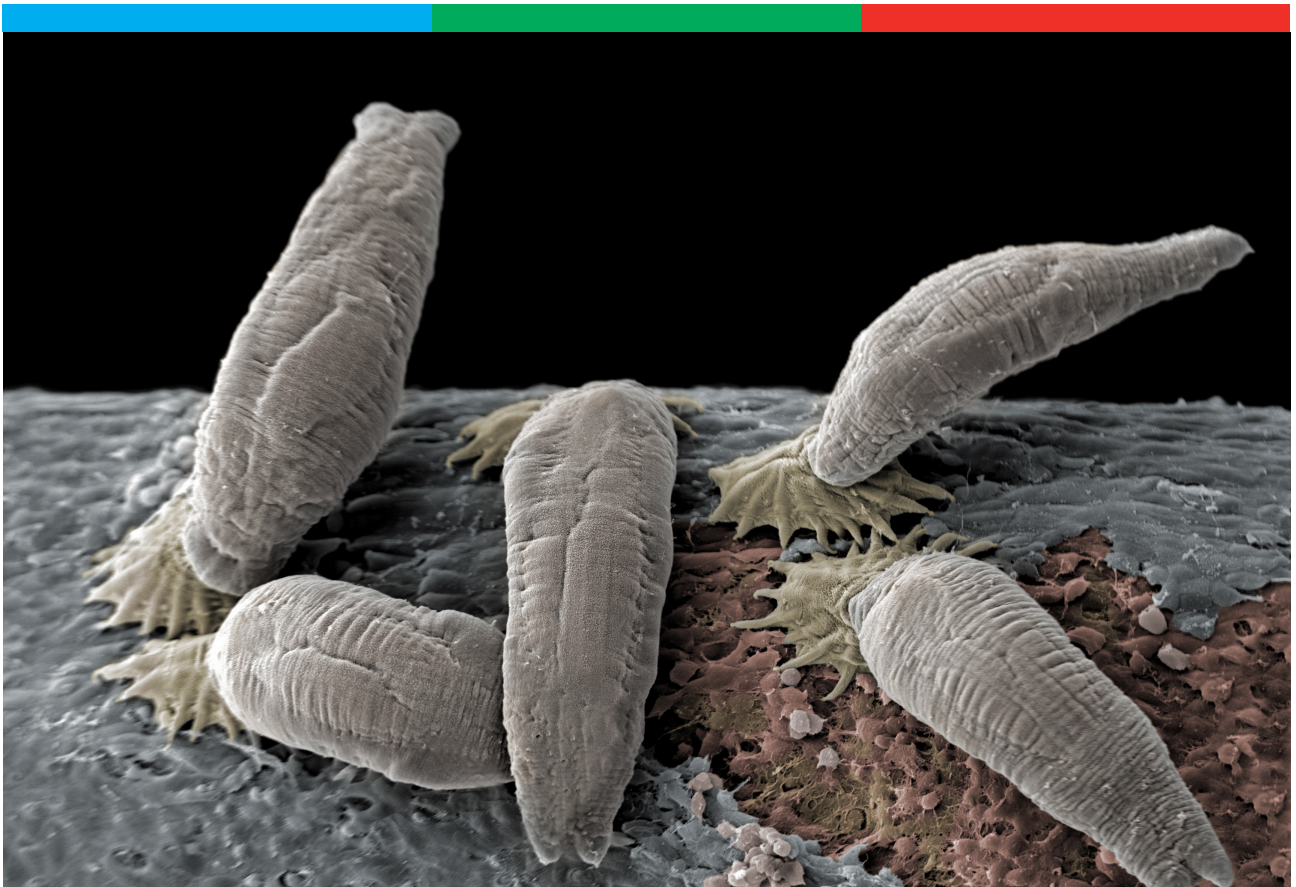




The surveillance programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway 2021



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The surveillance programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway 2021

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Summary

Altogether, 2412 specimens of Atlantic salmon from 72 rivers and 3010 specimens of Atlantic salmon and rainbow trout from 89 farms were examined in the surveillance program for *Gyrodactylus salaris* in 2021. *Gyrodactylus salaris* was not detected in any of the examined samples.

The status at the beginning of the year 2022 is that *G. salaris* is still confirmed present in eight Norwegian river systems.

Introduction

During the period 1975 - 2021, 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*). The latest detection was in 2019, in River Selvikvassdraget, in Vestfold and Telemark County, where *G. salaris* parasites were found on salmon analysed as part of the surveillance program

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 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.

