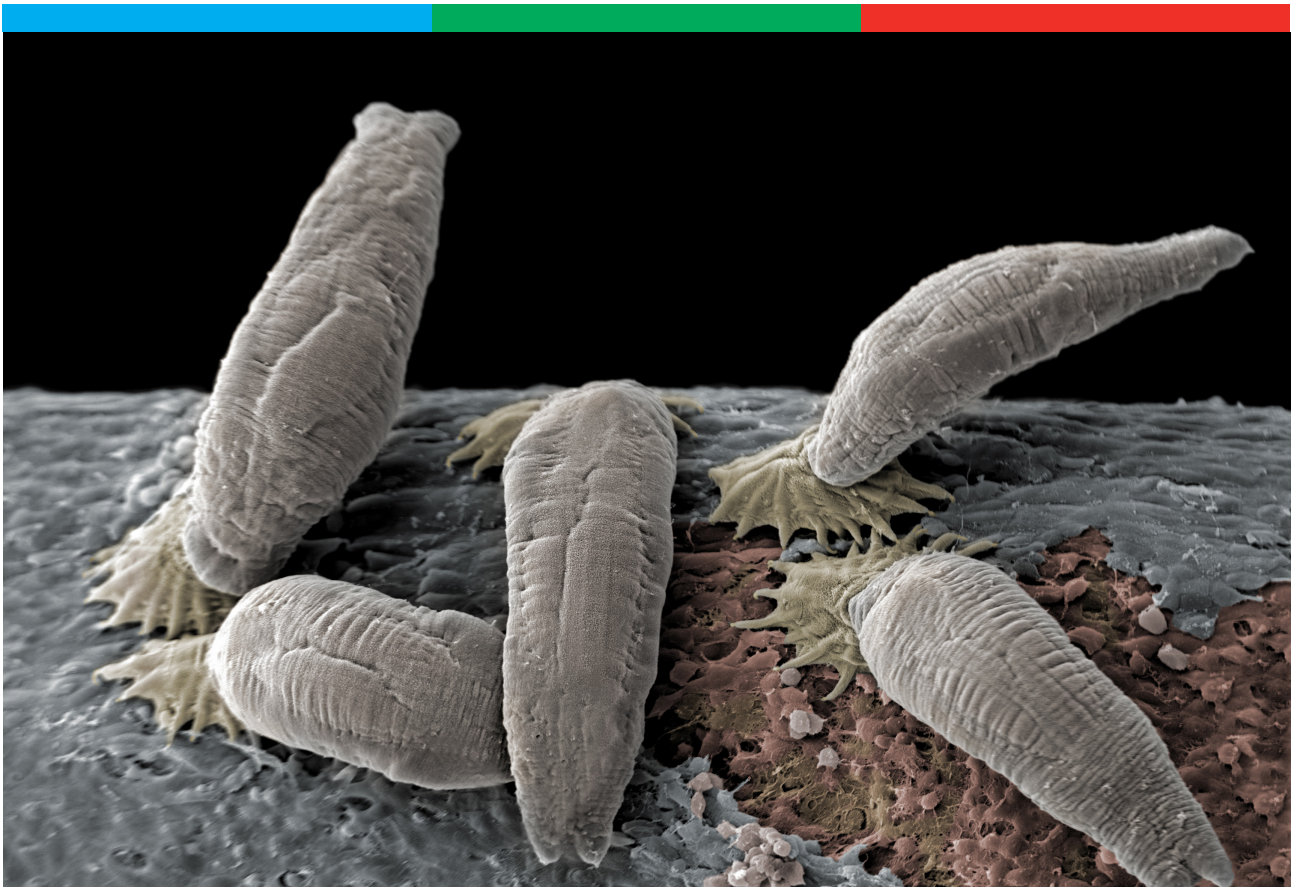




The surveillance programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway 2022



REPORT 20/2023

The surveillance programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway 2022

Authors

Haakon Hansen, Gunn Jorid Fornes, Saima Nasrin Mohammad, Jonas Havn Børresen, Marit Måsøy Amundsen and Hilde Irene Welde

Suggested citation

Hansen, H., Fornes, G. J., Mohammad, S. N., Børresen, J. H., Amundsen, M. M. and Welde, H. I. The surveillance programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway 2022. Surveillance program report 20. Veterinærinstituttet 2023. © Norwegian Veterinary Institute, copy permitted with citation

