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# Content

# Summary

In 2025, which was the first year of the post-treatment surveillance program for *Gyrodactylus salaris* in the Driva infection region, 498 salmon juveniles from the rivers Driva (109.Z), Batnfjordselva (108.3Z), Litledalselva (109.5Z), Usma (109.4Z) and and Gylelva (109.7Z) in Møre og Romsdal county, were surveyed. In addition to the standard surveillance where salmon juveniles are sampled by electrofishing and examined under a stereo microscope, environmental DNA monitoring was also carried out. *Gyrodactylus salaris* was not detected in any of the samples taken in the surveillance program.

# Introduction

In the period from 1975 until the start of 2025, pathogenic strains of *Gyrodactylus salaris* have been detected on Atlantic salmon (*Salmo salar*) fingerlings/parr in 54 rivers, 13 hatcheries/farms with Atlantic salmon parr/smolts and 26 hatcheries/farms with rainbow trout (*Oncorhynchus mykiss*). In addition, both pathogenic and non-pathogenic strains of *G. salaris* have been found on Arctic charr (*Salvelinus alpinus*).

The policy of the Norwegian authorities is to eradicate *G. salaris* from infected watersheds and farms (Anon, 2014). If *G. salaris* is detected in a farm, eradication is carried out by eliminating the hosts (Atlantic salmon and/or rainbow trout). This also ensures elimination of the parasite since it lacks specialised free-living stages and does not use intermediate hosts in its life cycle. In rivers, the eradication is done by chemical treatment. In most instances rotenone has been the preferred chemical. One exception to this is the treatment of River Lærdalselva in 2011-2012, where acidified aluminium sulphate was used as the main chemical to eradicate the parasite (Hindar et al., 2015). Recently, full-scale treatment using chlorine as the main chemical was carried out in river Driva, Møre og Romsdal county in 2022 and 2023 (Olstad et al., 2024). After these first two years of *treatment*, environmental DNA (eDNA) analyses were positive for DNA from Atlantic salmon upstream of the migration barrier and it was decided that an extra year of treatment, in 2024, should be carried out. This treatment only focused on the stretch in the upper part were the positive eDNA samples had been obtained and the stretch downstream of the migration barrier (Garvik et al., 2025). In contrast to rotenone treatment, treatment with aluminum sulfate and chlorine will kill the parasite, but not the host.

By the entrance to 2025, *G. salaris* was confirmed eradicated from 43 rivers and from all hatcheries/fish farms. Only the rivers in the Driva infection region (rivers Driva (109.Z), Batnfjordselva (108.3Z), Litledalselva (109.5Z), Usma (109.4Z) and Gylelva (109.7Z) are included in the surveillance program for 2025, while eradication measures are in progress in the Drammen infection region; rivers Drammenselva (012.Z), Lierelva (011.Z), Vesleelva (Sandeelva)(013.Z), Selvikvassdraget (013.1Z) and Bergerelva (012.3Z).

*Gyrodactylus salaris* is included in the list F of nationally listed and notifiable diseases, and Norway has implemented national measures for the parasite which comply with Regulation (EU) 2016/429, article 226 (3). *Gyrodactylus salaris* is also listed as a notifiable aquatic animal disease by the World Organization for Animal Health (WOAH). Surveillance for *G. salaris*, aiming to declare freedom from the parasite in treated rivers, has been ongoing since the early 1980s. The Norwegian Veterinary Institute (NVI) coordinates the surveillance programme on behalf on the Norwegian Food Safety Authority (NFSA) and publishes the overall results in annual reports available on the website of the Norwegian Veterinary Institute (NVI). (www.vetinst.no).

NVI is responsible for the sampling in the rivers, but County Environmental Departments and other institutions/companies are commissioned to carry out the actual sampling. NVI is responsible for both examination of the fish samples and subsequent species identification if specimens of *Gyrodactylus* are detected.

# Aims

The post-treatment surveillance programme for *Gyrodactylus salaris* aims to document the absence of the parasite in previously infested watercourses after the implementation of eradication measures. This documentation provides the basis for the Norwegian Food Safety Authority to declare the salmon populations free from infection.

# Materials and methods

An adequate surveillance, covering both space and time, is required to ascertain freedom from infection with *G. salaris* in the treated rivers. Declaring a river free from parasites requires examination of salmon juveniles sampled over a time period of a minimum of five years after an eradication measure is completed. This time frame is based on a smolt age of four years, adding one year safety margin. In rivers with higher smolt age, the time to ascertain freedom from infection is increased proportionally.

For 2025, Driva (109.Z), Batnfjordselva (108.3Z), Litledalselva (109.5Z), Usma (109.4Z) and Gylelva (109.7Z) were included in in the post-treatment surveillance programme for *Gyrodactylus salaris* in Norway.

