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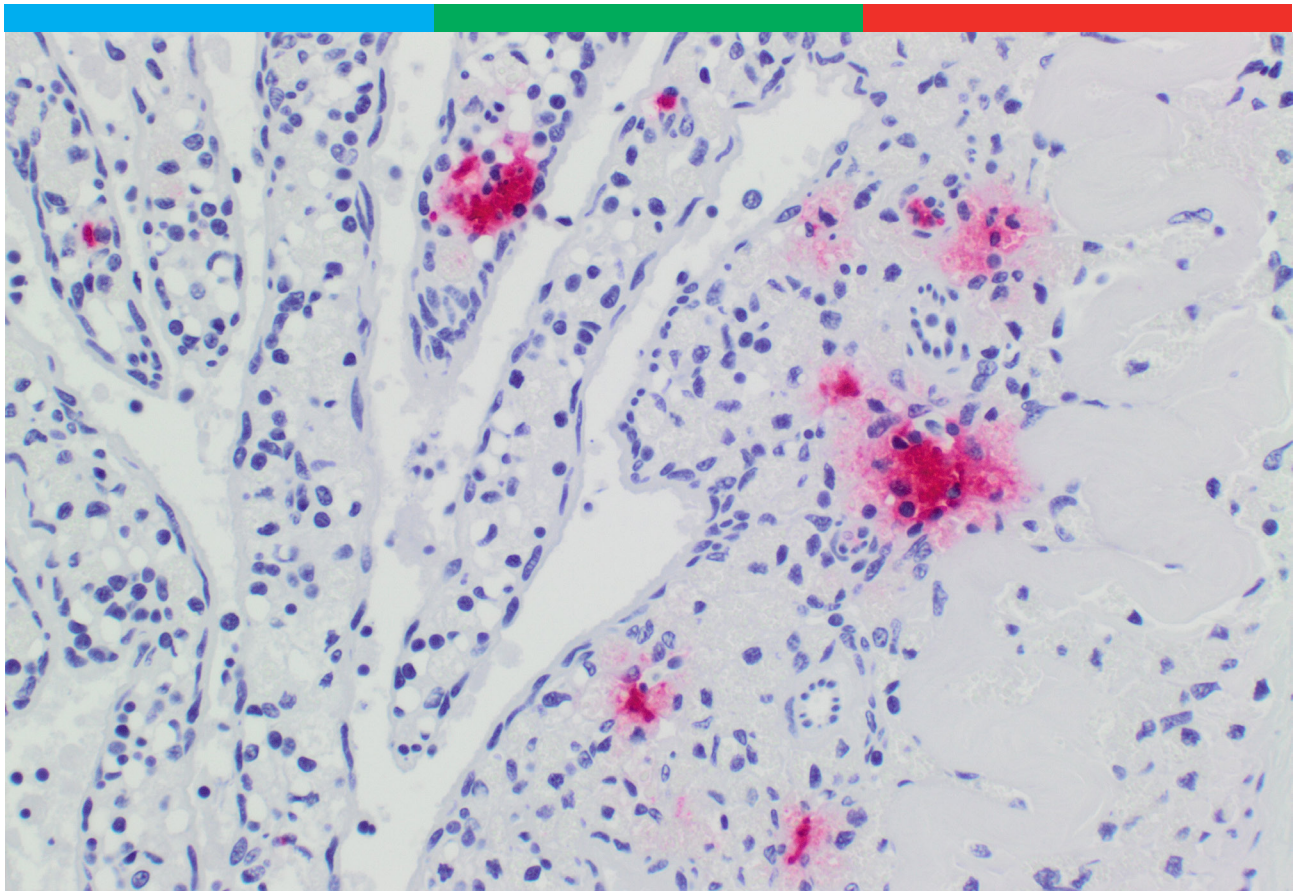
Risk based health monitoring of wild finfish in Norway 2022



REPORT 10/2023

Risk based health monitoring of wild finfish in Norway 2022

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Cover photo: *Aeromonas salmonicida* ssp. *salmonicida* in the pyloric caeca area of a wild Atlantic salmon from a Norwegian river. Micro colonies are tagged red with immunohistochemistry technique. Photo: Toni Erkinharju, Norwegian Veterinary Institutewww.vetinst.no

Content

Summary

A national notification portal for disease and mortality in wild fish was established in 2020 in cooperation between NVI and the Norwegian Food Safety Authority (NFSA).The main purpose of this portal is to facilitate early detection of serious disease in wild fish by simplifying the reporting procedure. The reports themselves and the subsequent diagnostic work provide an insight into the health of wild fish. In addition, health problems that are candidates for further attention through surveillance and monitoring are identified. The notification portal has thus become an integral part of health monitoring of wild fish both in freshwater and in the marine environment.

