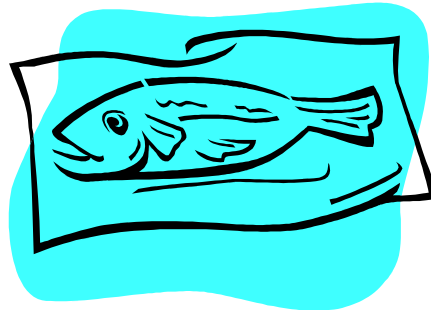




Sampling plan

Surveillance programme with focus on notifiable fish diseases 2020



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Compulsory notification and general surveillance

On behalf of the Icelandic Food and Veterinary Authority (MAST), District Veterinary Officers are responsible for monitoring general animal health within each district. For diseases in fish, molluscs and crustaceans, the Veterinary Officer for Fish Diseases shall carry this responsibility. All private practicing veterinarians are obliged to be alert and to report any suspicion regarding the diseases to MAST. Furthermore, according to Act No. 25/1993 *on animal diseases and measures to control them*, any person who has a reason to believe that an animal is suffering from an infectious disease covered by the legislation, shall immediately report this to any veterinarian who can be reached or to the police, who shall immediately contact a veterinarian. If a veterinarian sees a reason to take action, he/she shall immediately take steps to confirm the diagnosis and prevent the disease from spreading. If testing shows or a suspicion arises of an infectious disease, previously unknown in the country or specified in Regulation No. 52/2014 *on notifiable and reportable animal diseases*, MAST shall immediately be informed, and precautionary biosecurity measures applied.

Listed fish diseases

Serious notifiable diseases: Transmissible diseases which have the potential for very serious and rapid spread, and which are of serious socio-economic importance in the international trade of live fish, eggs and gametes. Serious notifiable diseases will be met with stamping out procedures as these diseases are considered as dangerous and exotic in Iceland. Measures are taken immediately, and reports submitted to the OIE and EU.

Other notifiable diseases: Transmissible diseases which are considered to be of socio-economic importance within the country and which are significant in the international trade of live fish, eggs and gametes. Measures are variable, from stamping out to general vaccination.

Reportable diseases: Diseases registered once a year, no special measures.

Serious notifiable diseases:	Other notifiable diseases:	Reportable diseases:
<ul style="list-style-type: none"> ● Epizootic haematopoietic necrosis (EHN) ● Viral haemorrhagic septicaemia (VHS) ● Infectious haematopoietic necrosis (IHN) ● Infectious salmon anemia (ISA) ● Pancreas disease (PD/SAV) ● Infectious pancreas necrosis (IPN) ● Oncorhynchus masou virus (OMV) ● Cardiomyopathy syndrome (CMS/PMCV) ● Koi herpesvirus (KHV) ● Spring viraemia of carp (SVC) ● Viral nervous necrosis (VNN) / Viral encephalopathy and retinopathy (VER) ● Gyrodactylosis 	<ul style="list-style-type: none"> ● Furunculosis ● Piscirickettsiosis ● Bacterial Kidney disease (BKD) ● Proliferative kidney disease (PKD) ● Whirling disease ● Swimbladder nematode of eel ● Salmon louse infection (<i>Lepeophtheirus salmonis</i>) 	<ul style="list-style-type: none"> ● Viral erythrocytic necrosis (VEN) ● Ulcerative dermatic necrosis (UDN) ● Heart and skeletal muscle inflammation (PRV/HSMI) ● Salmon gill poxvirus (SGPV) ● Papillomatosis ● Atypical furunculosis ● Cold water vibriosis ● Enteric red mouth (ERM) ● Epitheliocystis ● Mycobacteriosis ● Winter ulcers ● Vibriosis ● Marine louse infection (<i>Caligus elongatus</i>)

