



# The post-treatment surveillance programme for *Gyrodactylus salaris* in Norway 2023



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## Summary

In 2023, 153 salmon juveniles from Fustavassdraget (152.Z) in Nordland county, were examined in the post-treatment surveillance programme for *Gyrodactylus salaris* in Norway. In addition, fins from 519 Arctic char from the lakes Fustvatnet, Mjåvatnet and Ømmervatnet, sampled upstream the migration barrier for salmon in Fustavassdraget, were examined. *G. salaris* was not detected in any of the samples.

The examination of the fins of Arctic char from the three lakes in Fustavassdraget was the third and final year of the surveillance program for these lakes. Samples of Atlantic salmon from the river Fustavassdraget has been examined every year since 2014, and together these examinations of both Arctic char and Atlantic salmon completed the surveillance program for this watercourse. As all samples collected during the duration of the program tested negative, the infection region was declared free from infection with *G. salaris*. Thus, by 31.12.2023, *G. salaris* was confirmed eradicated from 42 rivers and from all hatcheries/fish farms in Norway.

At the beginning of the year 2023, *G. salaris* was confirmed present in two different infection regions including eight river systems; Driva infection region with the rivers Driva (109.Z), Batnfjordselva (108.3Z), Litledalselva (109.5Z) and Usma (109.4Z), and the Drammen infection region with the rivers Drammenselva (012.Z), Lierelva (011.Z), Vesleelva (013.Z) and Selvikvassdraget (013.1Z). In the rivers in the Driva infection region, eradication measures are in progress, while planning is ongoing for future eradication measures in the rivers in the Drammen infection region. *Gyrodactylus salaris* was in 2023 detected in two more rivers; Gylelva (watercourse code 109.7Z) in the Driva infection region and Ebbestadelva (watercourse code 012.2Z)<sup>1</sup> in the Drammen infection region. Both detections were done in connection with investigation of the infection status in watercourses in regions with known infection. At the end of 2023, *G. salaris* is thus present in ten Norwegian river systems.

For 2024, no watercourses are included in the post-treatment surveillance programme.

## Introduction

In the period from 1975 until the start of 2023, pathogenic strains of *Gyrodactylus salaris* have been detected on Atlantic salmon (*Salmo salar*) fingerlings/parr in 51 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 char (*Salvelinus alpinus*).

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<sup>1</sup> This detection was originally erroneously reported as Knemsbekken (water course code 012.22X2) due to a misunderstanding. While Ebbestadelva is the correct name of the river, the name Knemsbekken has also been used for the same river.

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, but one exception to this is the treatment of River Lærdalselva in 2011-2012, where acidified aluminium sulphate was used to eradicate the parasite (Hindar et al., 2015). Recently, full-scale treatment using chlorine as the main chemical has been carried out in river Driva, Møre og Romsdal county (Olstad et al., 2024). In contrast to rotenone treatment, treatment with aluminum sulfate and chlorine will kill the parasite, but not the host.

By the entrance to 2023, *G. salaris* was confirmed eradicated from 41 rivers and from all hatcheries/fish farms. At the end of 2022, the parasite was still confirmed present in eight Norwegian river systems belonging to two different infection regions; Driva infection region with the rivers Driva (109.Z), Batnfjordselva (108.3Z), Litledalselva (109.5Z) and Usma (109.4Z), and the Drammen infection region with the rivers Drammenselva (012.Z), Lierelva (011.Z), Vesleelva (013.Z) and Selvikvassdraget (013.1Z). Eradication measures are in progress in the rivers in the Driva infection region, while planning is ongoing for the rivers in the Drammen infection region.

*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](http://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 2023 only Fustavassdraget (152.Z) in Nordland county, were included in the post-treatment surveillance programme for *Gyrodactylus salaris* in Norway.

Wild Atlantic salmon juveniles are sampled along the whole anadromous part of the river. The programme recommends sampling of at least 10 salmon juveniles near the river outlet to the sea, and further 10 salmon at every second kilometre, all the way up to the migration barrier in the main river as well as in the tributaries. Thus, the total number of sampled fish is dependent of the length of the anadromous part of the river system. 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.

