A PRELIMINARY RISK ANALYSIS FOR THE TRANSMISSION OF THE EXOTIC FISH PARASITE *Gyrodactylus salaris* BETWEEN RIVER CATCHMENTS IN ENGLAND AND WALES

by Edmund Peeler, Mark Thrush and Richard Gardiner

CEFAS The Centre for Environment, Fisheries & Aquaculture Science

Introduction

G. salaris is a viviparous, monogenean freshwater parasite of salmon that naturally infects Baltic stocks of salmon (*Salmo salar*) without causing clinical disease. However, in Atlantic stocks *G. salaris* is a serious parasite of pre-smolt stocks. It multiplies unchecked by an immune response and death normally results. The parasite can result in a 98% reduction in an affected salmon population. *G. salaris* was introduced into Norway, probably with salmon parr imported from Sweden in the early 1970's, and has resulted in the decimation of wild salmon populations in over 40 Norwegian rivers. The parasite is endemic in western Sweden, northern Finland and northern Russia. In addition to Norway, it has been introduced to Denmark and Germany, and its distribution in other European countries is unknown.

G. salaris is the most important exotic disease threat to the Atlantic salmon population of the UK

Once introduced into a river the parasite is likely to spread throughout the entire catchment with movement of wild fish (the parasite is able to survive for short periods on many species of fish). A disease control strategy must therefore be based on minimising the spread of the parasite from infected to uninfected catchments.

This risk analysis was undertaken in order to identify and rank all possible routes of transmission of _G. salaris_ from infected to uninfected rivers

Properties of *G. salaris*

- survives permanently on Atlantic salmon and rainbow trout (*Oncorhychus mykiss*) and can live for periods of 7-50 days on other salmonid and non-salmonid species
- rapidly detaches from a dead host
- highly efficient at finding a host
- survives for 6-7 days off the host in low water temperatures
- unable to survive freezing, elevated temperatures, full strength salinity and desiccation

Routes of transmission between rivers

The spread of *G. salaris* in Norway has been attributed to the movement of live salmonids (Atlantic salmon and rainbow trout), and to a lesser extent the migration of salmon between river catchments in brackish waters. However, the route of parasite transmission into a number of infected rivers was not conclusively demonstrated. Other potential routes of transmission exist. On the basis of the biological characteristics of the parasite and the experience in Norway the routes of transmission are ranked in Table 1.

Gyrodactylus salaris
(courtesy of Dr Tor Atle Mo)

Table 1: Routes of G. salaris introduction into an uninfected river

Rank	Route of transmission	Estimated level of risk
1.	introduction of live rainbow trout or salmon	very high
2.	introduction of other live fish	moderate
3.	movement of salmon between rivers in estuaries	low – moderate
4.	movement of equipment, vehicles and staff between farm sites	low – moderate
5.	effluent from a fish processing plant	low - moderate
6.	eels moving between river catchments	low
7.	canoes / boats etc. used on more than one river catchment	low
8.	diversion of water between river catchments	low?
9.	angling equipment, e.g. rods, keep nets etc. used on more than one river catchment	low - extremely low
10.	eggs purchased from an infected hatchery (disinfected)	extremely low
11.	piscivorous birds	extremely low

known route of transmission

Eels *– can move overland between rivers and carry the parasite for a few days*

Recreation on the river *– transmission may occur on rods, nets, boats and canoes?*

Estuaries *– salmon carrying the parasite may move between rivers (courtesy of European Sport Pilot Association)*

Live farmed fish *– movement of rainbow trout is the main route of spread between rivers*

Cormorants *– could they spread the parasite? (courtesy of Graham Ekins and Les Steward)*

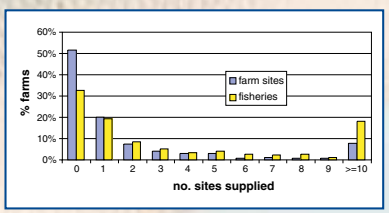
Assessment of the movement of live fish in England and Wales

The movement of live salmonids is undoubtedly the most important route of transmission of *G. salaris*. The main movements of live fish are:

- juvenile rainbow trout (fingerlings) from hatcheries to ongrowing sites
- 6-24 month old rainbow and brown trout from farms for stocking rivers and still-water fisheries
- coarse fish (carp, roach etc.) from farms, rivers and other wild waters to stock rivers and still-water fisheries

The main risk posed by the movement of species other than rainbow trout, comes from sites which farm rainbow trout and other species.

The movement of live rainbow trout is the most important route of transmission of _G. salaris_ between river catchments in England and Wales



Graph 1: Trout farms by number of farm and fishery sites supplied with live fish (FHI 2001 data)

The establishment of *G. salaris* in farms which supply a number of other farms and fisheries will result in the rapid dissemination of the parasite: 8% supplied 10 or more farms and 18% supplied 10 or more fisheries (Graph 1).

The risk of disease introduction will be positively associated with the number of live fish suppliers used; 20% of trout farms are closed (buy in no live fish), 34% use one supplier and 11% used 5 or more suppliers.

Distribution of trout farms in England and Wales

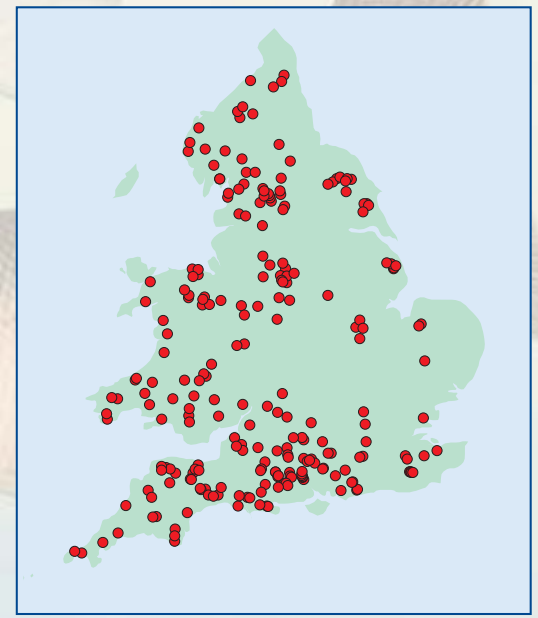
Rainbow trout and to a lesser extent brown trout (there are only 15 salmon hatcheries) are the major salmonid species farmed in England and Wales. Trout are farmed on 265 sites on 78 of the 180 river catchments in England and Wales (see map). 89 river catchments have wild salmon populations, 49 of which have trout farms (Table 2).

In the event of an outbreak of _G. salaris_ wild salmon populations at highest risk are those in the 49 rivers where trout farms are located

Table 2: River catchments classified by the presence of trout farms and wild salmon populations

Wild salmon populations	Trout farms		
	present	absent	*total*
present	49	40	89
absent	29	62	91
Total	78	102	180

Source: FHI data and the Database and Atlas of Freshwater Fish (funded by the Environment Agency, Joint Nature Conservation Committee and the Centre for Ecology and Hydrology)



Distribution of trout farms in England and Wales

Conclusions and recommendations for further work

- In the event of a *G. salaris* outbreak the main objective of a disease control programme must be to protect uninfected salmon rivers
- Modelling the spread of *G. salaris*, though live fish movement and other routes, is needed to assess:
  - ➔ the likely extent of an outbreak and geographic distribution of the parasite with time to first detection
  - ➔ competing control strategies
- Further work is necessary to assess the importance of other routes of transmission

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The Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Weymouth Laboratory, Barrack Road, Weymouth, Dorset DT4 8UB, UK. http://www.cefas.co.uk