

Abstract

Gyrodactylus salaris is a viviparous, monogamous, freshwater ectoparasite. It is endemic to Swedish rivers and its natural host, Baltic salmon, has developed immunity to the parasite such that infection is uncommon. The parasite spread to Norway in the mid 1970s, which caused the near-destruction of a different strain of salmon, the Atlantic salmon, among other salmonids. The introduction of *G. salaris* crippled Norway's salmonid fisheries and this immediately prompted research in order to try and understand its ecology and figure out a way to eradicate it. After nearly two decades of research there may just now be an effective cure to rid Norway's rivers of *Gyrodactylus salaris* for good.

Gyrodactylus salaris

By Evan Turnbull

Methods for Control

1. Natural events are desiccation, freezing, elevated temperatures, and fall through salinity. *G. salaris* cannot survive these conditions (Pfeifer 2003).
2. Disinfections by using salt can be used to cure fish hatcheries of the monogamous (Pfeifer 2003).
3. A method that has been effective for eliminating *G. salaris* from small rivers and streams has been using a poison called Rotenone. This poison accumulates in the body of everything living and when concentrations are high enough the organisms will die. This poison does not kill *G. salaris* itself but rather destroys everything living in the river and as the parasite will die after a few days once there is nothing to reproduce on. Rotenone cannot be used in large rivers because the ecosystem is too complex (Pfeifer 2003).
4. Ted Atis Ma, PhD, the foremost expert on *Gyrodactylus salaris*, has informed me via email that he and several colleagues have developed a method using acidified aluminium that kills *G. salaris*. One river was treated in a test and after a year's time no *G. salaris* has been found on the fish. Furthermore, this treatment does not harm the other living organisms; it only kills *G. salaris*. It is possible that with this new method that *G. salaris* will be eradicated but only time will tell.

Economic/Social Impacts

1. Norway has the best conditions for catching salmonids and was producing most of the salmon consumption in the UK by catching them in the mid *G. salaris* was introduced to Norway. Since the introduction of this parasite caused such a devastating impact (both ecologically and economically to Norway), young salmon were imported from Sweden and Finland, which became a promising industry for those two countries. When the disastrous effects of Swedish and Finnish salmon were understood, importations ceased. By this time, however, it was too late to control the spread of *G. salaris*. While six years, salmon per density decreased by 50% and within 5-7 years the density was reduced to 2-4% (Malmberg 1988). The aquaculture industry suffered a huge hit.
2. In 1987 about 10⁷ less salmon were caught by anglers (Malmberg 1988). Salmon fishing was banned in most of the affected rivers in order to preserve what few specimens still around the rivers (Ma 1994).
3. Norway must provide funding now for research in order to understand how to eliminate the *G. salaris* epidemic so that its aquaculture industry can be what it used to be.

Taxonomy

1. Classification
 Kingdom: Eukaryota
 Phylum: Platyhelminthes
 Class: Trematoda
 Order: Monogenea
 Family: Gyrodactylidae
 Genus: *Gyrodactylus*
 Species: *Salaris*
 Source: <http://www.ncbi.nlm.nih.gov/Taxonomy/ncbi>

2. Gene sequences
 • There are 7 *G. salaris* protein gene sequences known in GenBank.



Figure 7: A portrait of an Atlantic salmon which was decimated by *G. salaris*. Source: www.maf.gov.uk/mafishpage

Hosts

- Primary (natural) host:
- Baltic salmon
- Secondary hosts:
- Atlantic salmon (*Salmo salar*)
 - Rainbow trout (*Oncorhynchus mykiss*)
 - Brown trout (*Salmo trutta*)
 - Crayfish, carp, roach, etc
- Source: Pfeifer

