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The Icelandic Radiation Safety Authority Environmental Monitoring Measurements 2016 - 2020

Environmental monitoring report

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ICELANDIC RADIATION SAFETY AUTHORITY

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Edition Nr 1

ISBN 978-9935-9521-8-9

Reykjavík, October 2025

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Summary

Systematic monitoring of environmental radioactivity in Iceland has been conducted since the late 1980s. The present report summarizes the measurements from the Icelandic Radiation Safety Authority's regular monitoring of radioactive cesium (Cs-137) in the environment and foodstuffs during the years 2016-2020.

The long-term monitoring program provides valuable data demonstrating the stability and gradual decrease of residual radioactive fallout in Iceland's environment and food chain. Cs-137 has been measured systematically in air (airborne particulates), precipitation, cow's milk (fresh milk and milk powder), lamb meat, seawater, seaweed, fish, and other food products.

Results indicate that Cs-137 concentrations are steadily decreasing across all monitored media. Yearly averages for milk powder and fresh milk are approximately 5 and 0.5 Bq/kg, respectively; lamb meat averages about 7.5 Bq/kg; cod, as a reference fish species, averages 0.12 Bq/kg. These values remain well below Icelandic regulatory limits. The Cs-137 levels in Icelandic sea water averages around 1 Bq/m^3 and are well below international reference values.

Real-time gamma radiation monitoring is conducted at four weather stations across the country, where ambient levels are typically low.

1. Introduction

This report presents the results of monitoring measurements conducted by the Icelandic Radiation Safety Authority (IRSA) from 2016 to 2020, focusing on radioactive caesium (Cs-137) in the environment and in foodstuffs.

Cs-137 is a long-lived fission product released during nuclear weapons testing and nuclear reactor accidents, most notably the Chernobyl accident in 1986 and the Fukushima accident in 2011. Because it has a half-life of about 30 years and behaves chemically like potassium, Cs-137 can enter the food chain and accumulate in living organisms. Regular monitoring of Cs-137 in air, water, soil, and food is therefore essential to assess environmental contamination, verify compliance with safety standards, and ensure that public radiation exposure remains well below internationally accepted limits.

Systematic monitoring of environmental radioactivity in Iceland has been carried out since the late 1980s, following increased global awareness after the Chernobyl accident. However, measurable Cs-137 in Icelandic samples originates primarily from atmospheric nuclear weapons testing conducted in the 1950s and 1960s. Fallout from these tests was distributed globally and deposited trace amounts of Cs-137 across the Northern Hemisphere, including Iceland. The impact of later events such as Chernobyl (1986) and Fukushima (2011) on Iceland's environment has been negligible, and no significant increases in Cs-137 levels have been detected in subsequent years. The long-term monitoring program has therefore provided valuable data confirming the stability and gradual decline of residual fallout in Iceland's environment and food chain.

Cs-137 has continuously been measured in the following sample categories:

- Air (airborne particulates)
- Precipitation
- Cow's mlk (fresh milk and milk powder)
- Lamb meat
- Seawater
- Seaweed
- Fish
- Miscellaneous food products

Real-time gamma radiation monitoring instruments are located at four weather stations spread across the country.

Results from the environmental monitoring conducted by IRSA between 1989 and 2015 have been published almost annually and are available on the authority's website.

2. Regulatory limits and reference levels

Icelandic regulations stipulate maximum levels for radioactive substances in food. The levels are specified in the regulation *"Regulation on Various Contaminants in Foodstuffs"* (Icelandic: Reglugerð um ýmis aðskotaefni í matvælum) [1]. The regulation sets distinct limits

for milk and infant food, as well as for all other foodstuffs. The maximum permitted activity of cesium (Cs-134 and Cs-137) is 370 Bq/kg in milk and infant food, and 600 Bq/kg in other food products. Limits for other radionuclides, including strontium-90, iodine-131, plutonium-239, and americium-241, are also defined. These values apply to foods as consumed, with adjustments made for processed or dried products to account for concentration changes.

Limits for radioactive substances in marine environment is not specified in Icelandic regulations. However, Iceland, as a contracting party to the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, participates in regional efforts to monitor and control radioactive substances in the marine environment. Under OSPAR, Iceland is responsible for reporting data on radioactive discharges and concentrations in seawater, sediments, and marine biota within its waters.

For assessment purposes, OSPAR has established screening reference levels for radionuclides in seawater [2]. For Cs-137, the reference concentration in filtered seawater is set at 4.50 Bq/L. Concentrations exceeding this level trigger further evaluation and potential management actions. These reference values are not legally binding limits but serve as assessment criteria to guide monitoring and risk management.

3. Results (2016-2020)

3.1 Real-time monitoring of gamma radiation in Iceland 2016-2020

Monitoring of radiation levels is a part of Iceland's preparedness for radiological incidents. The results of the measurements show background radiation, which is generally low but varies by location and over time. For example, precipitation can wash radioactive substances from the atmosphere down to the ground. Figure 1 shows the location of the four real-time gamma radiation monitoring stations operated by the Icelandic Meteorological Office for IRSA.