From 2022, the notification portal was linked to the NFSA health monitoring program in order to investigate the presence of cultivable virus and bacteria in wild fish reported. Accordingly, samples were mainly collected during disease outbreaks in wild populations, but also from individual fish showing adverse behaviour or other signs of ill health.

No viruses were detected by cultivation in selected cell lines, nor by specific qPCR. Listed bacterial diseases were not detected by cultivation of bacteria on growth media, nor by specific qPCR.

Classic vibriosis, caused by *Vibrio anguillarum,* was detected in wild Atlantic salmon (*Salmo salar*) in two rivers, Lysakerelva and Nordmarkselva (Akerselva), both draining to the inner Oslo fjord (Oslo County). In Lysakerelva number of reported dead Atlantic salmon was 60, while the mortality in Nordmarkselva was not estimated, but significantly lower than in Lysakerelva.

Mycobacteriosis, caused by *Mycobacterium salmoniphilum* was detected in a wild cod (*Gadhus morhua*) in the fjord Eidsfjorden, Vestland County.

In a number of rivers, there was high mortality among spawners due to saprolegniosis caused by *Saprolegnia parasitica*. In several of the affected fish, examinations showed growth of bacteria that are considered to be opportunistic pathogens. These bacteria were generally not isolated in pure cultures. This may indicate that the diseased individuals were infected due to a suppressed immune system or impaired barriers caused by lesions in the skin. The impact of the bacterial infections on the individual fish in the specific cases remain uncertain.

Introduction

In 2012, the Norwegian Veterinary Institute (NVI) and the Institute of Marine Research (IMR) were commissioned by the Norwegian Food Safety Authority (NFSA) to carry out annual health monitoring of wild anadromous salmonids in Norway (hereafter called the NFSA health monitoring programme). During the period from 2012 to 2021, NVI coordinated the programme in freshwater.

In 2020, the NVI, in agreement with the NFSA, launched a national notification system for disease and mortality in wild fish, the so called *wild fish health portal*. The main purpose of the portal was to facilitate early detection of serious disease in wild fish by simplifying the reporting procedure. The system also provides a general insight into the health of wild fish and highlight health problems that are candidates for further attention through surveillance and monitoring. The *wild fish health portal* is now an integral part of health monitoring of wild fish both in freshwater and in the marine environment.

From 2022, the NFSA health monitoring programme was linked directly to material provided by the *wild fish health portal*. The program investigates the presence of fish pathogenic cultivable virus and bacteria in dead and moribund wild fish reported to the system. Accordingly, samples were mainly collected during disease outbreaks in wild populations, but also from individual fish showing adverse behaviour or other signs of ill health.

Results are published in annual reports available on
https://www.vetinst.no/overvaking/health-monitoring-of-wild-fish

Aim

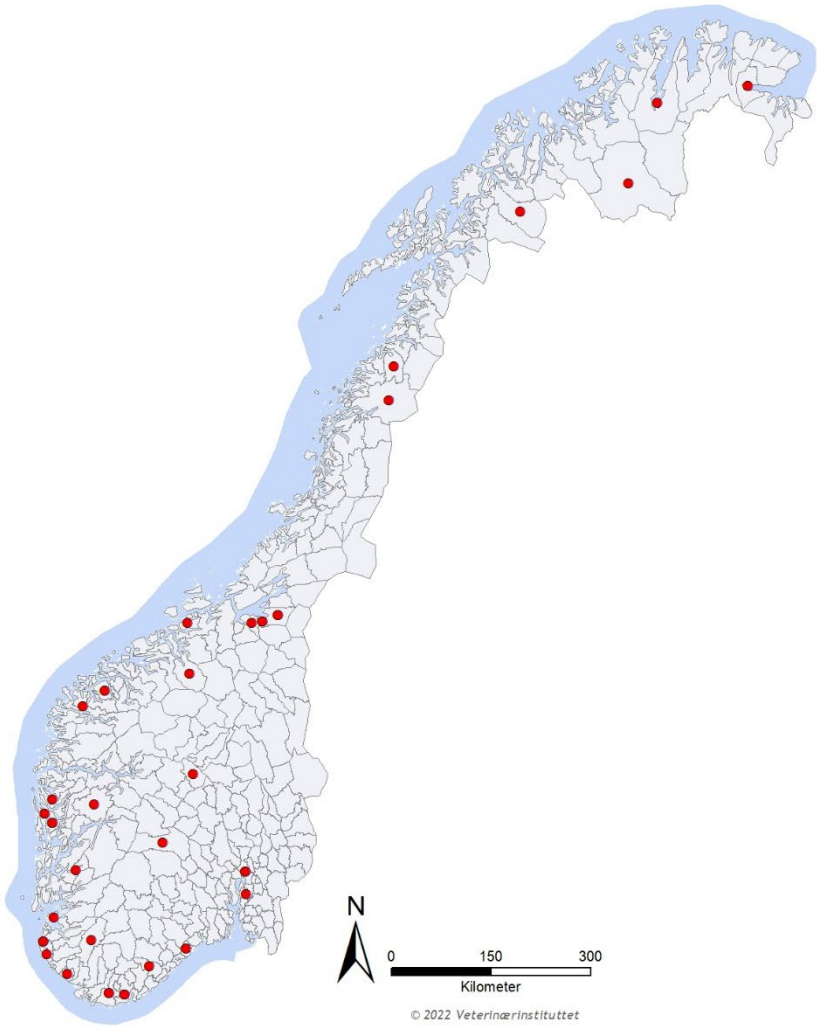
In 2022, the aim of the health monitoring programme was to investigate the presence of cultivable viral and bacterial agents in moribund wild fish.

