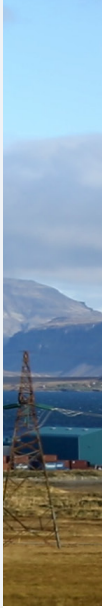


Environmental monitoring

GRUNDARTANGI INDUSTRIAL AREA

The results of the environmental monitoring of the Grundartangi industrial area in 2023 for freshwater, grass and ocean show that all the thresholds set in the operating permits and regulations were met. Air quality measurements for fluoride at Kríuvörðu were above the threshold limits set in Norðurál's operating permit. Other Air quality measurements were in all other cases below defined environmental limits. For those parameters for which reference values do not exist results are compared to background values and results from previous years.

The environmental monitoring of the industrial area at Grundartanga is carried out according to the environmental monitoring plan made in accordance with work permits and is approved by the Environment Agency. The companies that participate in the environmental monitoring are Elkem Ísland ehf., Norðurál Grundartanga ehf. and Alur Álvinnsla ehf.

Reports on the results of the monitoring can be found on the Environment Agency's website, www.ust.is.

Alur álvinnsla – endurvinnsla á áli – www.alur.is

Elkem – www.elkem.is

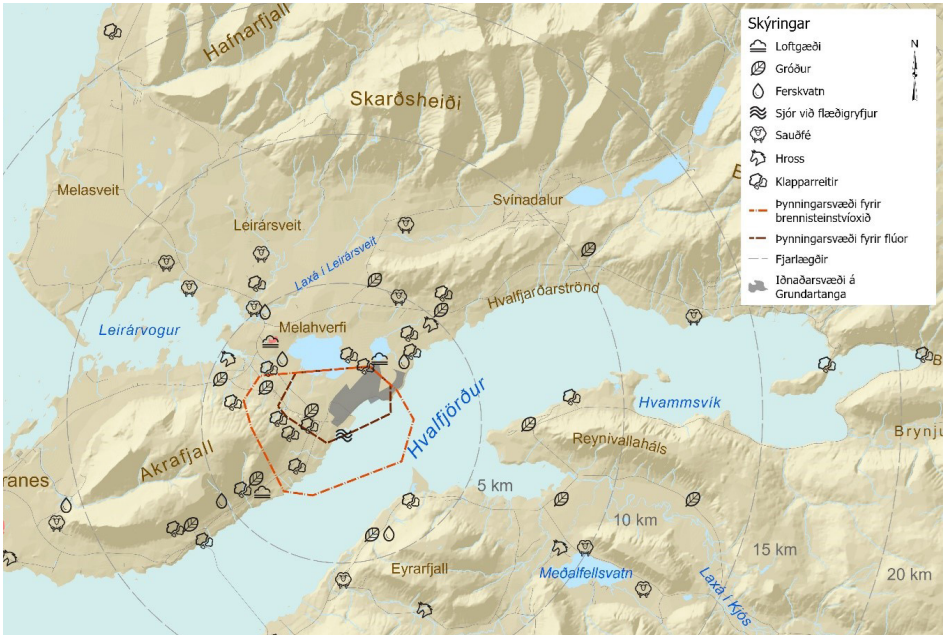
NORÐURÁL Century Aluminum – www.nordural.is

Results

RECEPTOR	PARAMETER	BELOW THRESHOLD	STATE OF AFFAIRS 2023
 AIR QUALITY	Fluorine Sulfur Other materials	✓ ✗	Fluorine levels at Kríuvarða were above the threshold limits set in Norðurál's operating permit. Fluorine, sulfur and other substances were in all other cases below defined environmental limits.
 FRESHWATER	Fluorine Sulfur Other materials	✓	The amount of fluoride has not changed in spring-fed rivers, but has increased in Kalmansá and Urriðaá compared to 1997.
 OCEAN OUTSIDE THE TIDAL LANDFILLS	Metals Cyanide Fluorine Other materials	✓	Insignificant effects are detected outside the seawater basins, similar to recent years.
 VEGETATION	Fluorine	✓	Fluorine in vegetation was in all cases below the tolerance limit of vegetation and below the regulatory limit for the amount of fluorine in fodder. Fluorine in grass and leaves is higher than it was in 1997.
 ROCK PATCHES	Vegetation changes of lichens and mosses. Sulfur in lichens. Fluorine in lichens.	✓	There is no visible damage to lichens directly attributable to air pollution from sulfur or fluorine. The average cover of mosses and lichens increased slightly on average between the years 2020 and 2023.
 SHEEP	Fluorine Teeth Forefoot joints	✓	Fluorine in lambs and adult sheep is higher than it was in 1997, and similar or lower than it was in 2007. There is no detectable effect of fluorine on the teeth and joints of sheep.
 HORSES	Teeth Forefoot joints	✓	There is no detectable effect of fluorine on the teeth and joints of horses.