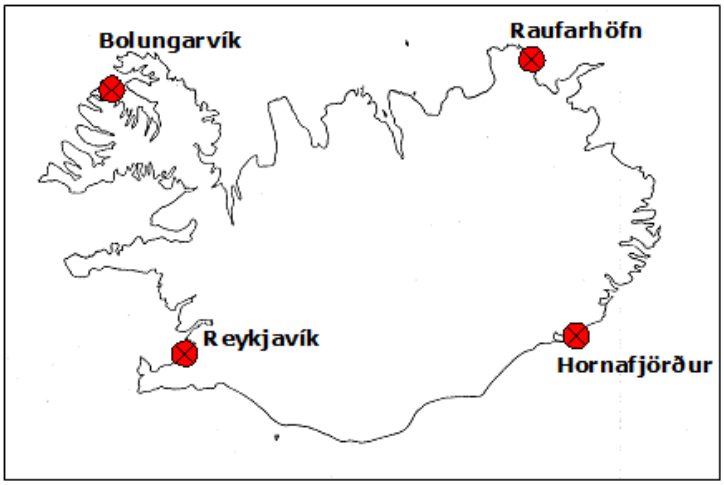

Figure 1: Locations of real-time gamma monitoring stations in Iceland.

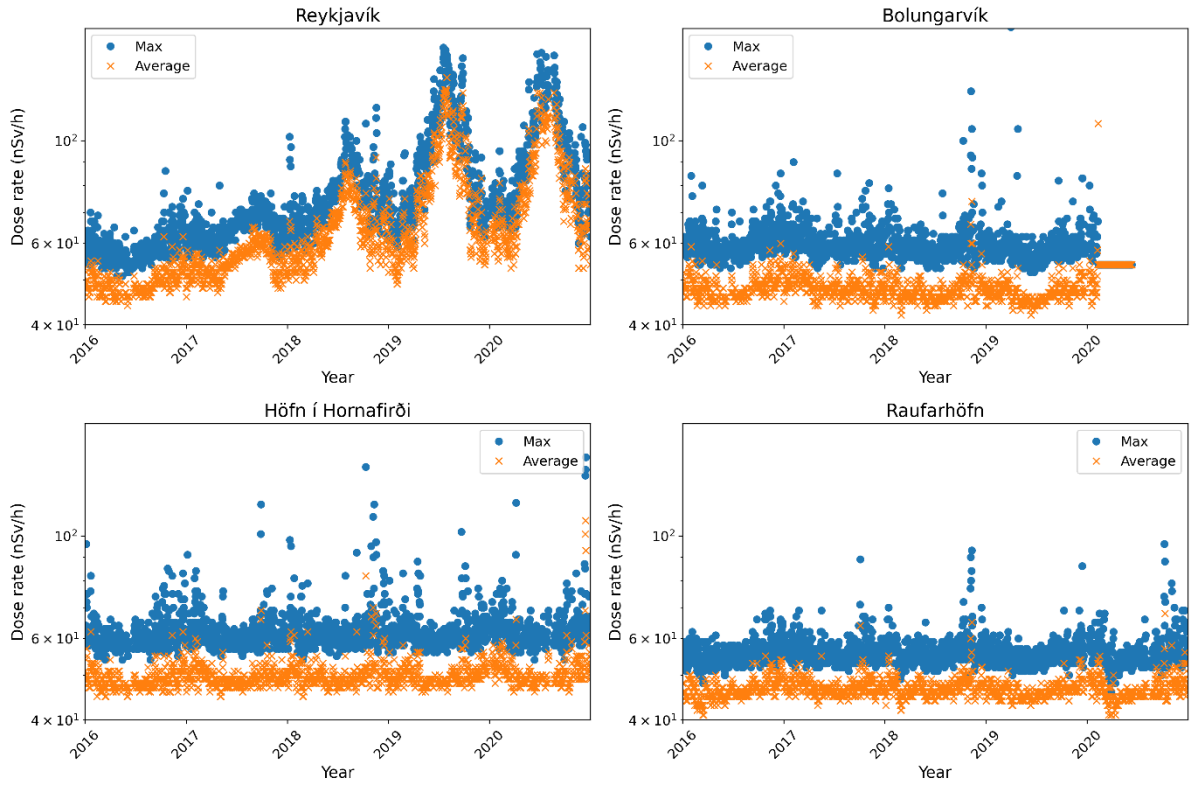

Figure 2: Results from the four measurement stations in Bolungarvík, Höfn í Hornafirði, Raufarhöfn and Reykjavík, respectively. Daily average dose rate is shown in orange, while daily maximum dose rate is shown in blue.

Figure 2 shows the daily measurements from the four stations in Iceland from January 1, 2016, to December 31, 2020. The daily averages (orange in the plots) in Bolungarvík, Höfn in Hornafirði and Raufarhöfn show steady dose rates well below 100 nSv/hour, while the daily maxima (blue dots in the plots) display more variation. For the data recorded from the station located in Reykjavík, it appears that there is a seasonal variation beginning in 2018 and steadily increasing. This, however, is not a real observation, but an artifact of a faulty detector, which has now been repaired.

3.2 Cs-137 in the environment and foodstuffs 2016-2020

3.2.1 Cs-137 in precipitation 2016-2020

Precipitation has for many years been collected by the Icelandic Meteorological Office at stations in Reykjavík and at Írafoss. As in measurements from previous years [3], Cs-137 is not detectable in the samples from 2016 to 2020. 8 samples in total were analyzed: two per station and year over the measurement period. Detection limits vary between samples but are usually around 1 µBq/l.

3.2.2 Cs-137 in airborne particulates 2016-2020

IRSA operates a monitoring station for radioactive particulate matter in the atmosphere on the premises of the Icelandic Meteorological Office at Bústaðavegur in Reykjavík. Airborne particles are collected using automated equipment operating continuously, 24 hours a day throughout the year. The routine daily measurements indicate consistently, over the entire

measurement period 2016-2020, Cs-137 concentrations below the detection limit, which is approximately 3 µBq/m³.

3.2.3 Cs-137 in milk and dairy products 2016-2020

The Icelandic Radiation Safety Authority has received samples of fresh milk (whole milk and low-fat milk) and milk powder from the main dairy producers in Iceland since the 1980s. The Authority receives monthly samples of fresh milk from MS Akureyri (whole milk) and from MS Selfoss (low-fat milk). The results from 2016 to 2020 are presented in Table 1.

