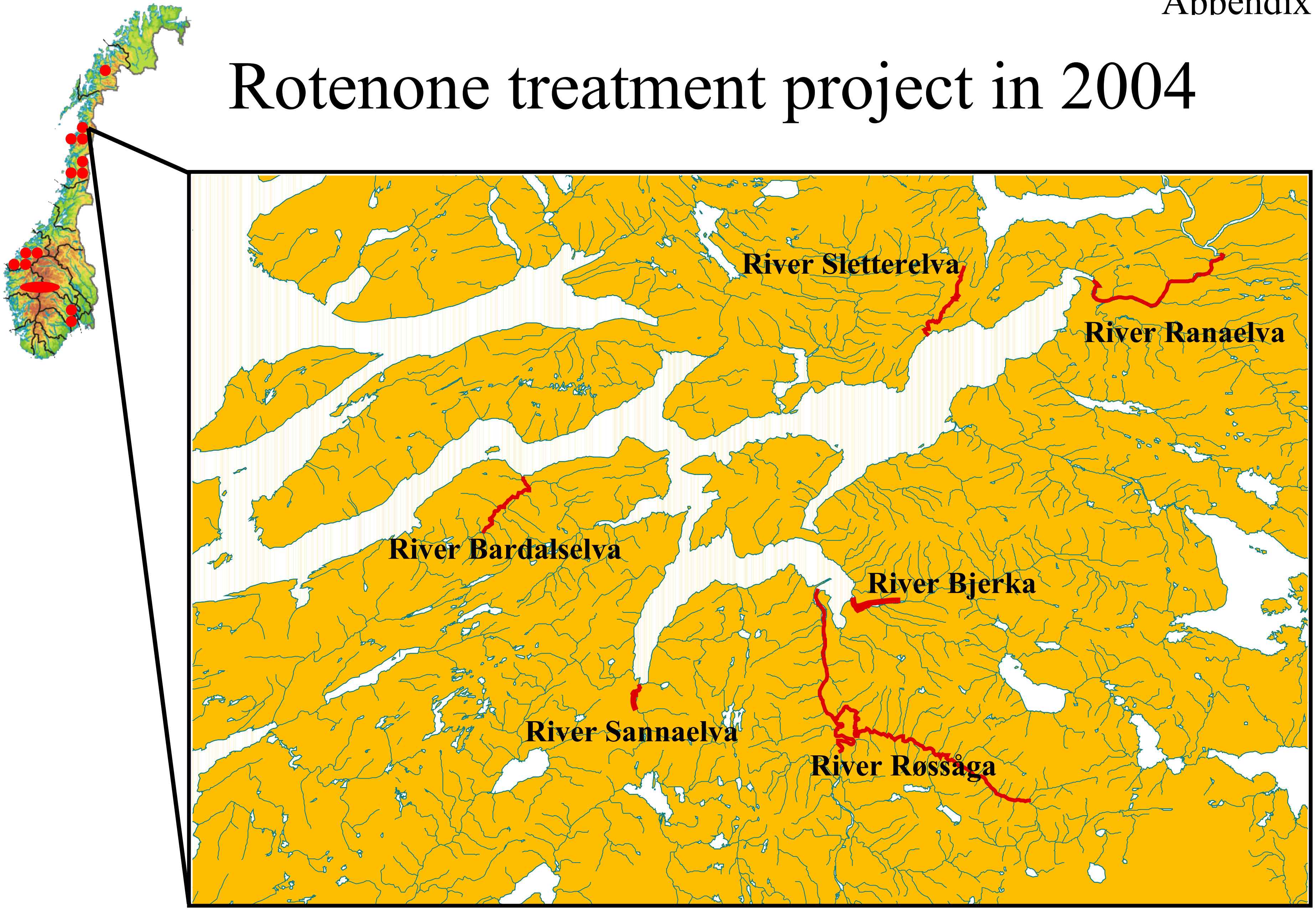
Norwegian rivers with previous or current infection of *G. salaris*

County	Rivers	Infection	Eradication	Infected today
Troms	Skibotnelva	1979		X
	Signaldalselva	2000		X
Nordland	Lakselva	1975	1990	
	Beiarelva	1981	1994	
	Ranaelva	1975		X
	Sletterelva	1993		X
	Røssåga	1980		X
	Bjerka	1980		X
	Sannaelva	1989		X
	Bardalselva	1989		X
	Leirelva	1996	1996	
	Drevja	1980		X
	Fusta	1980		X
	Vefsna	1978		X
	Hundåla	1992		X
	Halsanelva	2002	2003	
	Hestdalselva	2002	2003	
Nord-Trøndelag	Steinkjervassdraget	1980	2002	
	Figga	1980	2002	
	Lundselva	2001	2002	
	Vulluelva	1988	1988	
	Langsteinelva	1988	1988	
Møre og Romsdal	Bævra	1986	1989	
	Storelva	1989	1991	
	Batnfjordelva	1980		X
	Driva	1980		X
	Litledalselva	1981		X
	Usma	1980		X
	Rauma	1980		X
	Henselva	1980		X
	Skorga	1982		X
	Innfjordelva	1991		X
	Måna	1985	1993	
	Valldalselva	1980	1990	
	Tafjordelva	1981	1987	
	Norddalselva	1981	1990	
	Eidsdalselva	1981	1990	
	Korsbrekkeelva	1985	1986	
	Aureelva	1984	1988	
	Vikelva	1984	1988	
Sogn og Fjordane	Lærdalselva	1996		X
	Vikja	1981	1982	
Buskerud	Drammenselva	1987		X
	Lierelva	1987		X
Total number	**44**		**21**	**23**