Quality controlled by

Edgar Brun, Director of Aquatic Animal Health and Welfare, Norwegian Veterinary Institute

Published

2023 on www.vetinst.no
ISSN 1890-3290 (electronic edition)
© Norwegian Veterinary Institute 2023

Commissioned by

Norwegian Food Safety Authority



Colophon

Cover design: Reine Linjer
Cover photo: J. Wiik-Nielsen
www.vetinst.no

Content

Summary.....	3
Introduction.....	3
Aims	4
Materials and methods.....	4
Results and discussion	6
Acknowledgements	6
References	7
Appendix A.....	7
Appendix B	10

Summary

Altogether, 2273 specimens of Atlantic salmon from 71 rivers and 3216 specimens of Atlantic salmon and rainbow trout from 90 hatcheries/farms were examined in the surveillance program for *Gyrodactylus salaris* in 2022. *Gyrodactylus salaris* was not detected in any of the examined samples.

The status as of 31.12.22 is that *G. salaris* is confirmed present in eight Norwegian river systems.

Introduction

During the period 1975 - 2022, 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* was 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. Recently, testing and full-scale treatment using chlorine as the main chemical has been carried out in river Driva, Møre og Romsdal county.

By the entrance to 2022, *G. salaris* was confirmed eradicated from 39 rivers and from all hatcheries/fish farms. An additional four river systems were in the post-treatment surveillance program awaiting confirmation of eradication (Hansen et al., 2022). At the end of 2021, the parasite was still confirmed present in eight Norwegian river systems: Drammenselva (012.Z) and Lierelva (011.Z) in county Viken, Vesleelva (Sandeelva)(013.Z) and Selvikvassdraget (013.1Z) in county Vestfold og Telemark, and Batnfjordselva (108.3Z), Driva (109.Z), Litledalselva (109.5Z) and Usma (109.4Z) in county Møre og Romsdal.

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 of 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. To increase the sensitivity of the surveillance for the River Rana (Nordland county), where the source of the infection detected in 2014 remains unknown, an additional sample of 30 fish is taken one month after the first sample. 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 WOA reference laboratory for "Infection with *Gyrodactylus salaris*" and the methods used for species identification follow those given by the WOA Manual of Diagnostic Tests for Aquatic Animals:

https://www.woah.org/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, 2273 specimens of Atlantic salmon from 71 rivers and 3216 specimens of Atlantic salmon and rainbow trout from 90 farms were examined in 2022 (Table 1). *Gyrodactylus salaris* was not detected in any of the examined samples. In 2022, the Skibotn infection region, consisting of the rivers Skibotnvassdraget (205.Z), Signaldalelva (204.Z), and Kitdalselva (204.8Z), was declared free from infection with *G. salaris*.

The status at the end of the year 2022 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 2022.

County	Rivers				Farms/hatcheries			
	n rivers	species *	n examined	positive	n farms	species *	n examined	positive
Innlandet	-	-	-	-	6	RT	360	0
Viken	6	AS	153	0	1	AS	30	0
Oslo	3	AS	91	0	-	-	-	-
Vestfold og Telemark	2	AS	60	0	2	AS	61	0
Agder	5	AS	150	0	-	-	-	-
Rogaland	3	AS	90	0	6	AS	179	0
Vestland	7	AS	174	0	29	AS/RT	1117	0
Møre og Romsdal	7	AS	211	0	12	AS/RT	402	0
Trøndelag	10	AS	310	0	13	AS/RT	426	0
Nordland	15	AS	487	0	15	AS	458	0
Troms og Finnmark	13	AS	547	0	6	AS	183	0
Total	71		2273		90		3216	

* 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. Moreover, the authors would like to thank all personnel from the Norwegian Food Safety Authority for collection and submission of samples from the farms/hatcheries.

References

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

Hansen, H., Mohammad, Saima Nasrin, Welde, Hilde Irene og Amundsen, Marit Måsøy. The post-treatment surveillance programme for *Gyrodactylus salaris* in Norway 2021. Surveillance program report. Veterinærinstituttet 2022. © Norwegian Veterinary Institute.

Appendix A

Watercourses examined for *Gyrodactylus salaris* in 2022 sorted by watercourse code. Detected, ND = Not detected.