When applicable, the results are compared with the results of 1997, before Norðurál's smelter started operating, and with 2007 when all the smelter's cells (pots) became operational.

Monitoring sites 2023



The environmental monitoring in Hvalfjörður is one of the most extensive environmental monitoring carried out in Iceland. It includes research and monitoring by independent parties with more than 70 parameters in and around Hvalfjörður. In 2023, about 450 samples were taken from 171 sampling sites. Provisions in Icelandic regulations or in the companies' operating licenses exist for about 30 of these parameters. For those parameters for which Icelandic environmental limits have not been defined, the results were compared with background values and results from previous years.

Key figures

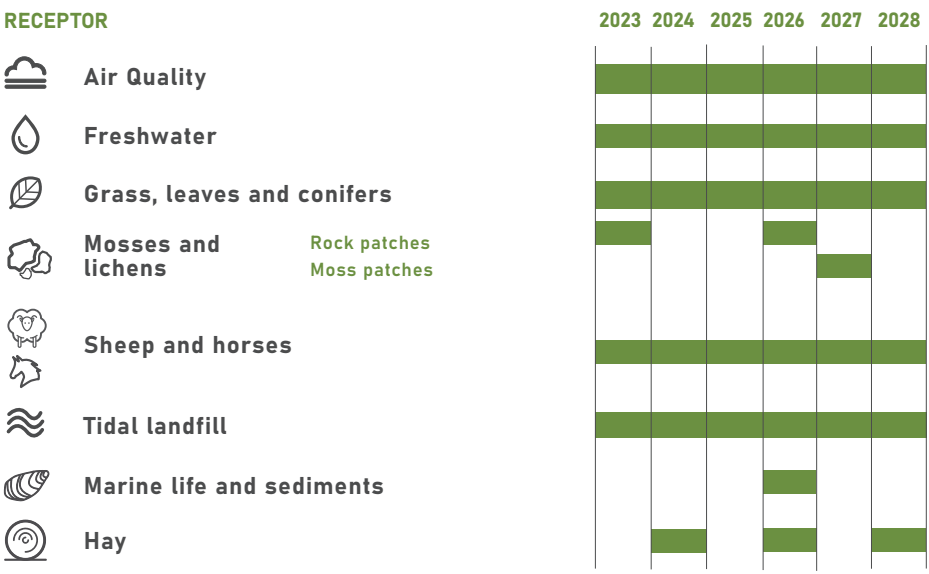
70
PARAMETERS

450
SAMPLES

171
SAMPLING SITES

Environmental monitoring schedule

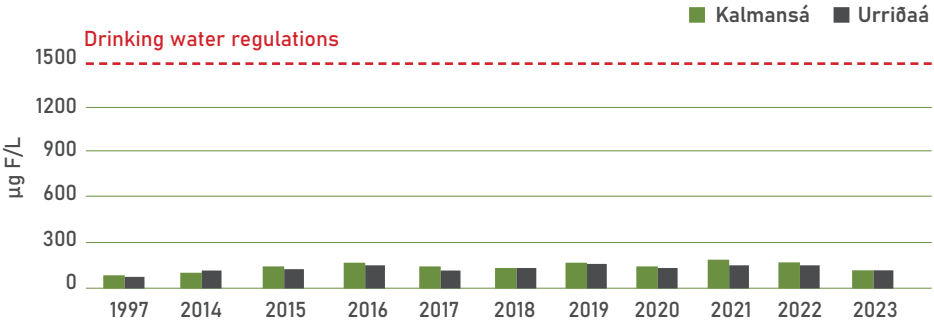
Obtained from the website of the Environment Agency, www.ust.is