Introduction

All Icelandic fish farms have been included in the official national health control programme since 1985. The surveillance also includes farms raising wild salmonids for restocking of rivers and lakes. This surveillance programme has a risk-based approach. Infections which can be latent and diseases which do not have clear clinical symptoms are monitored by routine sampling. Fish farms are selected at random, but the main focus is put on the broodfish farms. From 1993 European Union (EU) Directives on disease control measures have been followed. The surveillance is partly by regular "on-site" health inspections, under the supervision of the Veterinary Officer for Fish Diseases, and partly by laboratory work conducted at the National Reference Fish Disease Laboratory at Keldur in Reykjavík (NRL). The NRL in Reykjavík has a close inter-laboratory collaboration with the EU Reference Laboratory on virus diseases in Denmark. In addition, a big part of the diagnostic services is performed by the Food, Veterinary- and Environmental Agency, Department of Fish and Animal Diseases in Torshavn, Faroe Islands and to some extent also by the PatoGen Analyse A/S in Norway. All used laboratories are approved and accredited by an ILAC accredited agency to ISO 17025.

The sampling and diagnostic methods regarding viral examination has been a long the lines given in Commission Decision 2015/1554/EC, including relevant amendments. Screening of important virus agents causing serious infectious diseases like *Infectious salmon anaemia* (ISA), *Pancreas disease* (PD/SAV), *Infectious pancreatic necrosis* (IPN), *Viral haemorrhagic septicaemia* (VHS), *Infectious haematopoietic necrosis* (IHN) and *Cardiomyopathy syndrome* (CMS/PMCV) have been a big part of the surveillance program. Until spring 2009 the diagnostic methods were mainly based on EPC, BF-2 and CHSE-214 cell-lines in the routine screening, in addition with clinical signs, gross pathology and histopathological examination of vital organs. Since 2009 more and more routine samplings from wild and farmed fish are analysed by Real-time RT-PCR technique.

Bacterial examination is in general based on use of blood agar (with or without 2% NaCl, and 5% horse blood). An ELISA method has been used for the detection of BKD (*Renibacterium salmoninarum*) since 1991, with indirect fluorescent antibody test (IFAT) and/or RT-PCR methodology for confirmation.

Monitoring of certain fish diseases by systemic sampling of farmed and wild fish population in Iceland

Viral haemorrhagic septicaemia (VHS)

VHS-virus was for the first time detected in lumpfish of wild origin in Iceland in October 2015. The detection was made in a marine research farm owned by the Icelandic state and had no connection to the salmonid aquaculture. The lumpfish VHS-virus was sequenced by the European Reference Laboratory for Fish Diseases in Denmark and blasted towards other known genotypes. The results showed a totally new appearance of VHSV subtype, most likely a highly host specific and a unique variant for lumpfish.

VHS is a notifiable disease, according to Act no. 25/1993 *on animal diseases and measures to control them*. Routine targeted samplings have been performed since 1985.

Iceland obtained formally disease-free status for VHS by the fish health authority of the European Union in 2004. Following the virus detection in the wild lumpfish in 2015 the disease-free status was temporarily suspended. After stamping out of the lumpfish in the respective landbased research farm, Icelandic authorities started up with a new process of achieving VHS-free status for the broodfish companies of Atlantic salmon and Arctic char. This recognition was confirmed on 2 May 2016. Since 2016 VHS samples have also been analysed by Real-time RT-PCR, in addition to culture on cell-lines.

See Table 1 and 2a.

Sampling plan for 2020:

≈ 700 samples tested by PCR and ≈ 1.000 samples examined with culturing on cell-lines.

Infectious haematopoietic necrosis (IHN)

IHN has never been detected in Iceland. It is a notifiable disease, according to Act no. 25/1993. Routine targeted samplings have been performed since 1985. Iceland obtained formally disease-free status for IHN by the fish health authority of the European Union in 2004. Since 2017 IHN samples have also been analyzed by Real-time RT-PCR, in addition to culture on cell-lines.

See Table 1 and 2b.

Sampling plan for 2020:

≈ 250 samples tested by PCR and ≈ 1.000 samples examined with culturing on cell-lines.

Infectious pancreatic necrosis (IPN)

IPN-virus has been detected, but still restricted in its distribution to localized marine environments. Aquatic birnavirus was for the first time isolated from Atlantic halibut (*Hippoglossus hippoglossus*) in 1999, but in late 2019 an avirulent marine IPNV was for the first time detected in farmed Atlantic salmon in a sea-cage farm of the east coast of Iceland. There has never been evidence of IPN disease at freshwater sites. It is a notifiable disease, according to Act no. 25/1993. Routine targeted samplings have been performed since 1985 and test results from tens of thousands of samples show no indication of disease at freshwater sites. Consequently, Iceland is regarded as being free from IPN. Since 2010 samples have been analyzed for IPN partly on cell lines and partly by Real-time RT-PCR.