Table 1: Concentration of Cs-137 in milk from MS Selfoss and MS Akureyri for the years 2016–2020. Absence of data for a given month indicates that no sample was available for that month.

Month	Low-fat milk, Selfoss Cs-137, Bq/kg	Uncertainty %	Whole milk, Akureyri Cs-137, Bq/kg	Uncertainty %
January 2016	0,67	5,50	0,35	5,11
February 2016	0,71	4,24	0,39	7,16
March 2016	0,70[1]	4,64	0,44	6,72
April 2016	0,56	4,93	0,28	9,61
May 2016	0,66	4,59	0,34	8,67
June 2016	0,68	2,77	0,34	4,20
July 2016	0,68	4,56	0,30	10,07
August 2016	0,58	2,92	0,44	6,17
September 2016	0,90	4,25	0,42	3,96
October 2016	0,73	4,45	0,50	5,95
November 2016	0,64	3,37	0,44	6,00
December 2016	0,64	4,52	0,42	6,40
Average 2016	**0,68**	**4.23**	**0,38**	**6,67**
January 2017	0,77	4,09	0,37	6,60
February 2017	0,62	4,93	0,39	6,90
March 2017	0,55	2,90	0,34	5,31
April 2017	0,64	4,84	0,36	4,80
May 2017	0,57	5,29	0,32	5,55
June 2017	0,30	4,53		
July 2017	0,56	5,28	0,28	8,35
August 2017	0,32	4,89	0,22	10,66
September 2017	0,69	4,42	0,34	3,63
October 2017	0,65	4,64		
November 2017	0,51	2,63	0,39	6,25
December 2017	0,54	2,92		
Average2017	**0,56**	**4.28**	**0,33**	**6,45**
January 2018	0,56	3,8	0,24	9,7
February 2018	0,48	5,8		
March 2018	0,52	3,8		
April 2018	0,51	4,1		
May 2018	0,61	4,6	0,29	5,9
June 2018	0,43	6,1	0,30	5,9
July 2018	0,50	5,6	0,29	8,5
August 2018	0,60	3,6	0,30	15,6
September 2018	0,48	3,4	0,31	4,4
October 2018	0,54	5,1	0,33	7,8
November 2018	0,40	4,0	0,33	5,5
December 2018	0,34	4,2	0,22	10,1
Average 2018	**0,50**	**4.1**	**0,30**	**8.2**
January 2019	0,49	6,1	0,24	9,7
February 2019	0,40	3,7	0,27	8,5
March 2019	0,47	4,3	0,20	8,5
April 2019	0,31	5,5	0,31	4,27
May 2019			0,29	6,37
June 2019	0,52	6,2	0,29	6,37

July 2019	0,47	3,04	0,22	4,02
August 2019	0,49	6,3	0,35	7,07
September 2019	0,73	5,08	0,32	3,98
October 2019	0,53	3,57	0,33	7,78
November 2019	0,63	4,78		
December 2019	0,48	6,68	0,35	8,25
Average 2019	**0,50**	**5,02**	**0,29**	**6,80**
January 2020	0,52	5,33	0,34	4,50
February 2020	0,60	2,92		
March 2020	0,58	5,21	0,28	9,90
April 2020	0,39	2,71	0,35	7,07
May 2020	0,57	4,99	0,29	9,67
June 2020			0,30	8,15
July 2020	0,52	6,06	0,31	8,60
August 2020	0,67	5,01	0,35	7,98
September 2020	0,43	5,93	0,19	11,07
October 2020	0,48	5,54	0,74	7,23
November 2020	0,54	4,72	0,31	2,66
December 2020	0,55	5,63	0,35	4,55
Average2020	**0,53**	**4.91**	**0,35**	**7,40**

The Cs-137 activity in milk from MS Akureyri during the monitored period varies between approximately 0.2 and 0.5 Bq/l. For milk samples from MS Selfoss, the concentration varies between approximately 0.3 and 0.7 Bq/l. For both datasets, the activity levels display a decreasing tendency over time.

Samples of milk powder are received monthly from MS Selfoss. The results from milk-powder samples collected during the years 2016 to 2020 are presented in Table 2.

Table 2: Concentration of Cs-137 in milk powder samples from MS Selfoss for the years 2016–2020. Absence of data for a given month indicates that no sample was available for that month.

Month	Concentration Cs-137, Bq/kg	Uncertainty %
January 2016	5,68	2,20
February 2016	5,52	5,13
March 2016	7,95	2,14
April 2016	8,08	2,21
May 2016	5,40	2,77
June 2016	6,36	5,38
July 2016	4,86	5,15
August 2016	6,23	3,59
September 2016	5,26	3,90
October 2016	6,06	2,02
November 2016	7,94	3,40
December 2016	5,83	4,16
Average 2016	**6,26**	**3.50**
January 2017	5,32	4,55
February 2017	5,00	4,60
March 2017	7,11	2,79
April 2017		
May 2017	5,12	2,58
June 2017	4,35	3,63
July 2017	7,01	2,48
August 2017	3,90	2,65
September 2017	4,40	1,56
October 2017	5,26	3,16
November 2017	6,27	4,68
December 2017	6,97	8,01
Average2017	**5,52**	**3,70**