By 31.12.2021, *G. salaris* was confirmed eradicated from 39 rivers and from all hatcheries/fish farms. In additional four rivers, eradication measures have been completed, but eradication has not yet been confirmed. Thus, at the end of 2021, the parasite is still confirmed present in eight Norwegian river systems: Drammenselva and Lierelva in county Viken, Vesleelva (Sandeelva) and Selvikvassdraget in county Vestfold og Telemark, and Batnfjordselva, Driva, Litledalselva and Usma in county Møre og Romsdal.

Gyrodactylus salaris is a nationally listed (List 3) notifiable disease in Norway and it is listed under "Fish diseases" by the World Organisation for Animal Health (OIE). Surveillance of *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 NVI website (www.vetinst.no).

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

Aims

The surveillance programme aims to document freedom of *G. salaris* in Norwegian farms and rivers, and to detect and trace any spread of the parasite to new river systems or fish farms.

Materials and methods

The selection of rivers for inclusion in the surveillance programme follow specified criteria which takes into account the risk of infection with *G. salaris* (see text box 1). In general, a total of 30 wild Atlantic salmon juveniles are sampled from each selected river, preferably from three different sites located far apart. For the River Rana (Nordland county), where the source of the new infection detected in 2014 is unknown, two samples of 30 fish are taken to increase the sensitivity of the surveillance. In Tana (Troms and Finnmark county), 150 salmon are sampled from 15 sites due to the large size of this watercourse. Fingerlings/parr/smolts 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.

In farms and hatcheries, either 30 Atlantic salmon or 60 rainbow trout are sampled by seine net. The fish are killed and all fins (except the adipose fin) are cut off and preserved in 96% ethanol. Each farm/hatchery is examined every second year.

All samples are sent to the NVI for examination under a stereo microscope at 10 - 15 times magnification. For wild Atlantic salmon, the whole surface of the fish, including the skin, head, fins and gills, is examined, while only the fins from farmed fish are examined.

When *Gyrodactylus* specimens are detected, species determination is performed by NVI. NVI is the OIE reference laboratory for "Infection with *Gyrodactylus salaris*" and the methods used for species identification follow those given by the OIE Manual of Diagnostic Tests for Aquatic Animals:

https://www.oie.int/fileadmin/Home/eng/Health_standards/aahm/current/2.3.03_G_salaris.pdf

Criteria for inclusion of rivers in the surveillance program for *Gyrodactylus salaris* in short*.

- 1. Rivers declared free from infection after treatment.** This criteria states that when a watercourse is declared free from infection with *G. salaris*, it should be included in the surveillance program for a minimum of five (5) years. After five years, a watercourse can be excluded from the surveillance program unless it fulfils other risk factors for their continued inclusion (see below).
- 2. Large salmon rivers in terms of spawning targets.** This criteria states that the 30 largest salmon rivers in terms of spawning targets should be included in the surveillance program.
- 3. Rivers with a high risk of inter-river dispersal of *G. salaris*.** This criteria states that rivers with a high risk of being infected via inter-river (brackish-water) dispersal of *G. salaris* should be included in the surveillance program. Due to the decreasing numbers of infected rivers in Norway, the number of rivers included based on fulfilment of this criteria has decreased, and will continue to decrease, when further rivers are declared free from infection.
- 4. Rivers with other risk of infection:** this criteria overlaps somewhat with criteria 3, but the main focus is on the threat from areas bordering other countries.
- 5. Geographic coverage:** This criteria states that a minimum of two (2) rivers from each county where salmon rivers are present should be included in the surveillance program.

*For further details please consult the following document: Reply from the Norwegian Veterinary Institute (NVI) to the Norwegian Food Safety Authority (NFSA) 5th February 2020: FSA reference number 2020/173134, alt. NVI reference number 20/12419.

Results and discussion

Altogether, 2412 specimens of Atlantic salmon from 72 rivers and 3010 specimens of Atlantic salmon and rainbow trout from 89 farms were examined in 2021 (Table 1). *Gyrodactylus salaris* was not detected in any of the examined samples. Thus, the status at the end of the year 2021 is that the number of Norwegian river systems with a confirmed presence of *G. salaris* is eight, the same as for the previous year.

Table 1: Number of rivers, farms and fish examined for *Gyrodactylus salaris* in 2021.