See Table 1 and 2c.

Sampling plan for 2020:

≈ 1.000 samples tested by PCR and ≈ 1.000 samples examined with culturing on cell-lines.

Table 1. No. of samples analyzed for VHS, IHN and IPN since 1985 (culture on cell-lines):

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
1985	1.214	-	1.214	0
1986	5.591	-	5.591	0
1987	9.121	-	9.121	0
1988	10.503	-	10.503	0
1989	4.854	-	4.854	0
1990	6.831	-	6.831	0
1991	5.603	-	5.603	0
1992	2.763	-	2.763	0
1993	949	-	949	0
1994	610	16	610	0
1995	775	18	775	0
1996	601	17	601	0
1997	945	21	945	0
1998	806	19	806	0

1999	860	17	860	0
2000	696	15	696	0
2001	706	15	706	0
2002	533	12	533	0
2003	885	13	885	0
2004	1.109	16	1.109	0
2005	725	13	725	0
2006	524	13	524	0
2007	669	16	669	0
2008	812	15	812	0
2009	963	15	963	0
2010	1.220	13	1.220	0
2011	310	12	310	0
2012	335	12	335	0
2013	394	12	394	0
2014	432	12	432	0
2015	753	13	741	12*
2016	1.155	12	1.155	0
2017	1.127	13	1.127	0
2018	966	12	966	0
2019	1.178	13	1.168	10**

* VHS-virus positive **lumpfish of wild origin** in 1 farm.

** IPN-virus positive **Atl. Salmon in 1 marine farm** (avirulent without any clinical symptoms and mortality).
Diagnostic method: EPC, BF-2 and CHSE-214 cell-lines are used routinely.
Laboratory: Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Table 2a. Number of samples analyzed for *VHSV* (Real-time RT-PCR):

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2016	462	5	462	0
2017	614	5	614	0
2018	1.094	5	1.094	0
2019	931	5	931	0

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Table 2b. Number of samples analyzed for *IHNV* (Real-time RT-PCR):

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2017	22	3	22	0
2018	636	3	636	0
2019	228	2	228	0

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Table 2c. Number of samples analysed for *IPN* (Real-time RT-PCR):

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2010	928	4	928	0
2011	3.450	4	3.450	0
2012	1.009	3	1.009	0
2013	332	2	332	0
2014	0	0	0	0
2015	2.585	2	2.585	0
2016	824	2	824	0
2017	2.030	3	2.030	0
2018	1.459	6	1.459	0
2019	912	6	897	15*

* IPN-virus positive **Atl. Salmon in 1 marine farm** (avirulent without any clinical symptoms and mortality).
Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Infectious salmon anaemia (*ISA*)

ISA has never been detected in Iceland. It is a notifiable disease, according to Act no. 25/1993. The disease was described for the first time in Atlantic salmon (*Salmo salar*) in Norway in 1984 and has since been reported in several countries: UK, USA, Canada, Faroe Island and Chile. There are two main types of ISAV; one virulent type with varying pathogenicity associated with ISA outbreaks termed HPR-deleted ISAV (ISAV HPR-del) and the other type regarded as non-pathogenic, causing subclinical infections, termed ISAV HPR0.

Routine targeted samplings for Real-time RT-PCR analyses have been performed since 2009 and for culture on CHSE-214 cell-lines since 1985. Icelandic Atlantic salmon broodfish farms are formally declared free of ISA by the fish health authority of the European Union. According to ISAV, Iceland is recognized at the level of *øHPR0 ISAV endemic, but HPR-deleted ISAV free* by the OIE.

See Table 3.

Sampling plan for 2020:

≈ 7.000 samples tested by Real-time RT-PCR.