Freshwater

Fluorine in freshwater

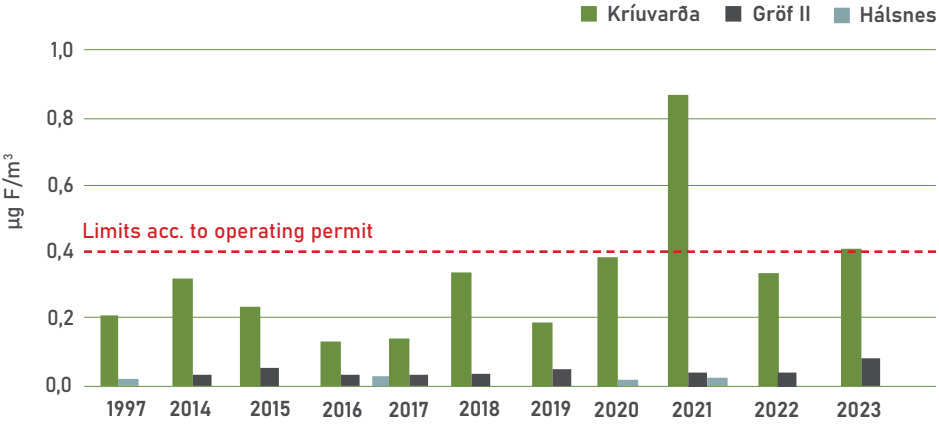
Fluorine was measured in six rivers in Hvalfjörður. Sources of two rivers are lakes located very close to the industrial area (Kalmansá and Urriðaá), while other rivers are fed by direct runoff (Berjadalsá, Fossá, Laxá and Kúludalsá). Fluorine measured four times lower in the runoff streams than in other monitoring streams. The acidity and average concentration of fluorine and sulfate in all rivers were within the limits defined in the drinking water regulation.



Air quality

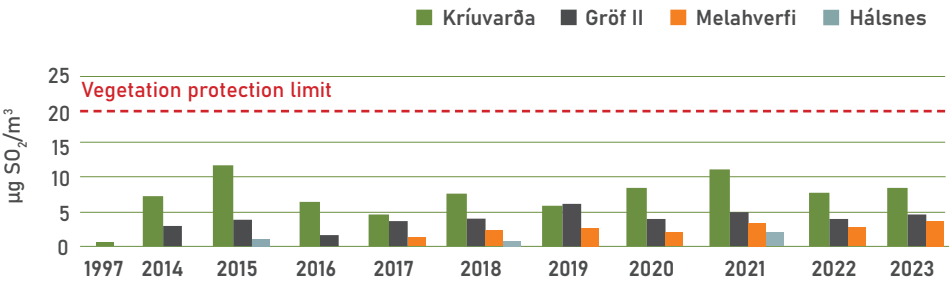
Total fluorine in the atmosphere (F)

Fluorine was measured at two monitoring stations. The concentration of total fluorine (F), i.e. the combined concentration of gaseous fluorine (HF) in the atmosphere and fluorine bound in dust at Kríuvörðu increased between years and was just over the threshold limit in Norðurál's operating permit. The amount of fluorine at Gröf was far below the permit's threshold.