Wild Atlantic salmon juveniles are sampled throughout the entire anadromous stretch of the river. The programme recommends sampling at least 10 juveniles near the river outlet, with additional 10 juveniles at every second kilometre upstream, continuing all the way to the migration barrier in the main river, as well as in tributaries. Thus, the total number of fish required from a river depends on the length of the anadromous stretch of that particular river system. Some locations may vary between years due to factors such as water flow or low fish abundance, but the general criteria are followed. Sampling is done twice a year between July and September and with at least a month between each sampling. Fingerlings and parr of an age of 1+ or older (preferred size ranging from 7 - 12 cm) are caught by means of electrofishing. The fish are killed and then preserved whole in 96 % ethanol.

All samples are sent to the NVI where they are examined. The whole surface of the salmon, including head, gills and fins, are examined under a stereo microscope at 10 - 15 times magnification.

When *Gyrodactylus* specimens are detected, species determination is performed by NVI. NVI is the WOAH reference laboratory for “Infection with *Gyrodactylus salaris*” and the methods used for species identification follow those given by the WOAH Manual of Diagnostic Tests for Aquatic Animals: https://www.woah.org/fileadmin/Home/eng/Health_standards/aahm/current/2.3.03_G_salaris.pdf

In addition to the standard surveillance method described above, environmental DNA (eDNA) monitoring was applied as a supplementary method in this surveillance program. This was done to further test the suitability of the method and to survey the part of the river upstream of the migration barrier, where DNA from Atlantic salmon were detected the year before the last treatment (Garvik et al., 2025).

Environmental DNA monitoring is a tool that can detect minute amounts of DNA in water samples using a combination of water filtering and molecular detection. All organisms in water shed cells containing DNA into the environment (Thomsen et al., 2012). By using species-specific primers and probes and sensitive PCR-methods, it is possible to detect and identify the presence of DNA from specifically targeted species in water samples. This method is also developed for detecting *G. salaris* (Rusch et al., 2018) and has previously been applied in field studies in the River Drammenselva and Driva (Fossøy et al., 2019; Hansen et al., 2025; Rusch et al., 2018).

In October, two eDNA samples were obtained from each of five locations in Driva, two downstream of the migration barrier and three upstream (see Table 2 and Fig 1). Water samples of 1-2 litres were collected and

filtered on site onto Dual eDNA filters (1.2 µm pore size, Sylphium, Groningen, The Netherlands) by pumping the water through the filters using a battery-operated peristaltic pump (Vampire sample collector, Bürkle). Qiagen ATL buffer was added to the filter capsule, and samples were brough back to the laboratory at NVI for analyses.