Table 3. Number of samples analyzed for *ISAV*:

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2009	2.764	2	2.716	48**
2010	4.644	4	4.588	56**
2011	8.206	3	8.139	67**
2012	8.230	2	8.178	52**
2013	10.777	2	10.659	118**
2014	10.355	4	10.295	60**
2015	14.151	8	14.102	49**
2016	13.427	8	13.388	39**
2017	13.296	8	13.265	31**
2018	10.817	8	10.762	55**

2019	7.391	7	7.379	12**
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** Low/non-pathogen ISAv (**HPR0**).

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland and to some extent also PatoGen Analyse A/S in Norway.

Pancreas disease (*PD/SAV*)

PD has never been detected in Iceland. It is a notifiable disease, according to Act no. 25/1993. Routine targeted samplings have been performed since May 2009, with a focus on salmon broodstock given eggs for export.

See Table 4.

Sampling plan for 2020:

≈ 4.000 samples tested by Real-time RT-PCR.

Table 4. *Number of samples analyzed for PD/SAV:*

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2009	1.908	2	1.908	0
2010	4.504	2	4.504	0
2011	8.206	3	8.206	0
2012	7.530	2	7.530	0
2013	8.506	2	8.506	0
2014	8.772	3	8.772	0
2015	9.247	4	9.247	0
2016	5.644	3	5.644	0
2017	5.074	4	5.074	0
2018	7.390	5	7.390	0
2019	4.488	6	4.488	0

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Cardiomyopathy syndrome / Piscine myocarditis virus disease (*CMS / PMCV*)

PMCV has never been detected in Iceland. It is a notifiable disease, according to Act no. 25/1993. Routine targeted samplings have been performed since August 2013, with a focus on salmon broodstock given eggs for export.

See Table 5.

Sampling plan for 2020:

≈ 2.500 samples tested by Real-time RT-PCR.

Table 5. Number of samples analyzed for *PMCV*:

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2013	908	3	908	0
2014	4.854	6	4.854	0
2015	3.369	8	3.369	0
2016	1.689	7	1.689	0
2017	3.094	5	3.094	0
2018	6.497	6	6.497	0
2019	3.286	5	3.286	0

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Heart and skeletal muscle inflammation (*HSMI / PRV*)

Piscine orthoreovirus (PRV) is endemic in Atlantic salmon, both in aquaculture as well as in the wild environment. HSMI is not a notifiable disease, according to Act no. 25/1993. Routine targeted samplings have been performed since 2015, but some monitoring was performed in 2011 and 2013.

See Table 6.

Sampling plan for 2020:

≈ 2.000 samples tested by Real-time RT-PCR.

Table 6. Number of samples analyzed for *PRV*:

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Prevalence of <u>positive</u> samples
2011	60	1	0 - 100%
2013	60	3	0 - 100%
2015	567	6	0 - 100%
2016	840	6	0 - 70%
2017	2.706	5	0 - 60%
2018	2.385	4	31%
2019	2.116	5	1,1%

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Salmon gill pox virus (*SGPV*)

Salmon gill pox virus (SGPV) is endemic in Atlantic salmon, both in aquaculture as well as in the wild environment. SGPV is not a notifiable disease, according to Act no. 25/1993. Routine targeted samplings have been performed since 2017.

See Table 7.

Sampling plan for 2020:

≈ 1.000 samples tested by Real-time RT-PCR.

Table 7. Number of samples analyzed for *SGPV*:

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Prevalence of <u>positive</u> samples
2017	52	2	38%
2018	450	4	1,3%
2019	1.388	5	11,2%

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Bacterial kidney disease (*BKD*)

Bacterial kidney disease occurs sporadically. It is a notifiable disease, according to Act no. 25/1993. Routine samplings have been performed since 1985.

Ireland, Northern Ireland, Isle of Man and Jersey have been given approval for national measures for BKD by the fish health authority of the European Union. In order to export salmon eggs to these countries, targeted surveillance must be conducted in an ISA-free zone. Sampling for BKD is an absolute demand only for the sites within the ISA-free zone that want to export eggs to countries with these national measures for BKD.

See Tables 8 and 9.

Sampling plan for 2020:

Farmed salmonids: \approx 3.000 samples tested by Real-time RT-PCR and \approx 200 by ELISA.

Wild salmonids: \approx 600 by ELISA.