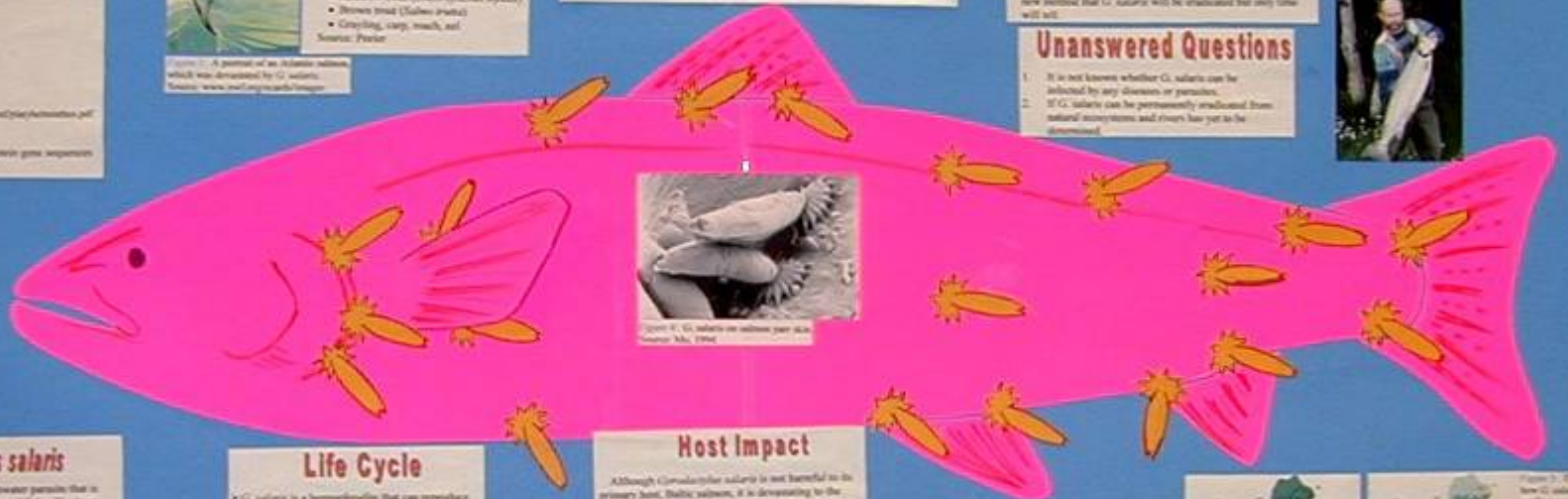


Figure 8: *G. salaris* on salmon just like before Ma, 1994



Figure 9: These pictures show how *G. salaris* spread through-out Norway to less than 5 islands. Source: www.maf.gov.uk/mafishpage

Unanswered Questions

1. It is not known whether *G. salaris* can be infected by any disease or parasites.
2. If *G. salaris* can be permanently eradicated from natural ecosystems and rivers has yet to be determined.

Gyrodactylus salaris

Gyrodactylus salaris is a freshwater parasite that is best adapted for feeding on salmonid fishes like trout and salmon. It was first documented in 1937 at the Maf Laboratory, a fish hatchery, in Sweden (Malmberg 1988). In the early 1970s Norway was buying juvenile salmon from Sweden for use in hatcheries and it is hypothesized that *G. salaris* was on one or more fish that were transported. In five years the parasite infestation spread from one river to twenty and after another five years 43 rivers were infested (Malmberg 1988). This reduced the salmon population to 90% of the original wild-salmon population size*. The high prevalence (frequently 100%) and the high abundance of the parasite on each fish is what lead to mortality (Pfeifer 2003).



Illustration of *G. salaris* on a fish. Source: Ma, 1994.

G. salaris attacks its host by latching onto the epidermis with specialized hooks. When it begins to feed, its mouthpart gives itself to the epidermis and releases proteolytic enzymes to digest the salmon skin. (www.bellona.no) The feeding activity results in scars and lesions on the skin of the salmon. Normally the epidermis can repair itself but in high abundance, as observed on Atlantic salmon, the large number of holes and scars produce vascular problems which lead to death (Ma 1994).