January 2018	5,45	4,06
February 2018	5,71	4,34
March 2018	6,46	4,02
April 2018	4,82	4,93
May 2018	4,08	5,79
June 2018	4,19	4,89
July 2018	3,80	3,09
August 2018	3,30	3,15
September 2018	3,77	3,95
October 2018	4,27	
November 2018	4,93	
December 2018	3,57	6,16
Average 2018	**4,53**	**4,44**
January 2019	5,23	9,90
February 2019	3,15	3,22
March 2019	3,51	4,14
April 2019	3,53	5,96
May 2019	4,37	3,05
June 2019	3,35	4,96
July 2019	6,28	4,96
August 2019	5,17	3,35
September 2019	5,04	4,53
October 2019	6,03	2,05
November 2019	4,66	4,36
December 2019	4,49	6,29
Average 2019	**4,57**	**4,73**
January 2020	4,18	2,01
February 2020	3,19	3,20
March 2020	3,11	3,37
April 2020	3,68	2,12
May 2020	3,75	4,14
June 2020	1,86	5,36
July 2020	6,13	2,85
August 2020	3,47	4,39
September 2020	5,57	2,52
October 2020	5,73	5,73
November 2020	4,95	4,83
December 2020	7,38	2,27
Average 2020	**4,42**	**3,57**

The Cs-137 activity in milk powder during the monitoring period is between approximately 3 and 8 Bq/kg. Since milk powder is produced by removing the water from fresh milk, resulting in a more concentrated product, this result is expected.

3.2.4 Cs-137 in lamb meat 2016-2020

Lamb meat is collected annually during the slaughter season through the Icelandic Food and Veterinary Authority (Icelandic: Matvælastofnunar). The results of Cs-137 measurements in lamb meat for the years 2016 to 2020 are presented in Table 3.

Table 3: Concentration of Cs-137 in lamb meat samples, 2016-2020

Year	Producer	Concentration Cs-137 Bq/kg	Uncertainty %
2016	Norðlenska Höfn	9,00	0,89
2016	Norðlenska Höfn	1,71	2,61
2016	Norðlenska Höfn	6,05	1,38
2016	Norðlenska Höfn	18,54	0,67
2016	Norðlenska Höfn	13,38	1,73
2016	Norðlenska Húsavík	10,70	0,86

2016	Norðlenska Húsavík	5,78	0,68
2016	Norðlenska Húsavík	5,81	1,21
2016	Norðlenska Húsavík	4,08	1,53
2016	Norðlenska Húsavík	3,67	1,13
2016	Fjallalamb Kópasker	5,04	1,28
2016	Fjallalamb Kópasker	6,60	1,17
2016	Fjallalamb Kópasker	0,82	3,04
2016	Fjallalamb Kópasker	0,62	8,82
2016	Fjallalamb Kópasker	2,39	3,03
2016	KS Sauðárkróki	2,55	5,15
2016	KS Sauðárkróki	23,80	0,91
2016	KS Sauðárkróki	3,75	2,15
2016	KS Sauðárkróki	4,50	1,93
2016	KS Sauðárkróki	7,26	1,19
2016	SS Selfoss	13,19	0,83
2016	SS Selfoss	4,62	1,43
2016	SS Selfoss	3,18	1,78
2016	SS Selfoss	8,11	1,09
2016	SS Selfoss	4,59	1,55
2016	**Average**	**6,79**	**1,92**
2017	KS Sauðárkróki	7,23	2,23
2017	KS Sauðárkróki	12,59	0,78
2017	KS Sauðárkróki	9,11	0,88
2017	KS Sauðárkróki	14,76	0,81
2017	SS Selfoss	15,75	0,37
2017	SS Selfoss	2,51	1,92
2017	SS Selfoss	7,00	1,18
2017	SS Selfoss	10,54	0,65
2017	SS Selfoss	10,51	0,91
2017	**Average**	**10,00**	**1,08**
2018	Norðlenska Húsavík	7,32	0,72
2018	Norðlenska Húsavík	6,07	0,89
2018	Norðlenska Húsavík	16,47	0,73
2018	Norðlenska Húsavík	11,81	0,89
2018	Norðlenska Húsavík	6,44	2,69
2018	Kaupfélag Skagfirðinga	8,24	0,52
2018	Kaupfélag Skagfirðinga	3,75	1,65
2018	Kaupfélag Skagfirðinga	6,65	1,21
2018	Kaupfélag Skagfirðinga	7,58	0,99
2018	SAH Blönduós	20,18	0,65
2018	SAH Blönduós	6,33	1,19
2018	SAH Blönduós	12,58	0,85
2018	SAH Blönduós	1,10	3,66
2018	SS Selfoss	15,04	0,38
2018	SS Selfoss	7,17	1,13
2018	SS Selfoss	2,47	1,11
2018	SS Selfoss	2,85	1,07
2018	Mast Akureyri	2,87	1,89
2018	**Average**	**8,05**	**1,23**
2019	KVH Hvammstanga	9,90	0,53
2019	Kaupfélag Skagfirðinga	6,31	1,23
2019	KVH Hvammstanga	15,79	0,50
2019	KVH Hvammstanga	4,94	1,50
2019	KVH Hvammstanga	23,36	0,42
2019	SAH Blönduós	9,65	0,90
2019	SAH Blönduós	7,37	0,65
2019	SAH Blönduós	7,27	1,32
2019	SAH Blönduós	5,66	6,71
2019	SS Selfoss	1,99	4,97
2019	SS Selfoss	3,46	1,94
2019	SS Selfoss	3,77	2,28
2019	SS Selfoss	7,42	1,02