County	Watercourse	Watercourse code	No of Atlantic salmon examined	<i>G. salaris</i>
Viken	Enningdalselva	001.IZ	30	ND
Viken	Glommavassdraget	002.Z	3	ND
Viken	Hølenelva	004.Z	30	ND
Oslo	Gjersøelva	005.42	30	ND
Oslo	Nordmarkvassdraget	006.Z	30	ND
Oslo	Lysakerelva	007.Z	31	ND
Viken	Sandvikselva	008.Z	30	ND
Viken	Askerelva	009.IZ	30	ND
Viken	Årosvassdraget	009.Z	30	ND
Vestfold og Telemark	Aulielva	014.Z	30	ND
Vestfold og Telemark	Numedalslågen	015.Z	30	ND
Agder	Arendalsvassdraget	019.Z	30	ND
Agder	Tovdalsvassdraget	020.Z	30	ND
Agder	Otra	021.Z	30	ND
Agder	Mandalselva	022.Z	30	ND
Agder	Lygna	024.Z	30	ND
Rogaland	Bjerkreimvassdraget	027.Z	30	ND
Rogaland	Figgjo	028.Z	30	ND
Rogaland	Suldalsvassdraget	036.Z	30	ND
Vestland	Vossovassdraget	062.Z	30	ND
Vestland	Lærdalsvassdraget	073.Z	31	ND
Vestland	Sogndalselvi	077.3Z	23	ND

Vestland	Gaularvassdraget	083.Z	23	ND
Vestland	Nausta	084.7Z	30	ND
Vestland	Jølstra	084.Z	7	ND
Vestland	Strynevassdraget	088.Z	30	ND
Møre- og Romsdal	Måna	103.1Z	30	ND
Møre- og Romsdal	Innfjordselva	103.2Z	31	ND
Møre- og Romsdal	Breidvikelva	103.42Z	30	ND
Møre- og Romsdal	Isa/Glutra	103.4Z	30	ND
Møre- og Romsdal	Skorgeelva	103.5Z	30	ND
Møre- og Romsdal	Rauma	103.Z	30	ND
Møre- og Romsdal	Surna	112.Z	30	ND
Trøndelag	Orkla	121.Z	30	ND
Trøndelag	Gaula	122.Z	30	ND
Trøndelag	Nidelvvassdraget	123.Z	30	ND
Trøndelag	Stjørdalselva	124.Z	31	ND
Trøndelag	Verdalselva	127.Z	33	ND
Trøndelag	Figga	128.3Z	31	ND
Trøndelag	Ogna	128.AZ	32	ND
Trøndelag	Stordalselva	135.Z	30	ND
Trøndelag	Årgårdsvassdraget	138.Z	31	ND
Trøndelag	Namsen	139.Z	32	ND
Nordland	Hestdalselva	149.61Z	30	ND
Nordland	Halsaelva	149.6Z	30	ND
Nordland	Hundåla	151.1Z	30	ND
Nordland	Vefsna	151.Z	30	ND
Nordland	Drevja	152.2Z	30	ND
Nordland	Dagvikselva	153.11Z	17	ND
Nordland	Nylandselva	153.1Z	30	ND
Nordland	Leirelva	153.22Z	30	ND
Nordland	Stillelva	153.3Z	30	ND
Nordland	Sannaelva	155.2Z	30	ND
Nordland	Bjerka	155.4Z	30	ND
Nordland	Røssåga	155.Z	30	ND
Nordland	Sletterelva	156.4Z	30	ND
Nordland	Ranavassdraget*	156.Z	80	ND
Nordland	Saltdalsvassdraget	163.Z	30	ND
Troms og Finnmark	Målselvassdraget	196.Z	31	ND
Troms og Finnmark	Nordkjoselva	198.Z	34	ND
Troms og Finnmark	Manndalselva	206.1Z	34	ND

Troms og Finnmark	Reisavassdraget	208.Z	33	ND
Troms og Finnmark	Altavassdraget	212.Z	33	ND
Troms og Finnmark	Repparfjordvassdraget	213.Z	31	ND
Troms og Finnmark	Stabburselva	223.Z	38	ND
Troms og Finnmark	Lakselvassdraget	224.Z	31	ND
Troms og Finnmark	Børselvassdraget	225.Z	32	ND
Troms og Finnmark	Tana	234.Z	157	ND
Troms og Finnmark	Komagelva	239.Z	31	ND
Troms og Finnmark	Vestre Jakobselv	240.Z	32	ND
Troms og Finnmark	Neidenvassdraget	244.Z	30	ND