County	Rivers				Farms			
	n rivers	species*	n examined	Positive	n farms	species*	n examined	Positive
Viken	6	AS	195	0	7	AS/RT	366	0
Oslo	3	AS	102	0	-	-	-	-
Vestfold og Telemark	2	AS	61	0	2	AS	62	0
Agder	4	AS	140	0	1	-	-	-
Rogaland	3	AS	106	0	3	AS	121	0
Vestland	6	AS	197	0	29	AS/RT	1042	0
Møre og Romsdal	8	AS	238	0	12	AS/RT	391	0
Trøndelag	10	AS	308	0	15	AS	452	0
Nordland	17	AS	536	0	19	AS	546	0
Troms og Finnmark	13	AS	529	0	1	AS	30	0
Total	72		2412		89		3010	

* AS = Atlantic salmon, RT = rainbow trout

Acknowledgements

The authors would like to thank Vidar Ahlsen Brevig and Dag Grønningen for excellent support with the logistics.

References

1. Anon (2014). Handlingsplan mot lakseparasitten *Gyrodactylus salaris* for perioden 2014-2016. Miljødirektoratet 2014. 114 s.

Appendix A

Watercourses examined for *Gyrodactylus salaris* in 2021 sorted by watercourse code. Detected, ND = Not detected.

County	Watercourse	Watercourse code	No. of Atlantic salmon examined	<i>G. salaris</i>
Viken	Enningdalselva	001.1Z	33	ND
Viken	Glomma	002.Z	33	ND
Viken	Hølenelva	004.Z	33	ND
Oslo	Gjersjøelva	005.4Z	36	ND
Oslo	Nordmarksvassdraget (Akerselva)	006.Z	32	ND
Oslo	Lysakerelva	007.Z	34	ND
Viken	Sandvikselva	008.Z	33	ND
Viken	Askerelva	009.1Z	32	ND
Viken	Åroselva	009.Z	31	ND
Vestfold og Telemark	Aulielva	014.Z	33	ND
Vestfold og Telemark	Numedalslågen	015.Z	28	ND
Agder	Tovdalselva	020.Z	32	ND
Agder	Otra	021.Z	36	ND
Agder	Mandalselva	022.Z	37	ND
Agder	Lygna	024.Z	35	ND
Rogaland	Bjerkreimvassdraget	027.Z	37	ND
Rogaland	Figgjo	028.Z	35	ND
Rogaland	Suldalslågen	036.Z	34	ND
Vestland	Vosso	062.Z	30	ND
Vestland	Lærdalselva	073.Z	33	ND
Vestland	Gaularvassdraget	083.Z	34	ND
Vestland	Nausta	084.7Z	32	ND
Vestland	Loen	088.2Z	35	ND
Vestland	Strynseelva	088.Z	33	ND
Møre og Romsdal	Måna	103.1Z	30	ND
Møre og Romsdal	Innfjordelva	103.2Z	30	ND
Møre og Romsdal	Breidvikelva	103.42Z	30	ND
Møre og Romsdal	Isa - Glutra	103.4Z	30	ND
Møre og Romsdal	Skorga	103.5Z	29	ND
Møre og Romsdal	Istra	103.A1Z	29	ND
Møre og Romsdal	Rauma	103.Z	30	ND
Møre og Romsdal	Surna	112.Z	30	ND
Trøndelag	Orkla	121.Z	32	ND
Trøndelag	Gaula	122.Z	30	ND

Trøndelag	Nidelva	123.Z	30	ND
Trøndelag	Stjørdalselva	124.Z	31	ND
Trøndelag	Verdalselva	127.Z	31	ND
Trøndelag	Figga	128.3Z	30	ND
Trøndelag	Steinkjervassdraget	128.Z	32	ND
Trøndelag	Stordalselva	135.Z	31	ND
Trøndelag	Årgårdsvassdraget	138.Z	30	ND
Trøndelag	Namsen	139.Z	31	ND
Nordland	Hestdalselva	149.61Z	30	ND
Nordland	Halsanelva	149.6Z	30	ND
Nordland	Hundåla	151.1Z	30	ND
Nordland	Vefsna	151.Z	30	ND
Nordland	Drevja	152.2Z	30	ND
Nordland	Dagsvikelva	153.11Z	25	ND
Nordland	Nylandselva	153.1Z	30	ND
Nordland	Leirelva	153.22Z	30	ND
Nordland	Stillelva / Ranelva	153.3Z	30	ND
Nordland	Bardalselva	153.6Z	30	ND
Nordland	Sannaelva	155.2Z	30	ND
Nordland	Bjerka	155.4Z	30	ND
Nordland	Røssåga	155.Z	30	ND
Nordland	Slettenelva	156.4Z	30	ND
Nordland	Ranavassdraget	156.Z	61*	ND
Nordland	Beiarelva	161.Z	30	ND
Nordland	Saltdalselva	163.Z	30	ND
Troms og Finnmark	Målselva	196.Z	30	ND
Troms og Finnmark	Nordkjøselva	198.Z	30	ND
Troms og Finnmark	Manndalselva	206.1Z	30	ND
Troms og Finnmark	Reisaelva	208.Z	33	ND
Troms og Finnmark	Altavassdraget	212.Z	30	ND
Troms og Finnmark	Repparfjorden	213.Z	32	ND
Troms og Finnmark	Stabburselva	223.Z	30	ND
Troms og Finnmark	Lakselvassdraget	224.Z	29	ND
Troms og Finnmark	Børselva	225.Z	31	ND
Troms og Finnmark	Tanaelva	234.Z	158	ND
Troms og Finnmark	Komagelva	239.Z	29	ND
Troms og Finnmark	Vestre Jakobselv	240.Z	31	ND
Troms og Finnmark	Neiden	244.Z	36	ND