2019	Norðlenska Húsavík	5,68	1,35
2019	Norðlenska Húsavík	1,37	2,81
2019	Norðlenska Húsavík	1,66	2,66
2019	Norðlenska Húsavík	11,04	0,72
2019	**Average**	**7,45**	**1,85**
2020	Fjallalamb Kópasker	13,14	0,67
2020	Fjallalamb Kóðasker	0,63	2,78
2020	KVH Hvammstanga	16,32	0,57
2020	KVH Hvammstanga	8,60	1,03
2020	Norðlenska Húsavík	12,51	0,68
2020	SAH Blönduós	2,87	0,99
2020	SAH Blönduós	3,04	1,26
2020	SAH Blönduós	9,58	0,73
2020	KVH Hvammstanga	2,74	2,54
2020	KVH Hvammstanga	13,56	0,72
2020	KVH Hvammstanga	2,53	2,00
2020	KVH Hvammstanga	7,22	0,87
2020	KVH Hvammstanga	4,66	1,27
2020	SS Selfoss	6,01	1,24
2020	SS Selfoss	17,95	0,61
2020	SS Selfoss	1,26	3,22
2020	Sláturfélag Vopnafirði	3,89	1,50
2020	Sláturfélag Vopnafirði	4,67	1,06
2020	**Average**	**7,28**	**1,32**

The results from measuring Cs-137 in lamb meat between 2016 and 2020 are shown in table 4.3. The activity ranges from 0.6 to 23 Bq/kg over the given period, but the general trend is that activity is decreasing over time. The average activity in 2016 is 6,79 Bq/kg, increases to 10,00 Bq/kg in 2017 and decreases in 2018 to 8,05 Bq/kg, to 7,45 Bq/kg in 2019 and 7,28 Bq/kg in 2020.

3.2.5 Cs-137 in fish 2016-2020

The Icelandic Radiation Safety Authority monitors Cs-137 in fish from Icelandic waters. Samples are obtained both from the Icelandic Food Research Institute (Matís), which collects specific samples annually, and from fish markets. Results from 2016 to 2020 are presented in Table 4.

Table 4: Concentration of Cs-137 in samples of fish from Icelandic waters (fresh weight). < before a value means that the minimum detectable activity (MDA) is displayed in the table and that the measured activity of the given sample is below the MDA.

Collection date	Species	Location	Concentration Cs-137 Bq/kg	Uncertainty %
06.12.2016	Ling *(Molva molva*)	Hornafjörður	0,14	10,02
06.12.2016	Cod *(Gadus morhua*)	Arnarstapi	0,11	15,08
28.12.2016	Cod *(Gadus morhua*)	Eskifjörður	0,10	16,88
01.12.2018	Plaice *(Pleuronectes platessa*)	Bolungarvík	<0,07	
01.12.2018	Ling *(Molva molva*)	Ólafsvík	0,15	8,19
01.12.2018	Cod *(Gadus morhua*)		0,09	11,05
01.12.2018	Haddock (*Melanogrammus aeglefinus*)	Grindavík	<0,04	
30.12.2019	Halibut (*Hippoglossus hippoglossus*)	Grundarfjörður	0,19	11,75
30.12.2019	Haddock (*Melanogrammus aeglefinus*)	Árskógssandur	0,14	14,13
01.12.2020	Carp *(Cyprinus carpio*)	Þórshöfn	0,10	1,03
01.12.2020	Cusk *(Brosme brosme*)	Þórshöfn	0,08	16,31
01.12.2020	Ling *(Molva molva*)	Höfn í Hornafirði	0,20	12,39
01.12.2020	Halibut (*Hippoglossus hippoglossus*)	Vestmannaeyjar	0,07	26,94

01.12.2020	Haddock (*Melanogrammus aeglefinus*)	Bolungarvík	0,06	12,22
07.12.2020	Plaice *(Pleuronectes platessa*)	Bolungarvík	0,06	29,44
07.12.2020	Cod *(Gadus morhua*)	Grindavík	0,18	11,50

The amount of Cs-137 in fish from Icelandic waters is very small, sometimes below the minimal detectable activity. The highest activity measured between 2016 and 2020 was 0.20 Bq/kg in a sample of ling.

3.2.6 Cs-137 in seaweed 2016-2020

Seaweed is collected at least once per year in Vestmannaeyjar (Heimaey). In addition, samples have been collected at various other locations in Iceland. Table 5 presents the results for seaweed samples collected from 2016 to 2020.

Table 5: Concentration of Cs-137 in seaweed samples. < before a value means that the minimum detectable activity (MDA) is displayed in the table and that the measured activity is below the MDA.

Sample date	Location	Concentration Cs-137 (Bq/kg)	Uncertainty %
01.08.2016	Fjörður (Reykhólar)	0,11	23,48
01.08.2016	Hvallátur	<0,08	
01.08.2016	Fagurey	<0,21	
01.08.2016	Fagurey	<0,17	
05.12.2016	Vestmannaeyjar	0,12	23,62
08.03.2017	Fagurey	<0,20	
22.01.2018	Fagurey	0,17	21,27
11.07.2018	Hrappsey	<0,07	
11.07.2018	Kiðey	<0,11	
18.07.2018	Kiðey	<0,07	
15.10.2018	Vestmannaeyjar	<0,08	
27.01.2019	Fagurey	0,23	12,0
06.02.2019	Fagurey	0,38	26,0
26.09.2019	Fjörður (Reykholar)	0,07	
07.01.2020	Purkey	<0,11	
31.01.2020	Ballará	0,16	29,55
01.04.2020	Vestmannaeyjar	<0,10	
14.05.2020	Miðjanes	0,10	22,57
27.07.2020	Miðjanes	0,14	22.42
15.12.2020	Vestmannaeyjar	<0,10	

A total of 20 samples were collected over the 5 years and Cs-137 was typically measured at activities between 0.1 and 0.2 Bq/kg. In 12 of 20 samples, Cs-137 was not detected above the detection limit, indicated in the table as < x.