Life Cycle

- *G. salaris* is a hermaphrodite that can reproduce asexually or sexually (www.bellona.no).
- *A. viviparus*, which means it gives birth to live offspring that will then attach to the same fish, and an interesting fact is the newly hatched offspring can be already pregnant with more offspring! Each parasite may contain 5-6 offspring and thus it only takes a few days for one individual to increase itself to hundreds or even thousands (www.bellona.no).
- It is a monogamous because it can live its entire life cycle on one host. In a matter of days one *G. salaris* can reproduce itself to hundreds or thousands of individuals (www.bellona.no).
- This parasite reproduces and survives permanently on Atlantic salmon and Rainbow trout only. It can survive for 7-10 days on non-salmonid species but cannot reproduce on them (Pfeifer 2003). Essentially non-salmonids serve only as transmission vectors.
- Reproduction rate decreases when water temperature exceeds 16 °C (Kotomaki 1988). *G. salaris* prefers acidic water and its greatest prevalence is in early spring when the water is still cold and the amount of daylight increases (Olsen 1988).

Host Impact

Although *Gyrodactylus salaris* is not harmful to its primary host, Baltic salmon, it is devastating to the Atlantic salmon populations. It is an Atlantic salmon parasite and *G. salaris* will increase its numbers until the host dies. Salmon skin samples taken one day after infection showed a decrease in their mucous cell density and their epidermis was thinner compared to uninfected salmon (Olsen 1988).

Rainbow trout were initially susceptible to *G. salaris* infections but they responded to it and eliminated their infections. The trout responded by increasing their epithelial cell layer thickness and their mucous cell density remained the same (Olsen 1988).



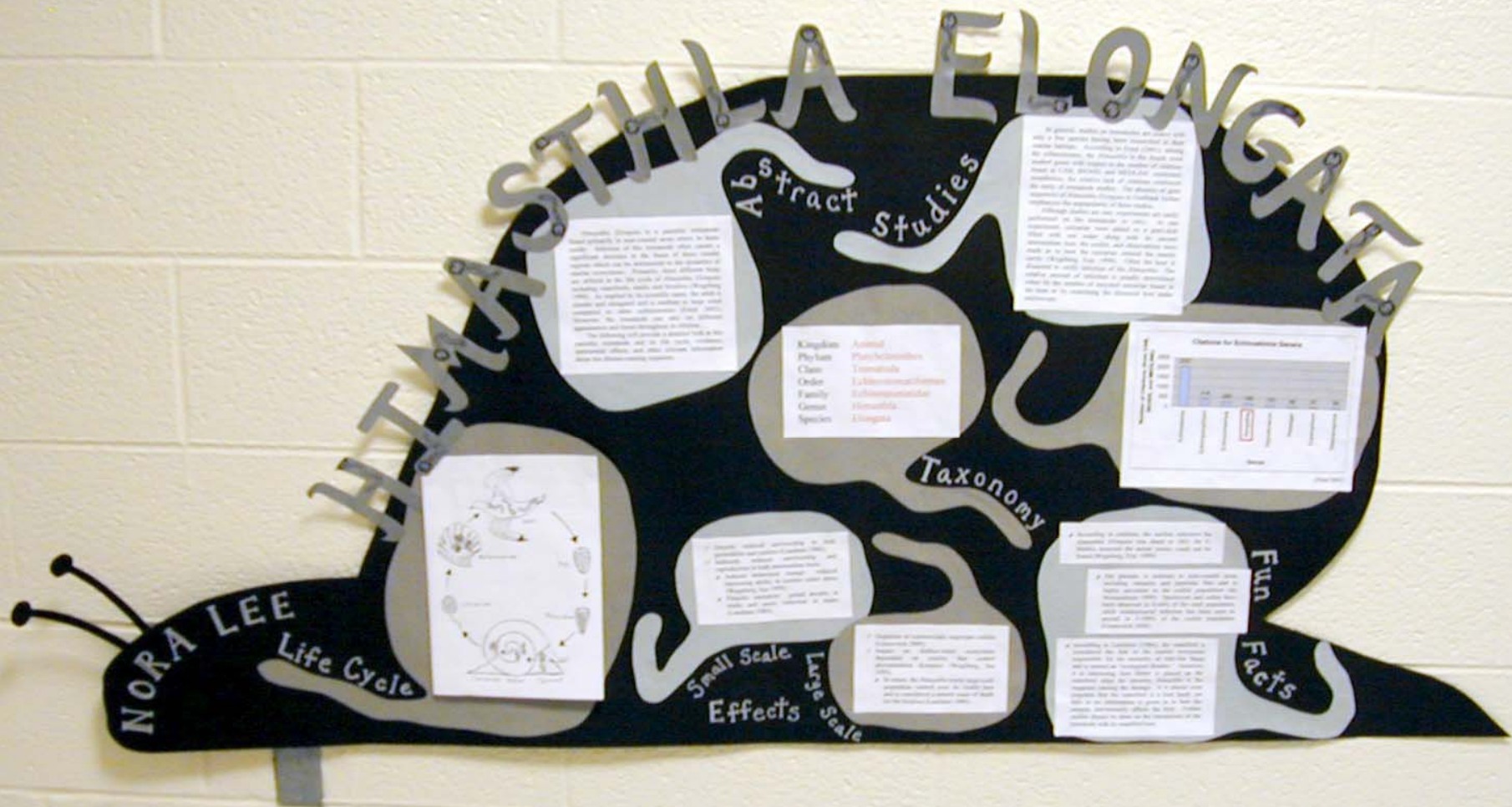
Figure 1: Salmon killed by *G. salaris*, just one day after infection. Source: www.bellona.no/Files/030604012003