* The number of fish from Ranavassdraget includes 20 fish sampled from Ytterbekken, a small stream draining into the same estuary as Ranavassdraget and with a previous history of infection

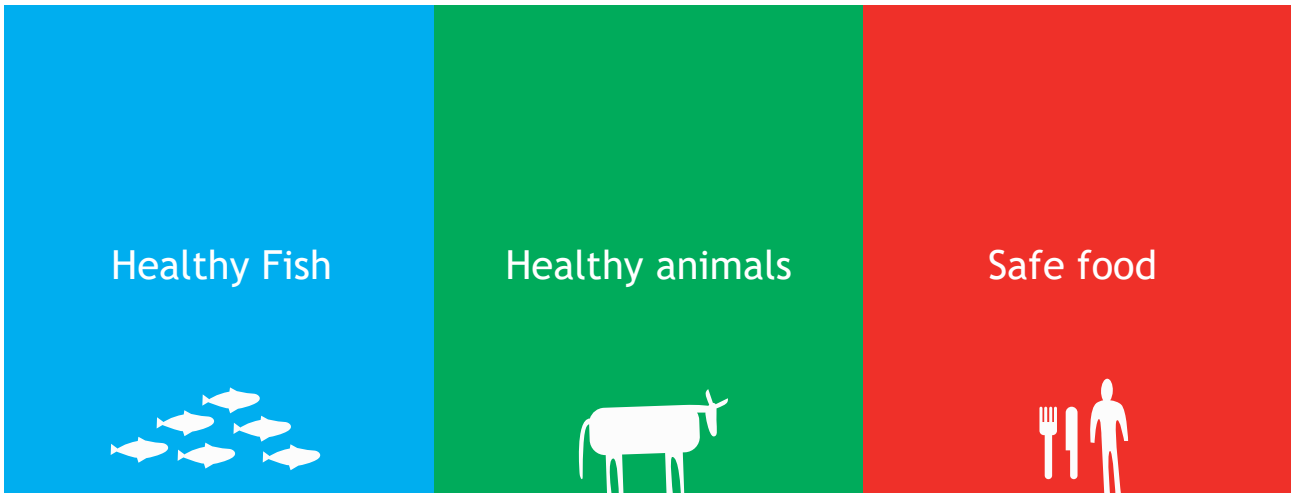
Appendix B

Farms and hatcheries examined for *Gyrodactylus salaris* in 2022 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	60	ND
Innlandet	Lofoss Mølle	12342	RT	60	ND
Innlandet	Haadem fisk	12517	RT	60	ND
Innlandet	Hande rakfisk	13716	RT	60	ND
Innlandet	Røn Gard	13881	RT	60	ND
Viken	(Nedre) Glomma kultiveringsanlegg	NA	AS	30	ND
Vestfold og Telemark	Fossing storsmolt	38917	AS/BT	31	ND
Vestfold og Telemark	Telemark Settefisk AS	NA	AS	30	ND
Rogaland	Dirdal	10131	AS	30	ND
Rogaland	Eiane	11894	AS	30	ND
Rogaland	Hognaland	12964	AS	30	ND
Rogaland	IMS II	11954	AS	29	ND
Rogaland	Klybbatårnet SSØ	13819	AS	30	ND
Rogaland	Trovåg	13637	AS	30	ND
Vestland	Alvøen	11579	AS/RT	63	ND
Vestland	Bjørsvik	13653	RT	60	ND
Vestland	Botnane	13152	RT	59	ND
Vestland	Dale klekkeri/Dalekvam	NA	AS	30	ND
Vestland	Drageide	12103	AS	30	ND
Vestland	Eidestø	12041	AS	30	ND
Vestland	Fjon	10060	AS/RT	30	ND
Vestland	Haukå	13486	AS	37	ND
Vestland	Ilsvåg	12116	AS	59	ND
Vestland	Kvinge S	13482	AS	35	ND
Vestland	Lianeset	11745	AS	32	ND
Vestland	Lønningdal III	14556	AS	30	ND
Vestland	Matredal	10156	AS	30	ND
Vestland	Nesfossen	11682	AS	30	ND
Vestland	Norddal	13713	RT	63	ND
Vestland	Nye Årøy Klekkeri	13667	AS	31	ND
Vestland	Ospenes	12096	AS	30	ND
Vestland	Rylandsvåg	10076	AS	35	ND