Materials and methods

Materials

The risk based health monitoring programme comprised wild fish that due to clinical disease and mortality were submitted to the Norwegian Veterinary Institute for examination. The majority of the fish were reported as dead and moribund in the wild fish health portal. An overview of investigated cases (species, location and main findings) included in the programme is listed in Appendix 1a-c. (Figure 1)

***Figure 1**. Map showing an overview of Norwegian municipalities with cases reported to the notification system indicated by red circles (From Sommerset et al. 2023, Ill.: Attila Tarpai).*



Virological examinations

Isolation of virus in cell culture

Tissue samples were investigated for the presence of virus by inoculation on a panel of cell lines according to the procedure described by the World Organization for Animal Health (WOAH) with minor modifications. The selected cell lines were bluegill fry cells (BF-2), *epithelioma papulosum cyprini* cells (EPC), Chum salmon heart cells (CHH-1) and Atlantic salmon gill cells (ASG-10). An in-house established epithelial cell line from Atlantic salmon skin (ASAS) was also used. The cell lines were selected partly based on their known susceptibility to a large number of viruses found in fish, and partly to represent various cell types and organs, with the purpose to increase the possibility for isolation of possible viruses in the tissue.

Samples from anterior kidney and/or myocardium and/or spleen were removed from the fish with sterile dissection tools and transferred to 30 ml Steriline® plastic tubes containing transport medium provided by the Norwegian Veterinary Institute. If indicated by skin or gill lesions, samples from gills and skin were deposited in a separate tube with transport medium.

Tissue samples were transported frozen or on ice to the Norwegian Veterinary Institute where they were homogenized, 1:10 (w/v), in transport medium. The homogenates were then clarified by centrifugation (2500 rounds per minute/ rpm), at 5℃. Aliquots of the resulting supernatants were transferred to Eppendorf tubes, then stored at -80 ℃ until inoculation.

One hundred and fifty (150) microliters of supernatant was inoculated onto BF-2, EPC, CHH-1 and ASG-10 cells in a 24 well cell culture plate. Supernatant from skin and gills samples were inoculated onto ASAS cells in 96 well cell culture plate. Inoculated cells were incubated at 15°C and examined for cytopathic effect (CPE) or possible toxicity at (5 and) 7 days, 14 days and 21 days post inoculation (dpi). At 21 dpi, the first passage (1p) cultures were subjected to 1 freeze/thaw cycle. Three passages were used and the total incubation period was nine weeks per sample.

Polymerase chain reaction (PCR or qPCR) analysis

Tissue samples (anterior kidney, myocardium, spleen and gill) were removed from the fish with sterile dissection tools and transferred to 1.5 ml plastic Eppendorf tubes with 1 ml DNA/RNA stabilising reagent (RNAlater™) according to the manufacturer's recommendation.

In cases with high mortality or when indicated by pathological findings, samples were analysed with specific qPCR.

Bacteriological examination by cultivation, MALDI-TOF MS and qPCR

Bacteria have different requirements pertaining to nutrient content in growth media, incubation temperature and duration of incubation (Figure 2).

Standard tissue for cultivation of bacteria is from head kidney and/or spleen. In addition, it is recommended to cultivate from visible lesions such as boils and ulcers. Table 2 lists the growth media and growth conditions most often used.

***Figure 2**. Growth of bacteria on different media. A) Flavobacterium psychrophilum grow as yellow colonies on Anacker and Ordal medium (Photo: Hanne Nilsen), b) Pseudomonas fluorescence on Kings agar B that is exposed to ultra violet light (Photo: Toni Erkinharju), c) Vibrio anguillarum with haemolysis on blood agar (Photo Duncan Colquhoun) and d) Mycobacterium salmoniphilum on Middlebrook 7H10 agar (Photo: Anne Berit Olsen).*