Transmission Mode

- *G. salaris* can only be transmitted by contact (www.bellona.no).
- Fish hatcheries are prone to *G. salaris* epidemics because the high density of fish in a small area makes contact occur frequently.
- The movement of Rainbow trout was identified as the most important route of transmission (Pfeifer 2003). Other secondary hosts can serve as transmission vectors also and the parasite can live for up to 50 days on them.
- *G. salaris* can only survive 6-7 days off of a host and when they fall from a host to the bottom where they can be picked up by other hosts. Infections and spread to new areas (www.bellona.no).
- The parasite can be transmitted via fish farm equipment from one catchment to another and by other mechanical means like boats, canoes, and angling equipment (www.bellona.no).



Figure 2: These pictures show how *G. salaris* spread through-out Norway to less than 5 islands. Source: www.maf.gov.uk/mafishpage



Abstract Studies

Himasthila elongata is a parasitic flatworm that probably is most common where there is high water turnover. It is a member of the family Himasthidae. In the form of three closely related species, it is responsible for the disease himasthiellosis in fish. The parasite is a member of the phylum Platyhelminthes, class Trematoda, and order Platyhelminthes. It is a member of the family Himasthidae, class Trematoda, and order Platyhelminthes. The parasite is a member of the phylum Platyhelminthes, class Trematoda, and order Platyhelminthes. The parasite is a member of the phylum Platyhelminthes, class Trematoda, and order Platyhelminthes.

In general, flatworms are considered to be one of the few groups having been considered in their own right. According to the classification of the phylum Platyhelminthes, the order Platyhelminthes is divided into three orders: Trematoda, Cestoda, and Monogenea. The order Platyhelminthes is divided into three orders: Trematoda, Cestoda, and Monogenea. The order Platyhelminthes is divided into three orders: Trematoda, Cestoda, and Monogenea.