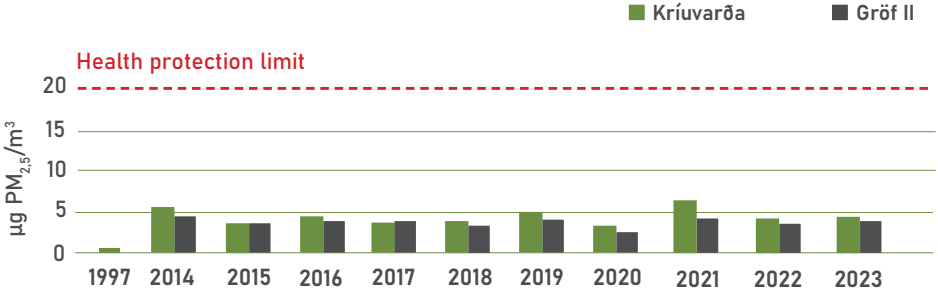
Sulfur dioxide (SO_2) in the atmosphere

Sulfur dioxide was measured at three monitoring stations. At all monitoring sites, higher SO_2 concentrations were measured in 2023 compared to 2022. Sulfur dioxide was in all cases below all defined thresholds.



Particulate matter ($PM_{2,5}$) in

Particulate matter in atmosphere was measured at two monitoring stations. The concentration was similar to previous years.



At all air quality monitoring stations, concentrations of hydrogen sulfide, nitrogen oxides, particulate matter and benzo(a)pyrene were in all cases below defined limits.

Wojciech Sasinowski, project manager at the Marine Research Institute, performing regular maintenance tasks at the air quality station at Gröf II.

Tidal landfills

Wojciech Sasinowski collecting samples in Hvalfjörður.

Metals, cyanide, fluorine and other substances are measured in ocean samples taken just outside the tidal landfills every year.

Average concentration of chemicals in ocean samples

Insignificant levels of pollution can be observed outside the tidal landfill, and the monitoring results for the year 2023 are similar or lower than those measured in recent years. Concentration in all samples was below the concentration considered to be able to affect sensitive ecosystems or thresholds in Norðurál's operating permit.

	As	Cr	Cu	Ni	Pb	Zn	Al*	Fe**	F*	CN**
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L
2016	1,7	1,6	0,6	1,3	<0,3	3,4		67	0,8	<0,005
2017	1,8	0,4	1,0	0,35	<0,3	1,5	22	56	1,3	<0,005
2018	1,5	0,27	1,0	0,66	<0,3	3,4	32	39	1,3	<0,005
2019	1,6	0,23	0,5	0,54	<0,3	1,4	28	35	1,4	0,005
2020	2,1	0,24	0,6	0,55	<0,3	<2	28	34	1,4	<0,005
2021	1,8	0,56	0,6	0,89	<0,3	2,4	30	48	1,3	<0,001
2022	1,5	0,23	0,8	1,01	<0,3	1,4	39	33	1,3	<0,002
2023	1,6	0,22	0,7	0,51	<0,3	<2	23	30	1,3	<0,010

Colors refer to environmental limits according to regulatio 769/1999.

Very small or no risk of effects Small risk of effects

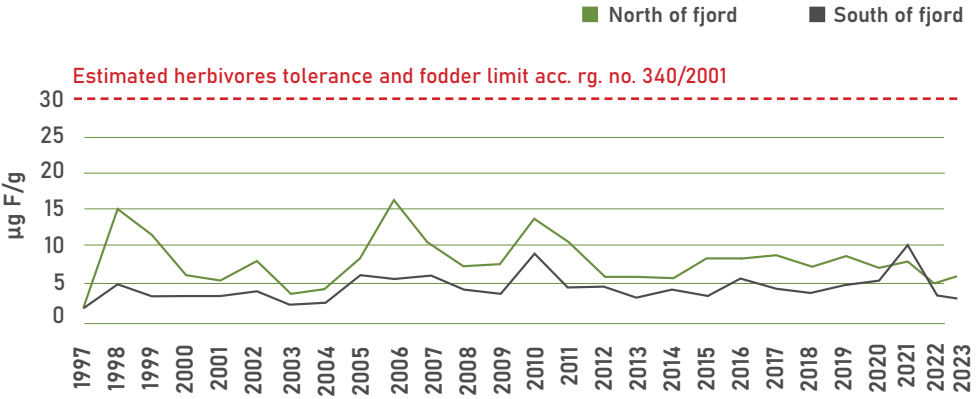
* Reference limits in Norðurál's operating permit for cooling water that can be discharged into the ocean: aluminum <20 mg/l and fluorine ≤ 50 mg/l