For the watercourse Fustavassdraget both fins of Arctic char, *Salvelinus alpinus*, from the lakes upstream of the migration barrier for salmon, and salmon from the river below the migration barrier are examined. The treatment of this watercourse in 2012 included the three lakes upstream of the migration barrier (Lakes Fustvatnet, Mjåvatnet and Ømmervatnet) as *G. salaris* was detected on Arctic char in these lakes (Hytterød et al, 2011). Arctic char is not the main host for *G. salaris* and the prevalence and intensity of infection is generally low on this host. Thus, to obtain a detection level of less than 0.5 % infected Arctic char in the lake, the programme recommends that a total of 500 fish are sampled and examined each year for a period of three years. Arctic char are sampled in fish traps or gill nets in different localities within the three lakes during the spawning season in the autumn and only fish larger than approximately 25 centimetres are collected (see Mo et al., 2023). The fish are killed and the fins are cut-off with a pair of scissors and then preserved 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, and the fins from Arctic char, 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 WOAHA reference laboratory for "Infection with *Gyrodactylus salaris*" and the methods used for species identification follow those given by the WOAHA Manual of Diagnostic Tests for Aquatic Animals:

[https://www.woaha.org/fileadmin/Home/eng/Health\\_standards/aahm/current/2.3.03\\_G\\_salaris.pdf](https://www.woaha.org/fileadmin/Home/eng/Health_standards/aahm/current/2.3.03_G_salaris.pdf)

## Results and discussion

Altogether, 153 salmon juveniles from Fustavassdraget were examined in 2023. In addition fins from 519 Arctic char from the lakes Fustvatnet, Mjåvatnet and Ømmervatnet in the Fustavassdraget watercourse were examined. *Gyrodactylus salaris* was not detected in any of the samples from these rivers or watercourses.

With the sampling carried out in 2023, Fustavassdraget (Nordland county), which is part of the Vefsna infection region, completed the final year in the surveillance program.

Altogether 1313 salmon juveniles have been examined in Fustavassdraget in this surveillance program over a ten years period from 2014-2023 (Figure 1). In addition, fins from a total of 1562 Arctic char were examined in the period 2021-2023 (Figure 2). As all samples collected and examined from the river and lakes during the duration of the program tested negative, the watercourse was declared free from infection with *G. salaris*.

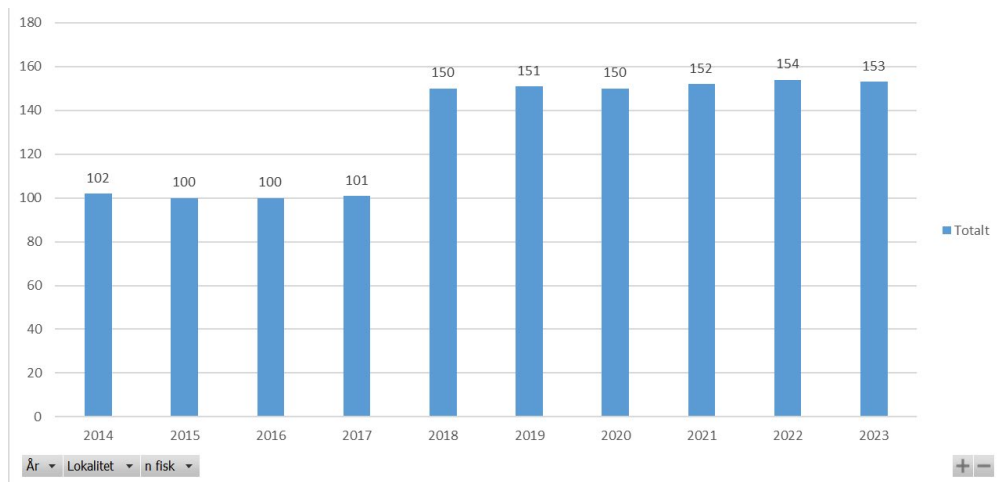


Figure 1. The number of juveniles of Atlantic salmon, *Salmo salar*, examined for the presence of *Gyrodactylus salaris* in the river Fustavassdraget (watercourse code 152.Z) during the period 2014 -2023.