Kingdom:	Animal
Phylum:	Platyhelminthes
Class:	Trematoda
Order:	Platyhelminthes
Family:	Himasthidae
Genus:	Himasthila
Species:	elongata



Taxonomy

Small Scale Effects

Small scale effects of himasthiellosis include reduced growth rates, reduced fecundity, and increased mortality in fish. Small scale effects of himasthiellosis include reduced growth rates, reduced fecundity, and increased mortality in fish. Small scale effects of himasthiellosis include reduced growth rates, reduced fecundity, and increased mortality in fish.

Large Scale Effects

Large scale effects of himasthiellosis include population declines and local extinctions of fish. Large scale effects of himasthiellosis include population declines and local extinctions of fish. Large scale effects of himasthiellosis include population declines and local extinctions of fish.

Fun Facts

Fun facts about himasthiellosis include that it is a parasitic flatworm that probably is most common where there is high water turnover. Fun facts about himasthiellosis include that it is a parasitic flatworm that probably is most common where there is high water turnover. Fun facts about himasthiellosis include that it is a parasitic flatworm that probably is most common where there is high water turnover.

NORA LEE
Life Cycle

KOI HERPES VIRUS

Abstract

The *Koi Herpes Virus* infects *Koi*, the most popular freshwater ornamental pond fish. The disease produces lesions in the skin and gills, leaving *Koi* vulnerable to secondary bacterial infections. KHV has been isolated and studied using Polymerase Chain Reaction (PCR) and only small fragments are needed to confirm the presence. The virus, belonging to the *Iridoviridae* genus, the same virus causing lesions in ornamental carp, is present in the spring and fall when water is available at the ideal production pond water temperature of 18-21°C. There is no definite cure but feeding the pond fish with a healthy population nearby can reduce the disease and cure the infected fish.

KHV is vertically transmitted and spreads quickly in ponds for the winter, with mortality of 70-90%, causing severe financial losses to *Koi* breeders and hobbyists. The virus is common enough, causing epidemics all over the world from the U.S. to Europe and Asia.

Effects

Some *Koi* have a natural immunity to the virus and can appear totally unaffected while most other *Koi* around them are severely ill. The clinical signs of disease are: lethargy, gasping, anorexia, swollen eyes, patches in the skin, increased mucus secretion and white stringy ulcers, along with gill necrosis. Lesions appear on the skin as they tend spots that gradually increase in size to cover large areas of the skin. Body color of the fish may become bloody and the internal organs may be damaged or even liquefied.

Koi Herpes Virus is highly contagious and extremely virulent and 100% capable of mortality, but that has not been practically proven. However, this disease is not treated as to humans, or being the infected with KHV has no effect.

Koi

Koi is a variety of common carp (*Cyprinus carpio*) and are bred to produce ornamental fish all over the world. They were principally originally to produce those and later for their working appeal in Japan. *Koi* are cultured in wide range of temperatures and have an average life span of about 20 to 30 years with a maximum life span of over 200 years. *Koi* can be easily reproduced, ranging from a 1 inch fish for \$20 to a 22 inch fish for \$200.

Cure

The best defense against KHV is a healthy population, that eat well, which are used to change the pH of the water, a factor the virus is susceptible to, are other ways to stop the proliferation of the virus, and spread of *Koi Herpes Virus*. Mortality of *Koi* may be kept below 70%, if the fish are regularly vaccinated to about 90%.

FYI

Definition: *Koi Herpes Virus* (KHV)

Disease caused: *Koi Herpes Virus*

- Classification:**
- *Iridovirus*
 - *Iridoviridae* virus, an RNA virus
 - *Iridoviridae*
 - *Iridoviridae* *Iridoviridae*

Signs: Mortality is restricted to *Koi* and common carp, populations, in particular. Fish of several closely related species were found to be completely unresponsive to the disease, even after intensive experimentation with diseased fish.