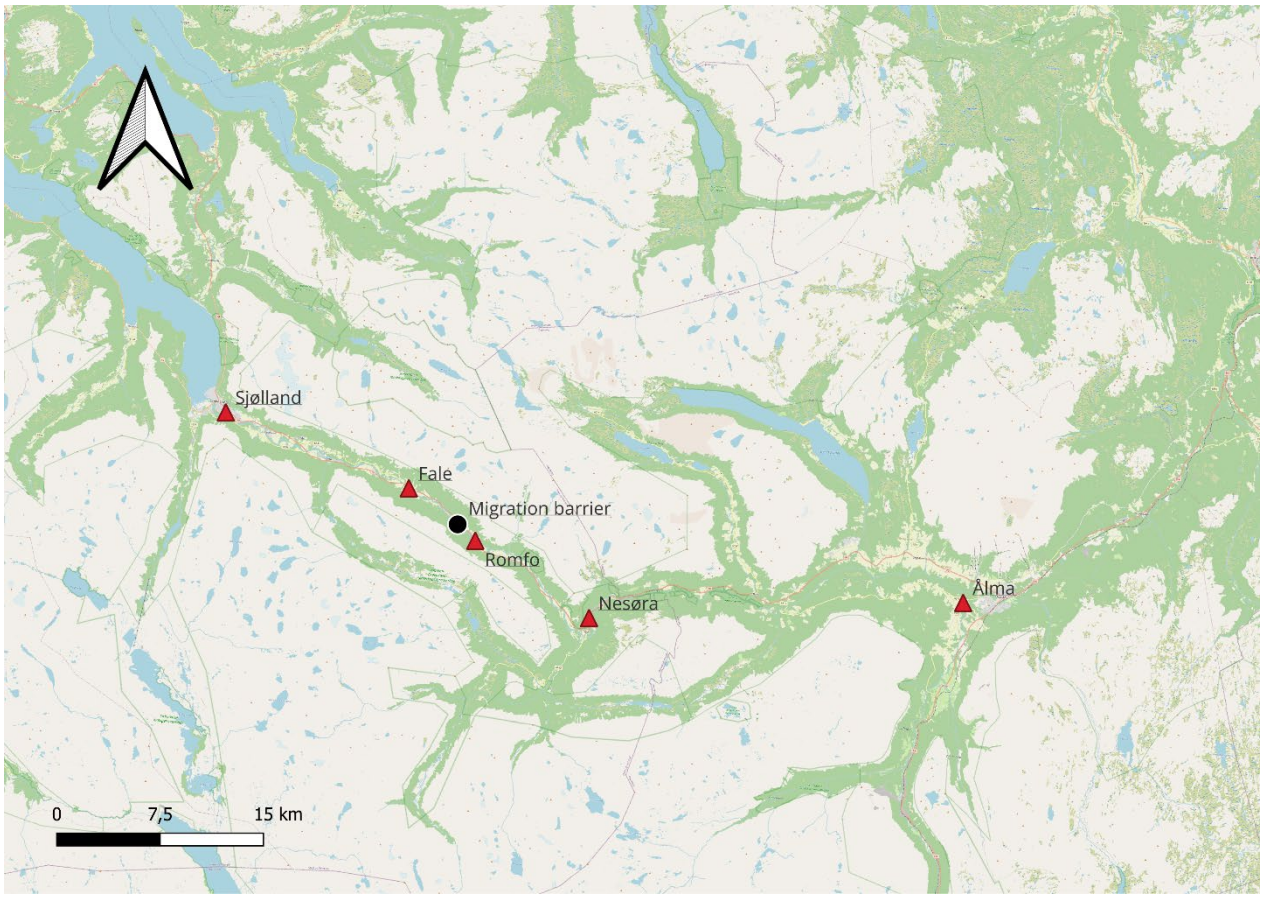


Figure 1. Map showing the localities for environmental DNA samples taken in Driva in 2025. Red diamonds = localities, black circle = migration barrier for fish.

DNA was isolated in the laboratory using a Nucleospin Plant II midi kit and Qiagen buffers according to Fossøy et al. [15]. The eDNA samples were analysed with qPCR assays designed to detect two parasite host pairs, i.e. *G. salaris* (Rusch et al., 2018) and Atlantic salmon (Matejusová et al., 2008) and trout (*Salmo trutta*) (Carim et al., 2016) and *G. derjavinoides* (Collins et al., 2010). *Gyrodactylus derjavinoides* is a species that is present on brown trout in Driva as well as in several other river systems in Norway, and in many rivers it also infects Atlantic salmon. The assays for trout and *G. derjavinoides* were included as positive controls for parasite and host amplification in the qPCR in all five samples, while the assay for Atlantic salmon was included both as positive control downstream of the migration barrier and for possible detection of stationary Atlantic salmon upstream of the barrier.

The qPCR analyses on the eDNA samples were run with three technical replicates. The Cq cut-off value was set to 40, and each sample were considered positive if two out of the three replicates had a Cq value below 40.

# Results and discussion

Altogether 498 specimens of Atlantic salmon from the rivers Driva (109.Z), Batnfjordselva (108.3Z), Litledalselva (109.5Z), Usma (109.4Z) and and Gylelva (109.7Z) in Møre og Romsdal county, were examined (see Table 1) and all these were identified as *G. derjavinoides* and not *G. salaris*.

In addition, environmental DNA monitoring was also carried out on samples from five locations in Driva. All of the samples were negative for *G. salaris* eDNA, while the samples from the two stations downstream the migration barrier was positive for Atlantic salmon eDNA (Table 2). All samples were positive for *G. derjavinoides* and trout (Table 2).

Table 1. Names of rivers and the number of fish examined for Gyrodactylus salaris in 2025.

| Water course (Water course code) | Sampling month | n fish | *G. salaris* |
|---|---|---|---|
| Driva (109.Z) | August | 177 | Ikke påvist |
| Batnfjordelva (108.3Z) | August | 103 | Ikke påvist |
| Litledalselva (109.5Z) | August | 4 | Ikke påvist |
| Driva (109.Z) | September/October | 132 | Ikke påvist |
| Batnfjordelva (108.3Z) | September | 74 | Ikke påvist |
| Usma (109.4Z) | September/October | 8 | Ikke påvist |
| | | 498 | |

Table 2: Environmental DNA results from Driva in 2025. Location in relation to migration barrier is listed in column three.

| River | Location | Migration barrier | eDNA positive samples | | | |
|---|---|---|---|---|---|---|
| | | | Atlantic salmon | *G. salaris* | Brown trout | *G. derjavinoides* |
| Driva | Nesøra | Upstream | 0 | 0 | 2 | 1 |
| Driva | Romfo | Upstream | 0 | 0 | 2 | 2 |
| Driva | Ålma Oppdal | Upstream | 0 | 0 | 2 | 2 |
| Driva | Fale | Downstream | 2 | 0 | 2 | 2 |
| Driva | Skjølland | Downstream | 2 | 0 | 2 | 2 |

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