** Environmental limits not defined

Vegetation

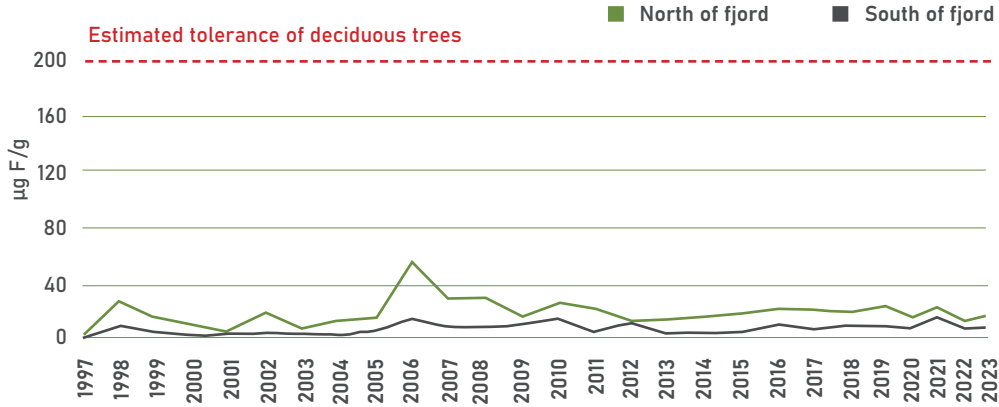
Fluorine in grass

Samples of grass were collected from 12 monitoring sites in Hvalfjörður. Fluorine was in all grass samples below the fodder reference values and the estimated tolerance limits of herbivores. Fluorine in grass in 2023 increased slightly from the previous year. There was an increase in the average concentration of fluorine in grass both north and south of the fjord, compared to 1997.



Fluorine in leaves and conifer

Samples of leaves and conifer were collected from 13 monitoring sites in Hvalfjörður. Fluorine was in in all samples below the tolerance limit of deciduous and coniferous trees. The average concentration of fluorine in leaves in 2023 was similar to the concentration in previous years. There was an increase in the average concentration of fluorine in leaves both north and south of the fjord, compared to 1997.



Sampling site.

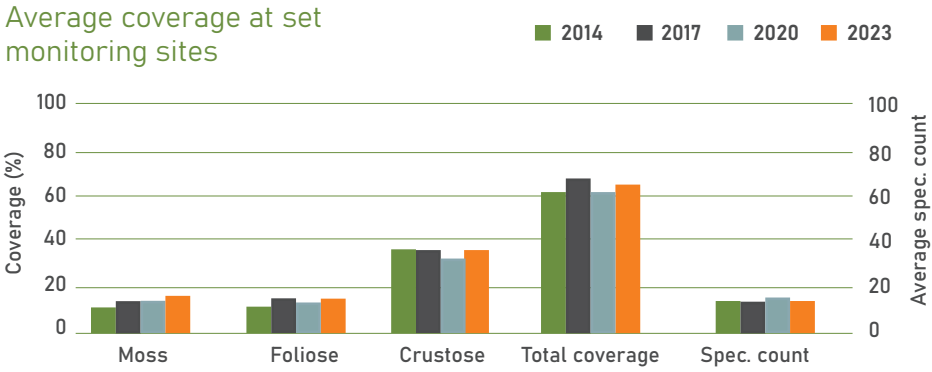
Rock patches

Starri Heiðmarsson from the Northwest Iceland Nature Research Center, conducting vegetation research.

Research on the communities of mosses and lichens is carried out every three years. There are 59 monitoring sites that are monitored, located both inside and outside dilution zones.