Vestland	Sima kraftverk	NA	AS	30	ND
Vestland	Skagen	10199	AS	32	ND
Vestland	Skogseidvatnet II	27956	AS	30	ND
Vestland	Skogseidvatnet III	28796	AS	30	ND
Vestland	Skålvik	11636	AS/RT	60	ND
Vestland	Storevatn	13206	AS	31	ND
Vestland	Sørebø	12177	AS	31	ND
Vestland	Trosnavåg	11453	RT	36	ND
Vestland	Tørvikvatnet	13156	AS	30	ND
Vestland	Vassbygdi	NA	AS	33	ND
Vestland	Åreneset	12219	AS/RT	60	ND
Møre og Romsdal	Botn	10220	AS	31	ND
Møre og Romsdal	Dravlaus	12214	AS	30	ND
Møre og Romsdal	Rossåa Settefiskanlegg	NA	AS	32	ND
Møre og Romsdal	Sagosen	12460	AS	30	ND
Møre og Romsdal	Sagvikvatnet	12474	AS	30	ND
Møre og Romsdal	Sjølseng	12917	AS/RT	33	ND
Møre og Romsdal	Standal Y.	12278	AS	31	ND
Møre og Romsdal	Statkraft Eresfjord	NA	AS/BT	32	ND
Møre og Romsdal	Storelva	12986	AS	30	ND
Møre og Romsdal	Tafjord	18355	RT	60	ND
Møre og Romsdal	Vestrefjord	10191	AS	30	ND
Møre og Romsdal	Vestseøra	24096	AS/RT	33	ND
Trøndelag	Hopla	10385	AS	30	ND
Trøndelag	Kaldvella	NA	AS/BT	30	ND
Trøndelag	Kongsmoelva	10265	AS	29	ND
Trøndelag	Laksåvatnet	12422	AS	30	ND
Trøndelag	Lauvsnes	12623	AS	33	ND
Trøndelag	Osavatnet	13181	AS	33	ND
Trøndelag	Sagelva	12813	AS	33	ND
Trøndelag	Salsbruket	13180	AS	29	ND
Trøndelag	Saltbuodden	13740	AS	30	ND
Trøndelag	Svaberget	39717	AS	30	ND
Trøndelag	Sætran	12639	RT	60	ND
Trøndelag	Tverrvågen	12428	AS	29	ND
Trøndelag	Vikbukta	12595	AS	30	ND
Nordland	Elvenesstrand	13943	AS	30	ND
Nordland	Glomfjord 1 + 3	13188/11127	AS	30	ND
Nordland	Grytåga	10948	AS	30	ND
Nordland	Holmvåg	13935	AS	31	ND
Nordland	Hopen	10484	AS	30	ND

Nordland	Hustadstranda	11313	AS	31	ND
Nordland	Innhavet	11296	AS	30	ND
Nordland	Mølnerodden	11220	AS	30	ND
Nordland	Nusfjord	11213	AS	31	ND
Nordland	Saglifossen	13183	AS	33	ND
Nordland	Sundsfjord	29316	AS	32	ND
Nordland	Tosbotn	13584	AS	30	ND
Nordland	Trollbukta	11264	AS	30	ND
Nordland	Åmøya	26375	AS	30	ND
Nordland	Leirfjord Kultiveringsanlegg	NA	AS	30	ND
Troms og Finnmark	Foldvik	11325	AS	30	ND
Troms og Finnmark	Friarfjord	13140	AS	30	ND
Troms og Finnmark	Neptunbruket	29796	AS	30	ND
Troms og Finnmark	Storelva Ellevollen	10741	AS	33	ND
Troms og Finnmark	Storelva i Berg	11426	AS	30	ND
Troms og Finnmark	Jøvik	11333	AS	30	ND



*Scientifically ambitious, forward-looking
and collaborative- for one health!*



Veterinærinstituttet
Norwegian Veterinary Institute

Ås

Trondheim

Sandnes

Bergen

Harstad

Tromsø

postmottak@vetinst.no
www.vetinst.no