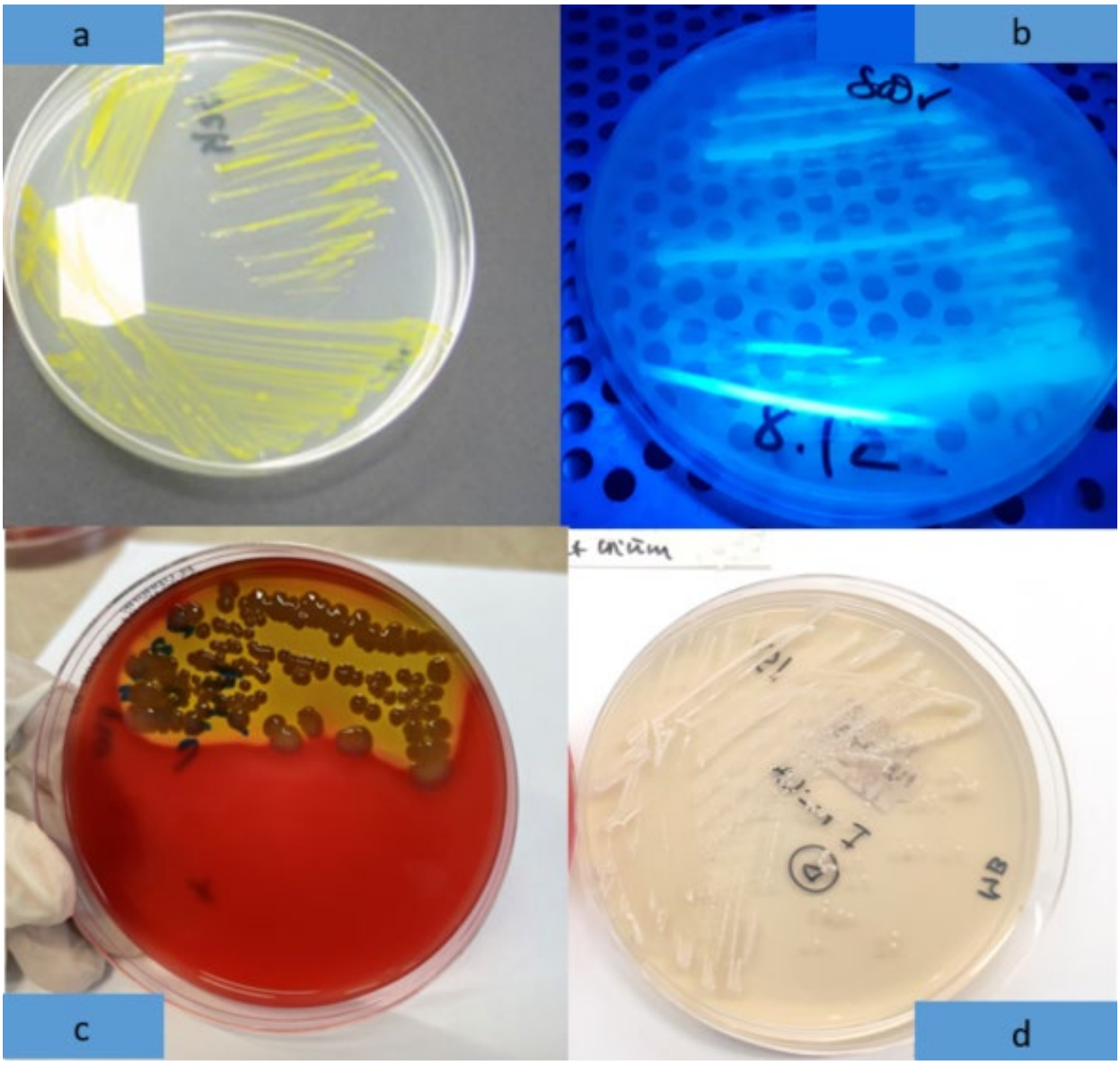


***Table 2**. Overview of growth media and incubation conditions used in investigation of fish diseases.*

Growth media	Characteristics	Bacteria or fungi/disease	Incubation temperature and time
Blood agar	5 % bovine blood ß-haemolytic activity is breakdown of red blood cells, α-haemolytic activity or 'partial haemolysis' is green/brown colour due to the conversion of haemoglobin to methaemoglobin, γ-haemolysis or non-haemolytic	*General growth media for several bacteria including Aeromonas salmonicida* subsp. *salmonicida/furunculosis, Vibrio anguillarum/vibriosis*	22℃, 7 days
Blood agar with 2% NaCl	Same as blood agar, but with NaCl to accommodate bacteria from the marine environment	*Vibrio anguillarum*	15℃, 7 days
Anackers and Ordal medium	Low nutrient content	*Flavobacterium* sp., *Flavobacterium psychrophilum* *Francisella noatunensis* subsp. *noatunensis*	15℃, 14 days
Kidney disease medium (KDM)		*Renibacterium salmoninarum* *Flavobacterium* sp.	15℃, 12 weeks (*R.s*)
Selective kidney disease medium (SKDM)		*Renibacterium salmoninarum* (bacterial kidney disease)	15℃, 12 weeks
Middlebrook 7H10		*Mycobacterium* sp.	22℃, 14 days
Cystein heart agar with blood (CHAB)		*Francisella noatunensis* subsp. *noatunensis* (francisellosis)	15℃, 14 days
Sabouraud agar (SAB)	Low pH (6-6.5), gentamycin (inhibits Gram-negative bacteria)	*Saprolegnia* sp.	22℃, 7 days
Marine agar	Heterotrophic marine bacteria		15℃, 7 days
Kings agar B	To identify fluorescence in *Pseudomonas fluorescence*	*Pseudomonas fluorescence*	15℃, 7 days