* In addition 10 Atlantic salmon and 17 arctic char were sampled in Ytterbekken, a small stream draining into the same estuary as Ranavassdraget and with a previous history of infection

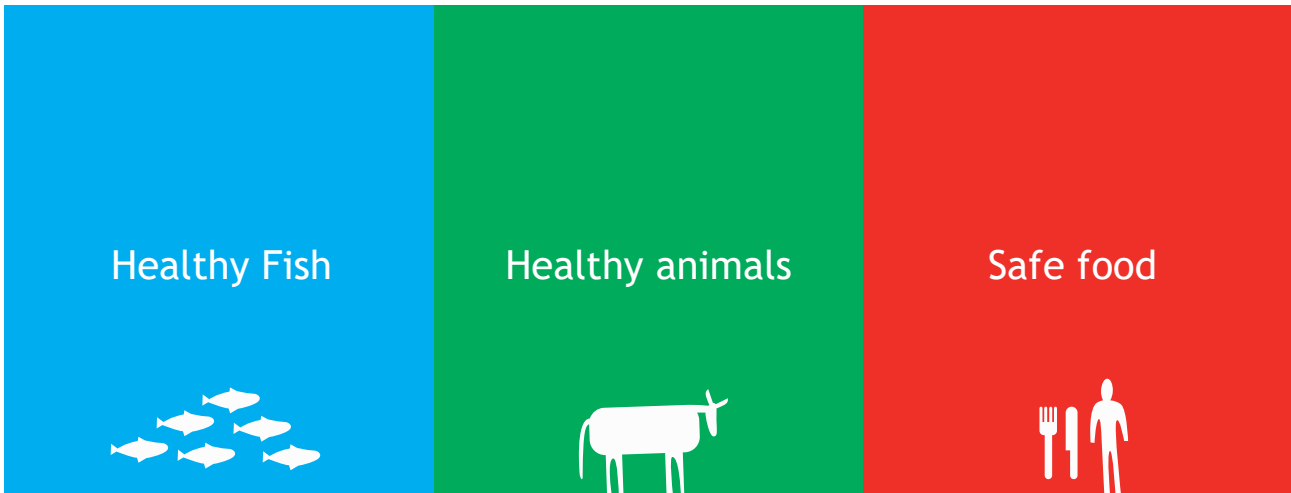
Appendix B

Farms and hatcheries examined for *Gyrodactylus salaris* in 2021 grouped by county from south to north. AS= Atlantic salmon, RT= Rainbow trout, ND = Not detected, NA = Not Available