3.2.7 Cs-137 in seawater 2016-2020

Seawater samples for radioactive substance analysis are collected annually during research cruises conducted by the Marine Research Institute (Icelandic: Hafrannsóknastofnun). The sampling locations for the period 2016–2020 are shown in Figure 3.

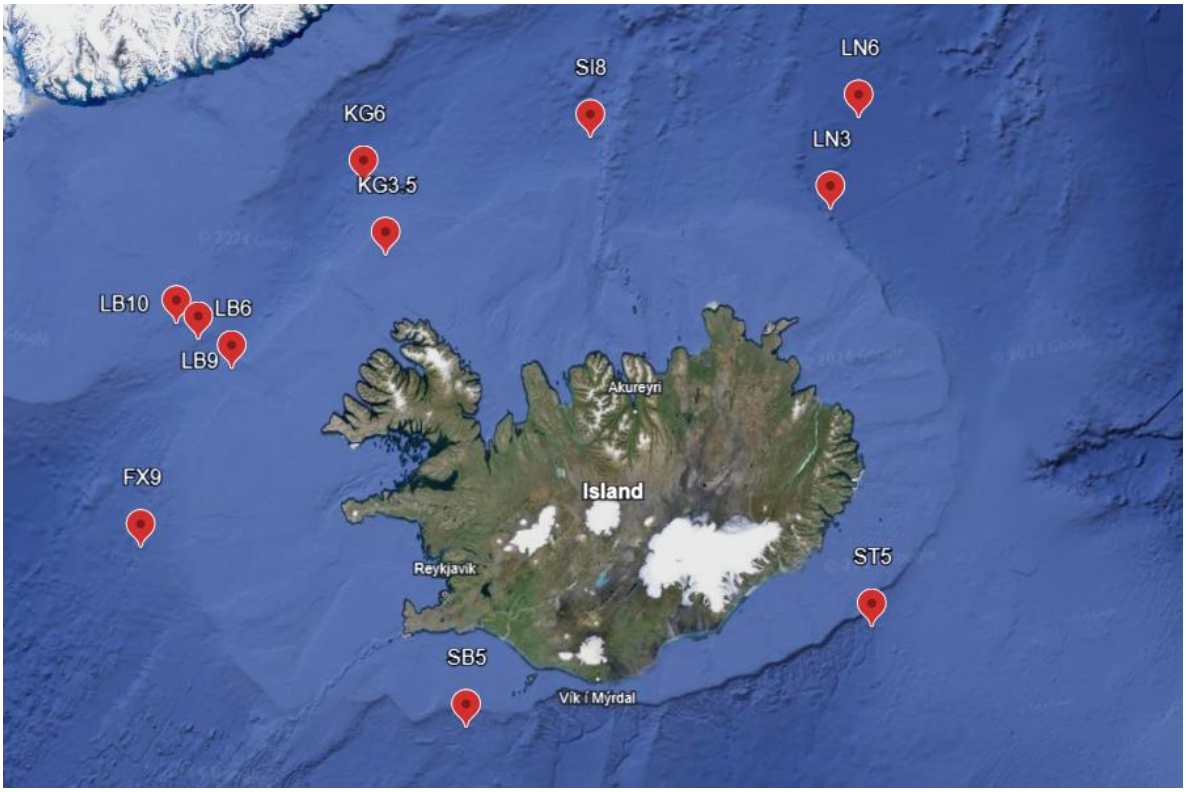

Figure 3: Map of Iceland with seawater sample locations.

Table 6 lists the sampling location with coordinates, organized by sampling date, along with details of each sample and the measured Cs-137 activity.

Table 6: Concentration of Cs-137 in Icelandic seawater. The table shows the latitude (N) and longitude (W) coordinates for the sample location, the sample depth (m), water temperature (°C), salinity in ppt, and Cs-137 concentration (Bq/ m^3) ± uncertainty. The sample locations are displayed in Figure 3.

Sample date	Sample location	Coordinate N	W	Depth m	Temperature °C	Salinity 0/00	Concentration Cs-137 (Bq/m^3)
17/02/2016	LB10	66°19’	27°37’	5	0,08	34,10	1,28 ± 0,10
20/05/2016	FX9	64°20’	27°58’	5	7,38	35,13	0,99 ± 0,11
26/05/2016	LN3	67°15’	13°34’	5	2,04	34,77	1,15 ± 0,10
04/02/2017	LB10	66°16’	27°45’	5	-0,22	34,44	1,82 ± 0,15
18/05/2017	LB9	66°09’	27°15’	5	6,10	35,02	0,91 ± 0,09
18/05/2017	LB6	65°56’	26°29’	5	6,23	35,01	1,95 ± 0,20
21/05/2017	SI8	68°00’	18°50’	5	2,85	34,85	1,42 ± 0,16
24/05/2017	LN6	68°00’	12°40’	5	3,07	34,76	1,52 ± 0,13
24/05/2017	LN3	67°15’	13°34’	5	4,90	34,82	1,09 ± 0,15
28/05/2017	ST5	63°40’	13°40’	5	9,54	35,12	0,55 ± 0,11
13/05/2019	FX9	64°20’	27°58’	5	7,16	35,03	0,97 ± 0,11
15/05/2019	LB6	65°56’	26°29’	5	6,70	35,00	0,93 ± 0,17
15/05/2019	LB9	66°27’	27°15’	5	6,80	35,02	0,98 ± 0,11
18/05/2019	KG6	67°35’	23°56’	5	2,31	34,69	1,44 ± 0,13
22/05/2019	SI8	68°00’	18°50’	5	5,63	34,95	0,92 ± 0,10
24/05/2019	LN3	67°15’	13°34’	5	3,58	34,82	1,43 ± 0,17
28/05/2019	ST5	63°40’	13°40’	5	8,53	35,17	1,51 ± 0,19
30/05/2019	SB5	62°59’	21°29’	5	9,66	35,07	1,37 ± 0,19
12/02/2020	LB10	66°15’	27°45’	5	1,32	34,33	1,23 ± 0,11
12/02/2020	LB9	66°09’	27°15’	5	-1,02	33,99	1,30 ± 0,11
12/05/2020	FX9	64°20’	27°58’	5	7,02	35,05	1,00 ± 0,12
15/05/2020	KG3.5	66°59’	23°22’	5	1,07	33,51	1,19 ± 0,12
18/05/2020	SI8	68°00’	18°50’	5	0,40	34,52	0,34 ± 0,03
21/05/2020	LN3	67°15’	13°34’	5	1,11	34,75	1,29 ± 0,09