Results and discussion

Virological examinations

Cytopathogenic or toxic effect in cell cultures were not observed for any of the inoculated samples.
All qPCR-analyses for IHNV, VHSV, ISAV and PRV-3 were negative for all analysed samples.

In conclusion, all investigations for virus were negative.

Bacteriological examinations

Listed bacterial diseases were not detected in the submitted material in 2023 (Table 2).
The two most serious bacterial diseases detected were *Mycobacterium salmoniphilum* infection in Atlantic cod (*Gadus morhua)* and classic vibriosis caused by *Vibrio anguillarum* in wild Atlantic salmon (*Salmo salar*) (Sommerset et al. 2023).

Table 2. Overview of results from bacterial investigations.

	Bacterium	Disease	Listing	Result
Listed diseases	*Renibacterium salmoninarum*	Bacterial kidney disease	3	Not detected
	Aeromonas salmonicida subsp. *salmonicida*	Classical furunculosis	3	Not detected
	Francisella noatunensis subsp. *noatunensis*	Francisellosis	3	Not detected
Non-listed diseases	*Vibrio anguillarum*	Vibriosis	-	Detected, Atlantic salmon
	Mycobacterium salmoniphilum	Mycobacteriosis	-	Detected, cod

Case reports[1]

Mycobacteriosis in wild cod (*Gadus morhua*)
In February 2022, a male cod with small white nodules in organs in the abdominal cavity, was captured in the fjord outside Nordfjordeid in the municipality of Stad (Vestland County) The gross pathology was consistent with disease signs described for mycobacteriosis and franciscellosis, the latter being a listed disease caused by *Francisella noatunensis* subsp. *noatunensis*.

The Norwegian Veterinary Institute received a spleen with multiple bright nodules, as well as the head of the cod (Figure 3). Histopathological examination of the spleen and pseudobranchia with routine H&E staining and special stains, confirmed multiple granulomas (chronic inflammatory nodules) infiltrated with large amounts of gram-positive, acid-fast bacteria. The findings were consistent with infection with *Mycobacterium* sp. Specific immunohistochemical examination visualised the bacteria in the tissue.

Samples of crushed granulomas from the spleen were inoculated onto different growth media. *Mycobacterium* sp. grew with white colonies on Middlebrook 7H10 agar (Figure 2d). Based on phenotypic investigations, mass spectrometry (MALDI-TOF MS) and genetic analyses the bacterium was identified as most similar to *Mycobacterium salmoniphilum* (*M. salmoniphilum*). The cod was diagnosed as a severe case of mycobacteriosis (Sommerset et al. 2023).

Figure 3. Spleen from a cod (Gadus morhua) infected with Mycobacterium salmoniphilum. Photo: Anne Berit Olsen

Classic vibriosis caused by *Vibrio anguillarum* in wild Atlantic salmon
In August and September 2022, classic vibriosis caused by *Vibrio* (*Listonella*) *anguillarum* (*V. anguillarum*) caused mortality in wild salmon in two rivers draining to the inner Oslo fjord (Figure 2c) (Sommerset et al. 2023). The accumulated mortality is uncertain in the river Akerselva, and was estimated to 60 salmon in the river Lysakerelva.

In this clinical case, the major signs of disease in the population were apathy and mortality in fish with ulcers or haemorrhages in the skin (Figure 4). In general, fish infected with *V. anguillarum* can also have protruding eyes (exophthalmos), blood stained boils in muscles, ascites, enlarged spleen and petechial bleedings.

High water temperatures is often a prerequisite for the development of classic vibriosis in wild marine fish. Since *V. anguillarum* is a common bacterium in seawater and brackish water, the salmon were probably infected there. Low water levels and water flow in the affected rivers seem to have delayed the salmon run and resulted in high fish density in the estuary and thus increased probability of infection.

During the outbreak of vibriosis in wild Atlantic salmon in Lysakerelva, several dead European flounders (*Platichthys flesus*) were observed in the estuary and along the river banks. The flounders were emaciated, had empty intestinal tracts and large gall bladders, all indications of an anorectic period prior to death. *Vibrio anguillarum* was not detected in the flounders (Sommerset et al. 2023).