County	Farm/hatchery	Hatchery code	Fish species	No. of AS/RT examined	<i>G. salaris</i>
Innlandet	Noraker Gård	10364	RT	60	ND
Innlandet	Trøsvik Gård	12341	RT	57	ND
Innlandet	Lofoss Mølle	12342	RT	45	ND
Innlandet	Haadem fisk	12517	RT	60	ND
Innlandet	Hande rakfisk	13716	RT	59	ND
Innlandet	Røn Gard	13881	RT	55	ND
Viken	Hamang klekkeri	NA	AS	30	ND
Vestfold og Telemark	Kjølebrønn	12961	AS	31	ND
Vestfold og Telemark	Telemark Settefisk AS	NA	AS	31	ND
Agder	Fjellsæ I	10581	AS	30	ND
Rogaland	Fister	10123	AS	31	ND
Rogaland	Lerangsvågen-land 2	11927	AS	30	ND
Rogaland	Årdal, RHM0702	45033	AS	30	ND
Vestland	Kvernavika	10287	RT	60	ND
Vestland	Sævareid	10141	AS	30	ND
Vestland	Strømsnes	11648	AS	30	ND
Vestland	Skogseidvatnet	12042	AS	30	ND
Vestland	Ljonesvågen	12079	AS	30	ND
Vestland	Femangervågen	12112	AS	30	ND
Vestland	Bjølvefossen	12172	AS	30	ND
Vestland	Herand	13157	AS	30	ND
Vestland	Kvernhusvika	13327	AS	32	ND
Vestland	Industrilab, HIB	11555	AS	30	ND
Vestland	Marineholmen Forskningspark	36577	AS	30	ND
Vestland	Sande	10170	AS	30	ND
Vestland	Gjøllanger	11795	AS	31	ND
Vestland	Hermansverk	12165	RT	64	ND
Vestland	Arnafjord Settefisk	12173	RT	66	ND
Vestland	Ljøsne Klekkeri	12343	AS	31	ND
Vestland	Barlindbotten	13843	AS	33	ND
Vestland	Midtneset	18336	RT	61	ND
Vestland	Suldal	NA	AS	33	ND

Vestland	Kjærelva	11493	AS	30	ND
Vestland	Skålevik	11540	AS	30	ND
Vestland	Gjeravågen	11589	AS	30	ND
Vestland	Eidesvik	11606	AS	30	ND
Vestland	Vågafossen	11892	AS	31	ND
Vestland	Øyerhamn	12032	AS	30	ND
Vestland	Fjæra	12073	AS	30	ND
Vestland	Brakedal	13149	AS	30	ND
Vestland	Flatråker	13826	RT	60	ND
Vestland	Sagvåg	28216	AS	30	ND
Møre og Romsdal	Kjørsvikbugen	12415	AS	30	ND
Møre og Romsdal	Aunvågen	10221	AS	30	ND
Møre og Romsdal	Haukvik genbank for villaks	NA	AS	30	ND
Møre og Romsdal	Sætre	13671	AS	30	ND
Møre og Romsdal	Hjelvik	13672	AS	30	ND
Møre og Romsdal	Herje Genbank		AS	30	ND
Møre og Romsdal	Steinsvik	12222	AS	31	ND
Møre og Romsdal	Videild	12223	AS	30	ND
Møre og Romsdal	Dale	12217	AS	30	ND
Møre og Romsdal	Urke	12269	AS	30	ND
Møre og Romsdal	Flø	12315	AS	30	ND
Møre og Romsdal	Moltustranda	12325	RT	60	ND
Trøndelag	Bessaker	12596	AS	30	ND
Trøndelag	Olden	12745	AS	32	ND
Trøndelag	Follafoss	13958	AS	30	ND
Trøndelag	Sunnskjør	23735	AS	30	ND
Trøndelag	Årvika	10406	AS	30	ND
Trøndelag	Røyklibotn	10412	AS	31	ND
Trøndelag	Survik	12672	AS	30	ND
Trøndelag	Kvernkvatnet	12686	AS	30	ND
Trøndelag	Skorstad	13739	AS	30	ND
Trøndelag	Lennavika	13742	AS	29	ND
Trøndelag	Lonet I Naustbukta	12719	AS	30	ND
Trøndelag	Moldtua	12737	AS	30	ND
Trøndelag	Nernesset	13178	AS	30	ND

Trøndelag	Lensvik	13179	AS	30	ND
Trøndelag	Belsvik	13964	AS	30	ND
Nordland	Mo Industripark	11064	AS	30	ND
Nordland	Statkraft Genbank Bjerka	NA	AS	32	ND
Nordland	Nyksund	13940	AS	34	ND
Nordland	Steppan	11263	AS	30	ND
Nordland	Dyping	13191	AS	30	ND
Nordland	Mastermovika	15315	AS	28	ND
Nordland	Forsan	33217	AS	31	ND
Nordland	Breivika	13811	AS	30	ND
Nordland	Glomfjord 2	24016	AS	30	ND
Nordland	Reppen	34097	AS	30	ND
Nordland	Vinterneset	39737	AS	30	ND
Nordland	Sandøra	36477	AS	30	ND
Nordland	Skardalen	13192	AS	30	ND
Nordland	Sørfjorden	13946	AS	30	ND
Nordland	Salangsverket	36357	AS	30	ND
Nordland	Brenna	11180	AS	30	ND
Nordland	Framnes	10496	AS	31	ND
Nordland	Hellaren	11335	AS	30	ND
Troms and Finnmark	Adamselv	10665	AS	30	ND



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