Cs-137 activity in Icelandic seawater is generally very low. Between 2016 and 2020, the highest measured activity was 1.95 Bq/m³ at location LB6 in May 2017, while typical values are around 1 Bq/m³. The residual Cs-137 in Icelandic seawater primarily originates from nuclear weapons tests conducted during the 1950s and 1960s.

3.2.8 Cs-137 in miscellaneous samples 2016-2020

Occasionally, samples of foodstuffs beyond the routinely monitored media are analyzed. The Cs-137 concentrations measured in these samples are presented in Table 7.

Table 7: Concentrations of Cs-137 in miscallaneous samples. < before a value means that the minimum detectable activity (MDA) is displayed in the table and that the measured activity is below the MDA.

Date	Sample type	Location	Cs-137, Bq/kg	Uncertainty %
07.04.2016	Chicken		0.06 ± 0.0046	20,98
08.04.2016	Beef		3.07 ± 0.28	0,91
16.07.2016	Polar bear	Norðurland/Grænland	0.26 ± 0.017	6,52
16.07.2016	Polar bear	Norðurland/Grænland	0.22 ± 0.022	10,07
23.11.2016	Chicken		0.04 ± 0.011	26,69
25.11.2016	Beef		2.25 ± 0.049	2,17
31.12.2016	Sausage	Hvolsvöllur	1.21 ± 0.038	3,15
23.02.2018	Egg	Sveinsstaðir (Vesturland)	< 0.04	

During the period 2016-2020, eight samples were measured: two chicken samples, two beef samples, one sausage sample, one egg sample and two samples from a polar bear shot in the North of Iceland in 2016. The Cs-137 activity in beef was measured at some Bq/kg, though less than the average levels found in lamb meat. The Cs-137 activity in chicken was measured very low, at less than 0.1 Bq/kg. In the sausage sample, the measured activity was a little over 1 Bq/kg and in the egg sample, the measured activity did not exceed the minimal detectable activity. The samples of the polar bear, which originated from Greenland, had a Cs-137 activity just over 0.2 Bq/kg.

4. Comparison with previous years

Figures 4 and 5 present an overview of Cs-137 concentrations in the primary sample categories: foodstuffs (Figure 4) and seawater (Figure 5). The figures illustrate the temporal evolution from the onset of monitoring for each respective sample type, thereby providing insight into long-term variations in Cs-137 levels.