Classic vibriosis in wild Atlantic salmon is uncommon, but anecdotal descriptions do exist.

***Figure 4**. Atlantic salmon (Salmo salar) with classic vibriosis displaying haemorrhages in the skin. (Photo: Frode Dalen)*

[1] Text based on the Norwegian fish health report (Sommerset et al. 2023)

Mass mortality in marine schooling fish

In 2022, mass mortality was reported in Atlantic horse mackerel (*Trachurus trachurus*) in Gumøy, Kragerø (Figure 5) and in silvery lightfish (*Maurolicus muelleri*) in Salhusfjorden, Bergen was reported (Sommerset et al. 2023). In both cases, fish were submitted for examination. Samples were cultivated for viruses in the standard panel of cell lines and for bacteria on relevant growth media. In addition, silvery lightfish were examined for ISAV and VHSV by qPCR.

In Atlantic horse mackerel *Photobacterium* sp. was detected, but was not considered relevant as a causative agent. The investigation did not detect infectious agents that could explain the mortality.

***Figure 5**. Mass mortality of Atlantic horse mackerel (Trachurus trachurus). (Photo: Ragnhild Helsing).*

Opportunistic bacterial infections

In several rivers, there was high mortality among spawners due to saprolegniosis (Sommerset et al. 2023). The oomycete *Saprolegnia parasitica* was isolated in all saprolegnia cases investigated by the Norwegian Veterinary Institute. In several of the affected fish, bacterial examinations showed growth of bacteria considered to be opportunistic pathogens. These bacteria were generally not isolated in pure cultures. This may indicate that the diseased individuals were infected due to a suppressed immune system during the spawning season or impaired barriers due to lesions in the skin. Isolated bacteria were for instance *Aeromonas hydrophila*, *Carnobacterium maltaromaticum*, *Pseudomonas fluorescence*, *Yersinia ruckeri* O2, *Lactococcus* sp. The impact of these bacterial infections in the course of disease at the individual level in the specific cases remain uncertain.

Risk based surveillance

By examining moribund and dead fish the probability of discovering both known and hitherto unknown and undescribed cultivable fish pathogens increases. The program is based on broad cultivation techniques for bacteria and viruses, but is also assisted by gross the pathological examination, histopathology, qPCR and immunohistochemistry, which together increases the probability of discovering infectious diseases. The risk based programme thus aim at being an important contributor to anticipatory preparedness, i.e. anticipating tomorrow's health problems in wild and farmed fish.

Virus infections
It is important to identify severe listed viral diseases early in the process of disease investigation. Specific qPCRs for infectious haematopoietic necrosis virus (IHNV) and viral haemorrhagic septicaemia virus (VHSV) were therefore used whenever indicated by high mortality or pathological findings. Specific qPCR for other viruses were also used when indicated by histopathological findings.

Cultivation on cell lines have limitations. The technique can only detect viable and cultivable viruses. Accordingly, viruses that are not cultivable, such as piscine orthoreovirus (PRV), piscine myocarditis virus (PMCV) and salmon gill poxvirus (SGPV) will not be detected. In addition, sub-optimal handling of the samples prior to inoculation can also reduce virus viability. As a consequence, a presence of virus in the sampled fish cannot be excluded (i.e., false negative samples).

Bacteriology
Disease history and gross and histopathological findings can give an indication of the disease at hand, but a confirmation by cultivating the bacteria, in case of bacterial infection, is often a diagnostic criterion to verify a diagnosis. Bacterial examination is therefore a standard procedure in post mortem examination and is carried out to detect bacteria that may have been the cause or contributing factor in the course of disease.
To recover a diverse range of bacterial pathogens in culture, it is necessary to culture on several media and at different incubation conditions. In this surveillance program, a standard panel of growth media and incubation conditions were not predefined. Accordingly, the decisions were made, case by case, by the responsible pathologist based on laboratory routines, experience and information about the clinical case at hand.

Acknowledgements

The authors would like to thank every person and institution that were involved in providing diseased wild fish for disease investigations. The authors also thank all pathologists and technical staff at the Norwegian Veterinary Institute for performing disease investigations with excellence.

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Appendix 1a Salmonids

*Appendix 1a displays a by county overview of diagnostic cases of salmonids included in the risk based surveillance program in 2022. Species include Atlantic salmon (Salmo salar), trout (Salmo trutta), Arctic char (Salvelinus alpinus) and pink salmon (Oncorhynchus gorbuscha). *Diagnostic cases from Q4 2022 are cultivated on cell-lines in 2023.*

