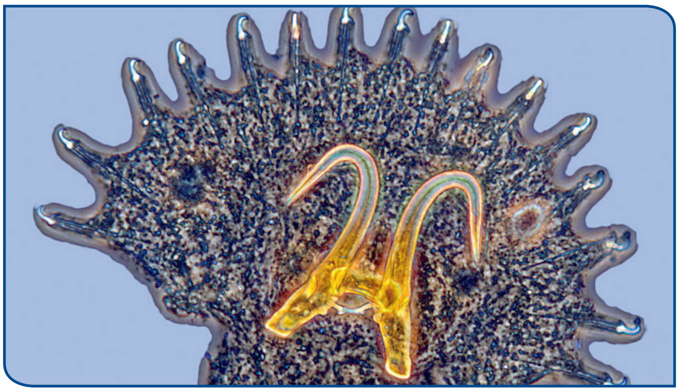
GYRODACTYLUS SALARIS



VIEW OF OPISTHAPTOR

GYRODACTYLUS SPP. GIVING BIRTH
REPRODUCED WITH THE PERMISSION OF DR T A MO, NATIONAL VETERINARY INSTITUE, OSLO.

What Is It?

Gyrodactylus salaris is a member of a genus of small parasitic worms which includes species infesting fish and frogs in both fresh and salt water. It was first described in Sweden in 1956. *G. salaris* measure approximately 0.5mm, and are visible only with the aid of magnification. In the field, it is possible to see them with a hand lens. Without magnification, salmon parr heavily infected by *G. salaris* appear greyish, with excess mucus, and possibly concurrent fungal infections.

G. salaris attach to the host by means of an organ called the opisthaptor at one end of the body. At the other end of the worm is the mouth.

The main body of the parasite contains a developing embryo, and *Gyrodactylus* gives birth to young that are virtually the same size as the mother. Inside that embryo there is already another developing worm, forming a 'Russian doll' arrangement. Reproduction occurs rapidly, particularly at higher temperature, when populations of parasites can double in four days. Once infected by *G. salaris*, individual young salmon (parr) can soon become almost completely covered by thousands of parasites, giving the impression of a thick layer of mucus. These heavy infections damage the skin and enable secondary infection by bacteria, viruses or fungi, which contribute to massive mortalities.

In Norway, catastrophic losses of Atlantic salmon (*Salmo salar*) were noticed following the introduction of *G. salaris* to the country in the 1970s on imported live fish from an infected area. By 2002, 44 Norwegian rivers had been infected, and their salmon populations decimated. Fishery losses due to the parasite have been estimated at over 40% of total reported catch of wild salmon.

Susceptibility

G. salaris cannot survive in full strength sea water. Adult salmon can become re-infected once they enter a river. Infection spreads to younger fish from fish harbouring the parasite from the previous year. Although the most severely affected species is Atlantic salmon, *G. salaris* has been reported on rainbow trout (*Oncorhynchus mykiss*), Arctic char (*Salvelinus alpinus*), North American brook trout (*Salvelinus fontinalis*), grayling (*Thymallus thymallus*), North American lake trout (*Salvelinus namaycush*) and brown trout (*Salmo trutta*).

Can *Gyrodactylus salaris* be treated?

In hatcheries, routine treatments with a variety of chemicals can control this pathogen. Complete eradication can only be achieved by removing all fish, drying the tanks, and instituting a fallow period.

Re-infection can occur if the parasite is present on wild populations and the water supply to the farm is not protected.

In an attempt to eradicate *G. salaris*, the Norwegian government is carrying out an extensive and costly programme to treat infected rivers. As of 2010, 35 Norwegian rivers have been treated. Rotenone is most commonly used and kills all fish able to harbour the parasite. After a period of monitoring to ensure all fish have been removed, the river can be re-stocked using eggs from stocks that were removed prior to rotenone treatment. This drastic measure has been successful in about 20 rivers. In a few rivers, the parasite has reappeared following rotenone treatment. Acidified aluminium sulphate has also been investigated to measure it's suitability to treat Norwegian river systems for the control of *G. salaris* at doses which are not lethal to fish

Is *G. salaris* a threat to salmon in Britain?

In an experiment to address this question salmon from Scottish rivers were transported to Norway and exposed to *G. salaris*. The rapid increase in the number of parasites on the fish showed that Scottish fish were highly susceptible. Movements of live fish from infected areas in other countries represent the highest risk to salmon in Great Britain (GB). Legislation to safeguard our fish by preventing such movements has been approved under Commission Decision 2010/221/EU.

Lower risks of introductions include contact with material from infected waters such as angling equipment and canoes. Practical measures that should be taken to ensure these risks are minimised are set out in the Code of Practice to Avoid the Introduction of *Gyrodactylus salaris* to GB (available from our website) and the leaflet Keep Fish Disease Out – A guide to protecting freshwater fish stocks from *Gyrodactylus salaris.*

Diagnosis and surveillance

The Scottish government maintains a surveillance programme for *G. salaris*, and has funded research to improve diagnostics and surveillance.

A comparison of several methods for identifying the parasite found that molecular genetic methods were most reliable but were relatively slow. A real time polymerase chain reaction (PCR) assay has now been developed at MSS which reduces screening times by at least five fold compared to previous molecular methods.

Emphasis on applying a risk based approach to surveillance for fish and shellfish disease is increasing. This involves focusing on areas where pathogens are most likely to occur and disease is most likely to develop. Factors which can contribute to the risk of *G. salaris* introduction and spread include:

- Imports of aquatic animals (including live or dead fish, their eggs or gametes);
- Mechanical transfer via boats or angling equipment;
- The extent of movements into or out of a farm or on a river;
- Sharing of water between catchments e.g. hydroelectric use;
- Proximity of river mouths to each other.

Knowledge of these, and other factors, and the extent to which they occur, help establish which areas have the highest risk of introduction or spread. Resource can then be applied proportionally, with more intense focus on high risk areas. Marine Scotland Science is considering this approach to monitoring for *G. salaris* in the future.

Simulation models, using available information, have been developed to help evaluate different surveillance strategies for detecting *G. salaris*. Probability values are inputted for each step of the surveillance process to estimate the chance of detecting *G. salaris* in a river catchment area if it is present. The models include variables such the frequency of sampling, the number of sampling sites, and the number of fish which are taken from each site. The most effective surveillance strategy will be a compromise between the cost of each surveillance scheme and the desire to detect the introduction of an infection before it spreads too widely.

The data used to determine the probabilities, especially with respect to how it might apply to Scotland, where *G. salaris* is not present, are still very limited. MSS will continue to update the data used in the models and risk maps in an on-going commitment to providing the most beneficial surveillance using the resources available.