Table 8. Number of samples from farmed salmonids analyzed for *BKD*:

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>positive</u> <u>farms</u>
1991	435	12	0
1992	558	13	1
1993	453	14	1
1994	522	12	4
1995	431	8	1
1996	594	8	0
1997	337	10	0
1998	362	8	1
1999	316	7	0
2000	361	6	0
2001	312	6	0
2002	357	7	1
2003	713	6	1
2004	1.306	8	3
2005	2.052	16	3
2006	3.048	19	4
2007	3.169	16	1
2008	3.134	11	0
2009	3.930	19	0
2010	2.839	12	0
2011	2.026	12	2

2012	1.399	12	0
2013	1.316	10	0
2014	1.985	13	2
2015	1.994	12	0
2016	1.396	18	3
2017	3.800	23	2
2018	5.550	25	1
2019	5.464	21	0

Diagnostic method: ELISA (enzyme-linked immunosorbent assay) and Real-time RT-PCR.

Laboratory: Institute for Experimental Pathology at Keldur in Reykjavik, Iceland, Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and PatoGen Analyse A/S in Norway.

Table 9. Number of samples from wild salmon analyzed for *BKD*:

Year	Number of individuals sampled	Number of rivers sampled	Number of positive samples	Number of positive rivers
1991	569	49	8	5
1992	470	55	13	8
1993	403	50	3	3
1994	333	38	2	2
1995	349	38	4	2
1996	253	38	1	1
1997	407	45	0	0
1998	291	37	0	0
1999	240	40	0	0
2000	242	38	1	1
2001	602	38	1	1
2002	530	49	3	2
2003	827	50	4	2
2004	1.279	51	35	6
2005	1.160	48	7	1
2006	1.359	52	157	26
2007	1.757	54	174	32
2008	1.775	48	463	35
2009	1.370	44	340	33
2010	905	38	87	15
2011	929	33	97	20
2012	620	25	38	10
2013	664	29	23	13
2014	625	24	13	6
2015	639	18	13	4
2016	767	14	27	3
2017	863	14	16	4
2018	666	15	39	9
2019	543	15	5	3

Diagnostic method: ELISA (enzyme-linked immunosorbent assay).

Laboratory: Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Enteric redmouth disease (*ERM*)

Enteric redmouth disease (*ERM*) is endemic in the wild environment. *ERM* is not a notifiable disease, according to Act no. 25/1993. Routine targeted samplings have been performed since 2015 with a focus on salmon broodstock given eggs for export.

See Table 10.

Sampling plan for 2020:

≈ 1.000 samples tested by Real-time RT-PCR.

Table 10. Number of samples analyzed for *ERM* – Enteric redmouth disease:

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2015	31	2	31	0
2016	496	2	496	0
2017	1.263	2	1.263	0
2018	1.444	2	1.444	0
2019	943	2	943	0

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Piscirickettsiosis / Salmon rickettsial septicaemia (*SRS*)

Piscirickettsia salmonis has never been detected in Iceland. It is a notifiable disease, according to Act no. 25/1993. The bacteria has been a problem in Atlantic salmon farming in some areas in Norway and Chile. Some targeted samplings have been performed in the Icelandic broodfish farms since 2018 on a demand from a foreign research company that must make a clear claim about all infectious agents used in infectious disease research and vaccine development.

See Table 11.

Sampling plan for 2020:

≈ 30 samples tested by Real-time RT-PCR.

Table 11. Number of samples analyzed for *SRS* – Piscirickettsiosis:

Year	Number of <u>individuals</u> sampled	Number of <u>farms</u> sampled	Number of <u>negative</u> samples	Number of <u>positive</u> samples
2018	12	2	12	0
2019	23	2	23	0

Diagnostic method: Real-time RT-PCR.

Laboratory: Food and Veterinary Agency, Department of Fish and Animal Diseases in the Faroe Islands and Institute for Experimental Pathology at Keldur in Reykjavik, Iceland.

Gyrodactylosis (*Gyrodactylus salaris*)

Gyrodactylus salaris has never been detected in Iceland. It is a notifiable disease, according to Act no. 25/1993. The official surveillance also includes farms raising wild salmonids for restocking of rivers and lakes. Icelandic hatcheries rearing fingerlings to the smolt stage are all using ópathogen free ground water without any presence of wild fish.