County	Location	Species	Fish	Virus samples	Bact. samples	qPCR	Diagnosis	Comments
Troms & Finnmark	Olderfjordelva, Kvænangen	Atlantic salmon	1	1	1	0	Neoplasia in skin	December 2021 Viral or bacterial disease not detected
	Javrrehus, Kautokeino	Arctic charr	1	2	2	0	Severe parasite infestation. Tapeworm (*Dibothriocephalus* sp.) and gill maggot (*Salmincola* Sp.)	July 2022 Viral or bacterial disease not detected
	Varanger-fjorden, Sør-Varanger	Atlantic salmon	1	2	2	0	Abnormal haemorrhage or necrotic lesion in muscle	September 2022 Cataract. Viral or bacterial disease not detected
	Lakselva, Porsanger	Atlantic salmon	1	2	7	0	Neoplasia in skin, alternatively an inflammatory response in skin.	September 2022 Parasites (Cestoda) Viral or bacterial disease not detected
	Lakselva, Porsanger	Pink salmon	2	6	12	0	Ichthyophonosis *Ichthyophonus* sp.	August 2021 Viral or bacterial disease not detected
Nordland	Rana-vassdraget, Rana	Atlantic salmon	1	2	4	0	Neoplasia in skin	September 2022 Viral or bacterial disease not detected

County	Location	Species	Fish	Virus samples	Bact. samples	qPCR	Diagnosis	Comments
Trøndelag	Gråelva, Stjørdal	Sea trout	2	2	4	2	Saprolegniosis *Saprolegnia parasitica*	October 2022 Mortality. VHSV and IHNV not detected (qPCR). Possible mixed secondary bacterial infections. Nephrocalsinosis
	Homla, Malvik	Atlantic salmon	13	0*	22	0	Saprolegniosis *Saprolegnia parasitica*	October 2022. High mortality. Mixed secondary bacterial infections (motile *Aeromonas* sp., *Lactococcus* sp. *Carmobacterium maltaromaticum*). Possibly *Flavobacterium* sp.
Møre & Romsdal	Driva, Sunndal	Atlantic salmon	1	1	0	2	Unknown	December 2021 Haemorrhage and pigmentation in testis. VHSV and IHNV not detected (qPCR)
Vestland	River Etne, Etne	Atlantic salmon	2	4	0	0	Papillomatosis	July 2022. Other viral disease not detected
Rogaland	Figgjo, Hå	Atlantic salmon	1	2	6	0	Saprolegniosis *Saprolegnia parasitica*	December 2021. Unspecific bacterial growth and no growth
	Nordre-Varhaugelv, Hå	Atlantic salmon	4	0*	16	8	Saprolegniosis *Saprolegnia parasitica*	November 2022. High mortality. *A. hydrophila* mixed with *Lactococcus* sp. one fish. *Lactococcus* sp. one fish.

County	Location	Species	Fish	Virus samples	Bact. samples	qPCR	Diagnosis	Comments
Agder	Søgneelva, Kristiansand	Atlantic salmon	1	2	6	0	Saprolegniosis *Saprolegnia parasitica*	October and November 2021. High mortality. Secondary bacterial infections, mixed: motile *Aeromonas* (*A. hydrophila*) *Lactococcus* sp., *Serratia* sp. Parasites: *Eustrongyloides* sp.
		Sea trout	2	4	12	0		
		Brown trout	3	3	6	0		
	Søgneelva Kristiansand	Atlantic salmon	1	4	3	0	Saprolegniosis	September 2022 *Yersinia ruckeri* O2, uncertain significance
	Mandalselva Lindesnes	Atlantic salmon	2	0*	4	4	Saprolegniosis *Saprolegnia parasitica*	November 2022. Mixed secondary bacterial infections, *Aeromonas* sp: *Yersinia intermedia*.
		Atlantic salmon	1	0*	3	2	Saprolegniosis	
		Brown trout	1	0*	3	2	Saprolegniosis	
	Sirdalsvatnet Sirdal	Brown trout	5	0*	10	20	Unknown, suspected saprolegniosis	December 2022 Possible bacterial septicaemia and bacterial skin infections (including flavobacteriosis based on IHC)

County	Location	Species	Fish	Virus samples	Bact. samples	qPCR	Diagnosis	Comments
Viken	Lysakerelva	Atlantic salmon	3	6	12	0	Classic vibriosis *Vibrio anguillarum*	August 2022, high mortality.
		Atlantic salmon	1	2	6	0	Classic vibriosis *Vibrio anguillarum*	September 2022
		Atlantic salmon	2	5	10	0	Classic vibriosis *Vibrio anguillarum*	September 2022 *V. anguillarum* in one salmon
	Nordmarkselva (Akerselva)	Atlantic salmon	2	2	2	0	Unknown	August 2022 During the vibriosis outbreak no bacterial growth, viral disease not detected
		Atlantic salmon	1	1	3	0	Classic vibriosis *Vibrio anguillarum*	August 2022 *V. anguillarum* in one salmon
	Sandvikselva Bærum	Atlantic salmon	2	4	10	0	Saprolegniosis *Saprolegnia parasitica*	September 2022 Morphology consistent with ulcerative dermal necrosis (UDN). Viral or bacterial disease not detected
		Atlantic salmon	5	0*	15	0	Saprolegniosis *Saprolegnia parasitica*	October 2022 Mixed secondary bacterial infections Viral disease not detected
	Fornebu, Bærum	Atlantic salmon	1	0*	2	0	Unknown	October 2022 Viral and bacterial disease not detected