Investigator

The virus, isolated from the cells of sick fish, was cultured and studied. The virus propagation and infection were synchronous effects. The first point indicator to find *Koi* the cell infection, PCR has been used to study the KHV, and it includes the sequencing of disease, after which a probe is used to find the level of the virus DNA. The viral DNA sequenced in fish tissues that only small fragments (10-60 base pairs) are needed to learn the sequence. Partial sequences of the 100 nucleotide (NT) gene of KHV appeared an resemblance to other *Koi Herpes Virus* TK genes suggesting that the virus is an unclassified species.

Guidance Research, Protein 1 (Proteinase Kinase)
Tachibana T.

Economic Loss

The viral disease has caused serious financial losses to *Koi* breeders, retailers and hobbyists world-wide. *Koi Herpes Virus* outbreaks in Japan in October 2001 cost the government about a 100 million yen (\$1,267,000,000) yen, has far-outlived angling lakes and could pose industry. Government officials that *Koi Herpes* problem for the carp business and the U.S. in a year angling industry.

Koi Herpes Virus infections in carp in the United States and other parts of the world. KHV has been first described in Europe, and even ago, KHV has been spread world-wide due to unregulated trade in ornamental fish. Total mortality is kept through Japan in 2001, killing 800 tons of carp and *Koi*. The virus was first detected in 1997 in Denmark and has found in Belgium, Britain, Germany, Indonesia, the Netherlands, Taiwan and the United States.

When the *Koi Herpes Virus* is introduced and we reach it, losses are high. There are a lot of unclassified questions.

Lead Facts:

Recent research carried out by Professor Wade Kester and colleagues at The Johns Hopkins University - Baltimore Medical School in Baltimore indicates that the virus may not be a *Koi Herpes Virus* at all, but a double-stranded DNA virus with unusual morphology that makes it resemble a *Koi Herpes Virus*. If this is correct, the *Koi Herpes Virus* will have to be reclassified.

Pathogen

KHV is one of the several herpesviruses that infect *Koi* and common carp populations. In addition, some unclassified herpesviruses of carp called *Cyprinid Herpesvirus* (CHV), an KHV causes the death of every and kind of all ages, whereas CHV causes the death of fish younger than 2 months old.

Herpesvirus occur between 18-27°C (64-80°F) and it can take 12-18 days or more longer for the infection to appear. KHV has a lipid envelope that makes them vulnerable to high temperatures, desiccation and pH variations. The virus, which "grows" at around 20°C that go on to infect others, or simply die off at 40°C. In some freshwater tanks in freshwater *Koi* and babies is 40% above 90% of infected fish.

When you see KHV and white stringy ulcers on the skin that are not caused by a bacterial infection.

A typical pond water temperature can kill an infected *Koi*, *Koi Herpes Virus*. Infection of the fish fish will be seen as they tend to be unresponsive.



KAPOSI'S SARCOMA- ASSOCIATED HERPESVIRUS

OMG
WELL
MM
WELL

ABSTRACT

INTRODUCTION

CLASSIFICATION

SYMPTOMS

LIFE CYCLE

TREATMENT AND DIAGNOSIS

WHAT DO WE STILL NEED TO KNOW?

KEY WORDS

REFERENCES

by natalie zawada

Black Rot of Cabbage and Crucifers

Link to graph

Abstract

Abstract text describing the study's objectives and findings.

Summing Up Disease

Summing Up Disease text block containing a graph showing data trends.

The Pathogen

The Pathogen text block describing the pathogen's characteristics.

The Host

The Host text block describing the host plant's characteristics.

Transmission

Transmission text block describing the pathogen's transmission methods.

Life Cycle

Life Cycle text block describing the pathogen's life cycle stages.

Pathogenesis

Pathogenesis text block describing the pathogen's pathogenesis process.

Host Resistance

Host Resistance text block describing the host's resistance mechanisms.

Social and Economic Importance

Social and Economic Importance text block describing the disease's impact.

Control and Management

Control and Management text block describing control strategies.

Interesting Facts

Interesting Facts text block containing additional information.