Rotenone treatment project in 2002



Rotenone treatment project in 2004



RUSSIA

Measures Implemented by the Russian Federation to Minimize the Threat Posed by *G. salaris*

All measures taken by the Russian Federation to minimize the risk of spread of the parasite *G. salaris*, other parasites and diseases are based on the "Instruction on veterinary control of transfers of live fish, fertilized eggs, crustaceans and other aquatic organisms", which has been effective in the Russian Federation since 1971. When aquatic organisms are imported into the Russian Federation from abroad the importer shall fulfill the "Veterinary requirements to import of live fish, fertilized eggs, crustaceans, mollusks, forage invertebrates and other aquatic organisms into the Russian Federation", No. 13-8-01/1-17, approved by the Veterinary Department of the Agriculture Ministry of the Russian Federation on 23 December 1999. Besides, effective in the territory of the Russian Federation is the Instruction on measures to counteract *G. salaris,* approved by the Veterinary Department on 8 June 1998.

The Murmansk Regional Veterinary Service is currently developing "Temporary veterinary and sanitary regulations for fish farming in the Murmansk region", which will regulate veterinary aspects of fish farming. Regional regulations for preventing the transmission and spread of *G. salaris,* other parasites and diseases have only so far been developed and are effective in the Murmansk region only, which is, in the first place, linked to the development of salmon farming there.

These regulations include:

- measures for control of the epizootic situation in areas where aquaculture facilities are sited, and measures to prevent the spread of *G. salaris*, other parasites and diseases;
- measures for preventing escapes of fish during movement and handling of stocks at aquaculture units; development of contingency plans to be implemented in the event of accidents which have led to significant escapes;
- mechanisms for control of movement of fish at aquaculture units;
- possibility of moving an aquaculture unit to another site, if non-compliance with any of veterinary and sanitary or biotechnological standards has been identified during operations;
- measures to minimize the risk of diseases in cultured fish and their transmission, which include vaccination of fish, use of optimal stocking densities, careful handling, frequent inspection of fish, proper diet and feeding regimes, avoidance of unnecessary disturbance of fish, detailed health inspections, disinfection of transportation equipment, etc.

All aquaculture units have a list of prevailing infectious diseases and parasites, and the methods in practice for their control and prevention are detailed in an annual plan of veterinary/sanitary and preventive measures established for each disease-free unit. At facilities with diseases, which require introduction of restrictions, plans of therapeutic/preventive and curative measures are established.

Currently under consideration is the question of establishing *wild salmon protection zones* on major salmon rivers in the region, developing requirements for siting of aquaculture units relative to the mouth of salmon rivers.

Movement of live fish into the Murmansk region from abroad has been forbidden following a direction by the Chief State Veterinary Inspector based on the collective decision with the Murmansk Regional Administration.

It should also be noted that all projects on salmon farming are subject to licensing; this is done on the basis of comprehensive evaluation of the proposed project, which includes a mandatory assessment of risk of transmission of *G. salaris* and other diseases.

The Veterinary Service of the Murmansk region has developed a programme for veterinary and sanitary control of aquaculture facilities, which provides for regular (at least 4 times a year) veterinary and sanitary inspection of farms and hatcheries and ichthyopathological examination of reared fish.

To minimize the risk of spread of *G. salaris* in the recreational fishery the Polar Research Institute and Murmansk Veterinary Laboratory developed and issued an information leaflet, which included information on the parasite, possible ways of its transmission to rivers and specifies requirements to be fulfilled by anglers to avoid transmission of this monogenea with tackle.

In Karelia, as presently a major part of the salmon stock in the Keret river is comprised of hatchery-origin fish (more than 70%), to reduce the risk of infection with the parasite a number of precautions are taken such as juveniles of salmon are released at low temperatures under ice in the second half of April, when the parasite is not active. The juveniles are stocked as 2-year-olds in the downstream part of the river. Most of them do not stay in the river for a long time, as they are released as pre-smolts and leave the river for the ocean within a week. To minimize the risk of spread of *G. salaris* the recreational fishery for salmon on the Keret river is allowed only from the river banks.