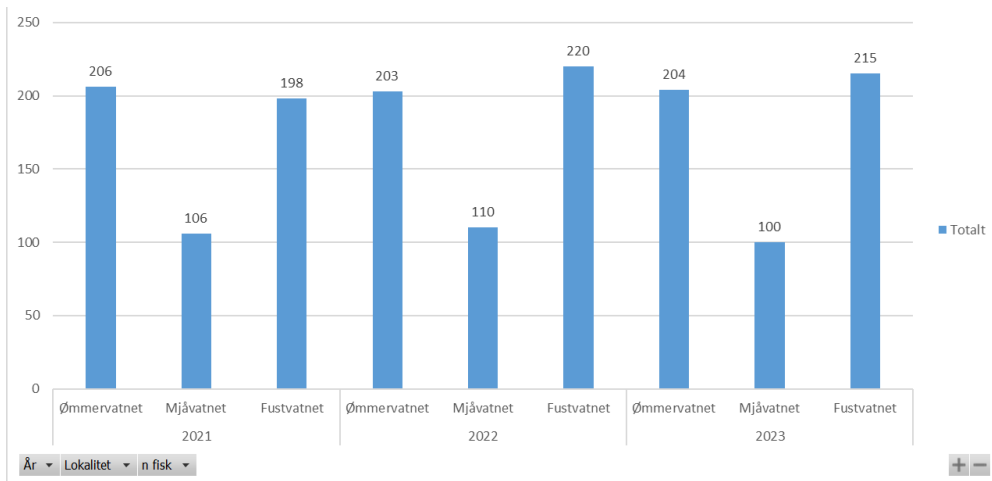


Figure 2. The number of Arctic char, *Salvelinus alpinus*, examined for the presence of *Gyrodactylus salaris* in the lakes Ømmervatnet, Mjåvatnet and Fustvatnet in the Fustvassdraget watercourse (watercourse code 152.Z) in the period 2021 -2023. Only fins were examined.

As *Gyrodactylus salaris* was detected in two more rivers in 2023; Gylelva (watercourse code 109.7Z) in the Driva infection region and Ebbestadelva (watercourse code 012.2Z) in the Drammen infection region, the status at the beginning of the year 2024 is that *G. salaris* is confirmed present in ten Norwegian river systems. No watercourses are included in the post-treatment surveillance programme for 2024.

## Acknowledgements

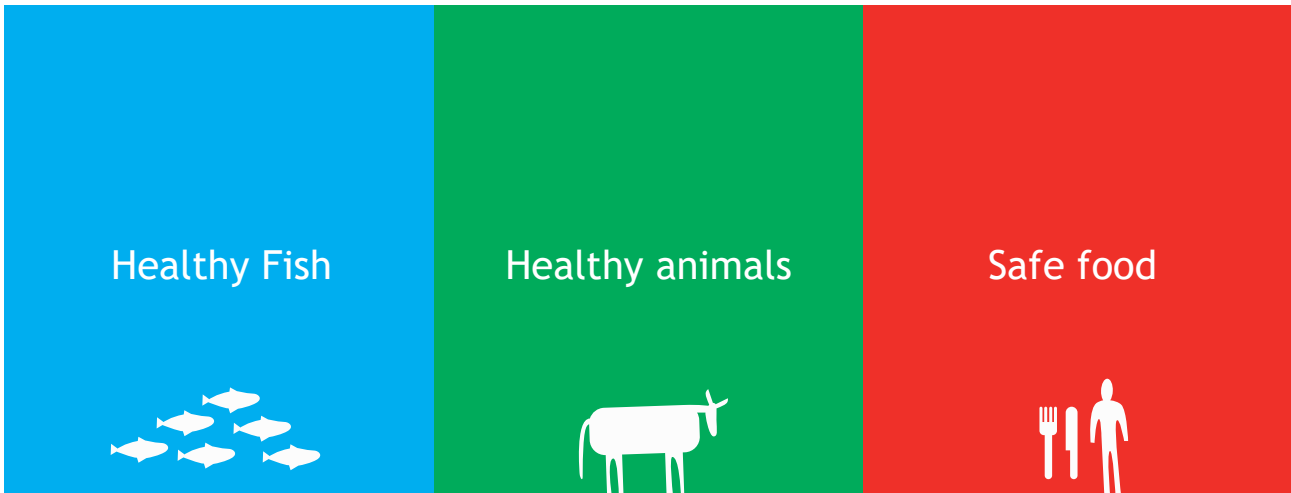
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