Appendix 1b Non-salmonid freshwater and diadromous fish

Appendix 1b displays a by county overview of diagnostic cases from non-salmonid freshwater and diadromous fish included in the risk based surveillance program in 2022. Species include ***European eel (Anguilla Anguilla)*** *and European perch (Perca fluviatilis).*

**Diagnostic cases from Q4 2022 are cultivated on cell-lines in 2023*

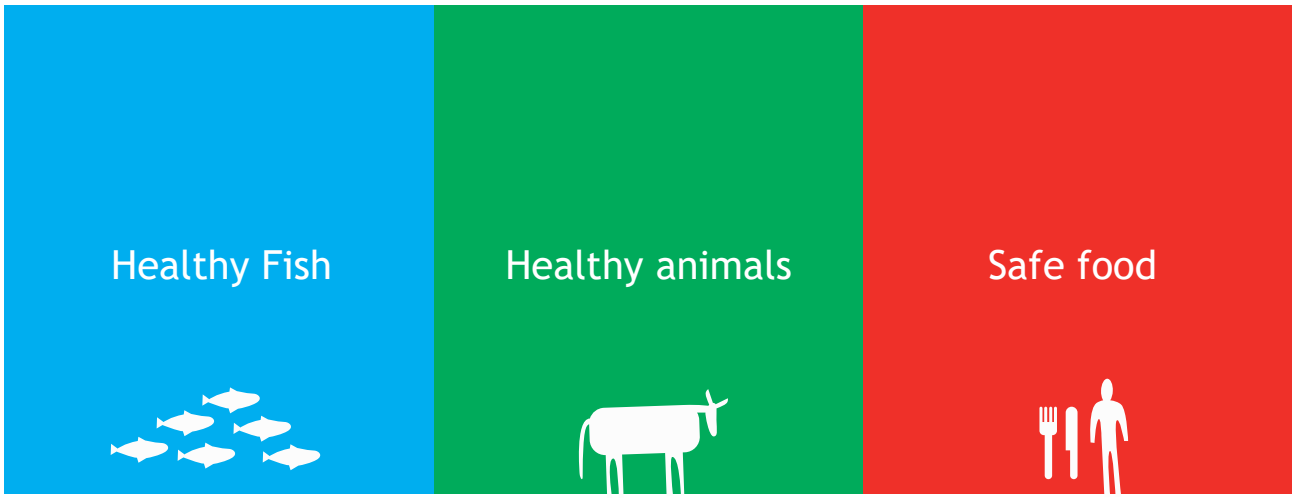
County	Location	Species	Fish	# Virus samples	# Bact samples	# qPCR	Diagnosis	Comments
Møre & Romsdal	Usma, Sunndal	European eel	4	4	0	0	CFT legumine	August 2022 CFL legumine treatment in river Usma. Skin discolorations.
Agder	Rosævatnet, Froland	European perch	3	0*	6	0	Emaciation	October 2022 Wild-caught fish kept in tanks, research

Appendix 1c Marine fish

Appendix 1c displays a by county overview of diagnostic cases from marine fish that were included in the risk based surveillance program in 2022. Species include Atlantic cod (Gadus morhua), Silvery lightfish (Maurolicus muelleri), Atlantic horse mackerel (Trachurus trachurus) and European flounder (Platichthys flesus).

**Diagnostic cases from Q4 2022 are cultivated on cell-lines in 2023*

County	Location	Species	Fish	Virus samples	Bact samples	qPCR	Primary diagnosis	Comments
Vestland	Eidfjorden, Stad	Atlantic cod	1	0*	6	1	Mycobacteriosis *Mycobacterium salmoniphilum*	March 2022, viral samples included in 2023 program.
	Salhusfjorden, Bergen/ Meland	Silvery lightfish	2	2	6	4	Unknown	April 2022. Mass mortality. VHSV and ISAV not detected (qPCR). Other virus, bacteria or fungi not detected
Vestfold & Telemark	Gumøy, Kragerø	Atlantic horse mackerel	13	6	14	0	Unknown	January 2022. Mass mortality, Mixed bacterial growth dominated by *Photobacterium* sp. Virus not detected
Viken	Lysakerelva	European flounder	2	2	6	0	Emaciation, anorexia. Adenomas, foci of cellular alterations in hepatopancreas (one fish),	September 2022. Mortality during classic vibriosis in Atlantic salmon. Virus, bacteria and fungi not detected. Detected: gill maggots, endoparasites.



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