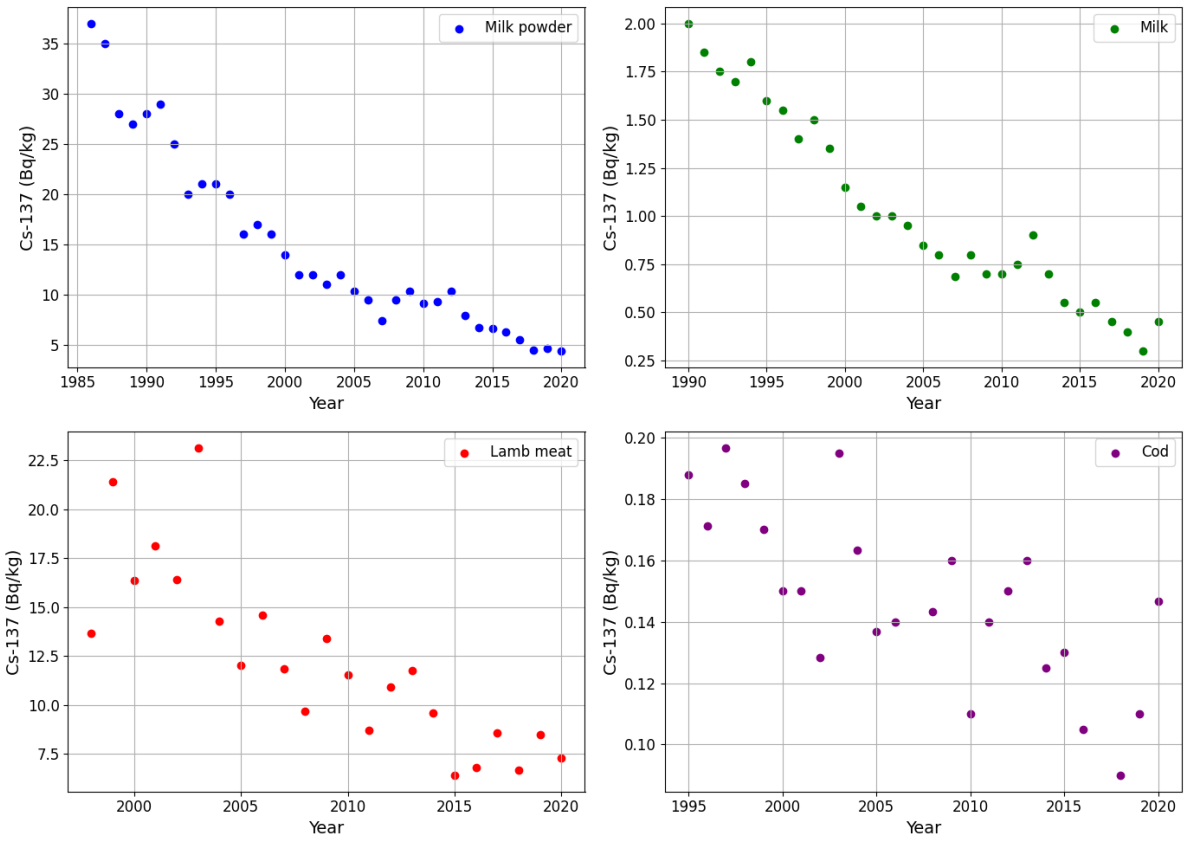

Figure 4: Cs-137 concentrations in milk powder (blue), milk (green), lamb meat (red), and cod (purple), showing the annual sample averages for each year from 1986 to 2020.

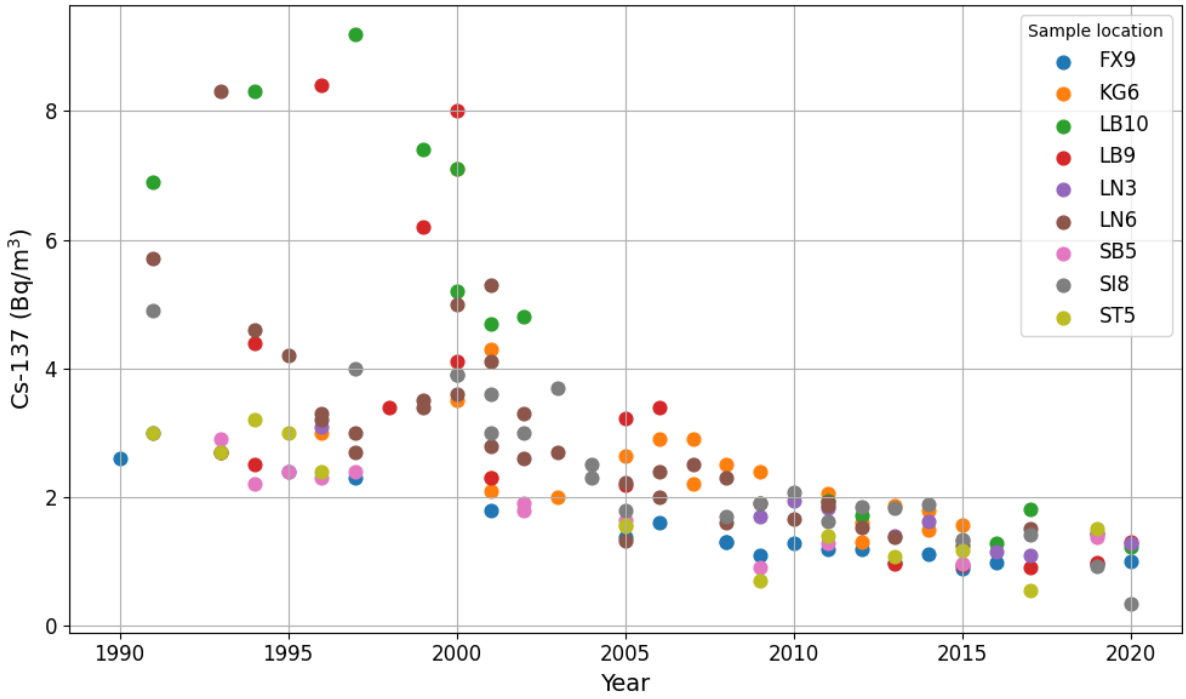

Figure 5: Cs-137 concentrations in seawater at various sampling locations. The sampling locations are shown in Figure 3.

As can be seen in figures 4 and 5, the Cs-137 levels are steadily decreasing in all environmental media monitored in Iceland. Yearly average concentrations of milk powder

and milk have decreased to around 5 and 0.5 Bq/kg, respectively. The average activity levels of lamb meat have decreased to about 7.5 Bq/kg and cod, as a reference fish sample, displays average concentrations of 0.12 Bq/kg. The concentration of Cs-137 in seawater has decreased to about 1 Bq/m^3 on average.

5. Conclusion

The environmental monitoring program of the Icelandic Radiation Safety Authority indicates that Cs137 activity in Icelandic environmental media and foodstuffs remains very low, consistently well below the prescribed regulatory limits. The authority notes that the observed activity levels continue to decline over time, in accordance with the radioactive decay of Cs137, with no indications of new releases. The ongoing environmental monitoring program is essential to confirm that activities remain low, to establish baseline data for potential new radionuclides, and to provide a reference framework for assessing any future radiological events or accidents.

6. Acknowledgement

The Icelandic Radiation Safety Authority expresses its profound appreciation to all collaborators across the country.

7. References

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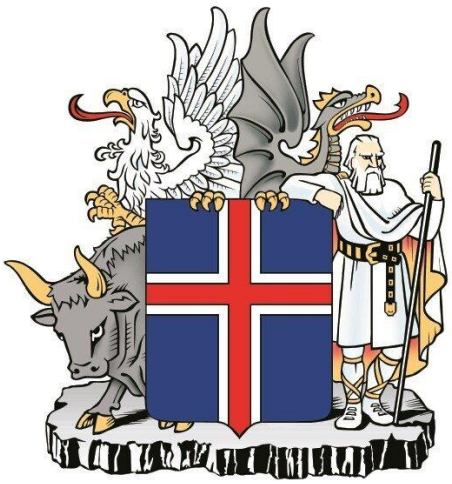

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