Thinning area

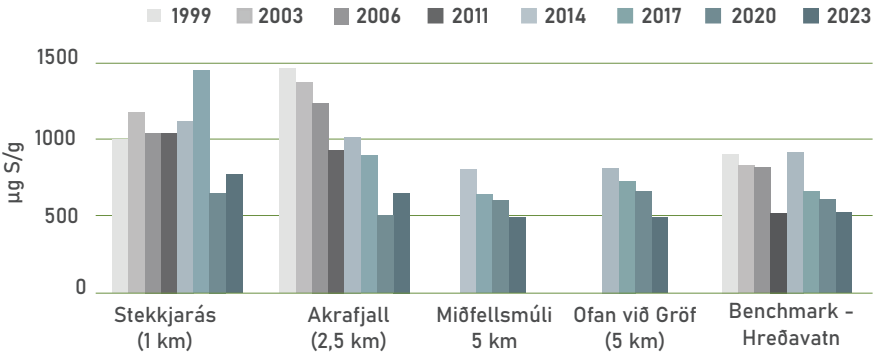
The coverage of moss and lichen increased slightly on average compared to the year 2020. There was some variation in coverage changes, but there was no detectable difference between fields inside or outside the thinning area.



Sulfur and fluorine in lichen

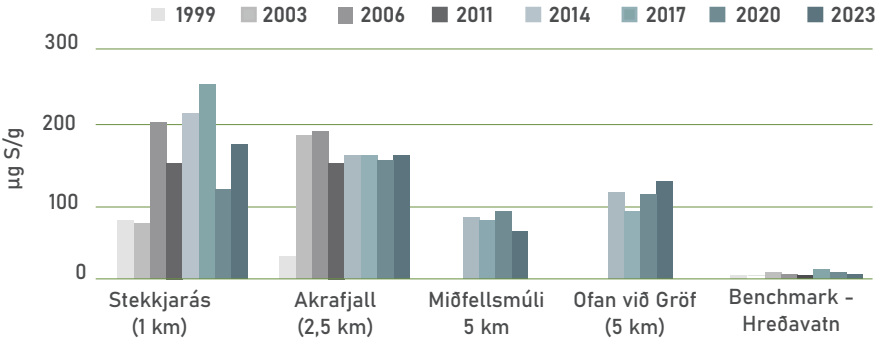
There is no visible damage to lichen that can be directly attributed to air pollution due to sulfur or fluoride. The concentration of sulfur increased in one lichen specie at sites closer to the industrial plants compared to the year 2020, but decreased at sites further away and the concentration at those sites is similar to that in reference samples from Hreðavatn in Borgarfjörður.

Sulfur in salted shield lichen



The concentration of fluorine in salted shield lichen either increased or decreased compared to the year 2020. The concentration increased the most at sites within the thinning area at Stekkjarás, where the highest concentration of fluorine was measured.

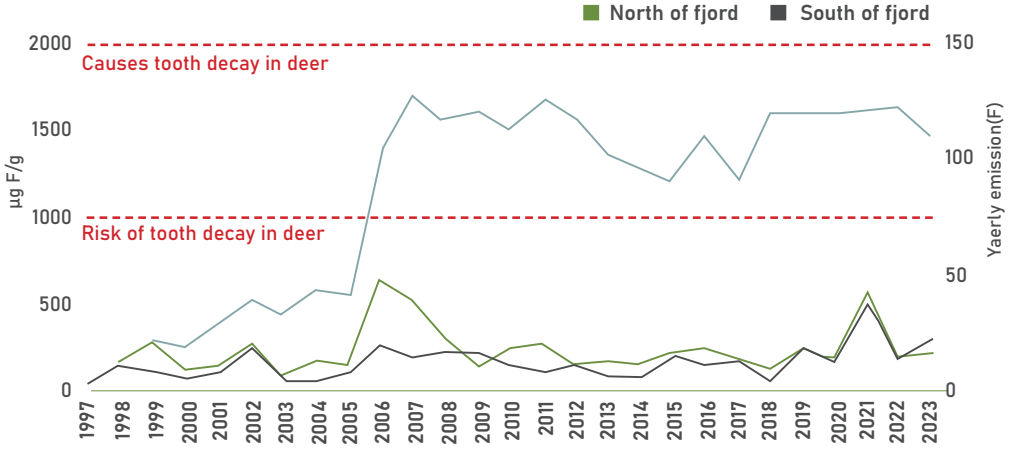
Fluorine in salted shield lichen



Herbivores

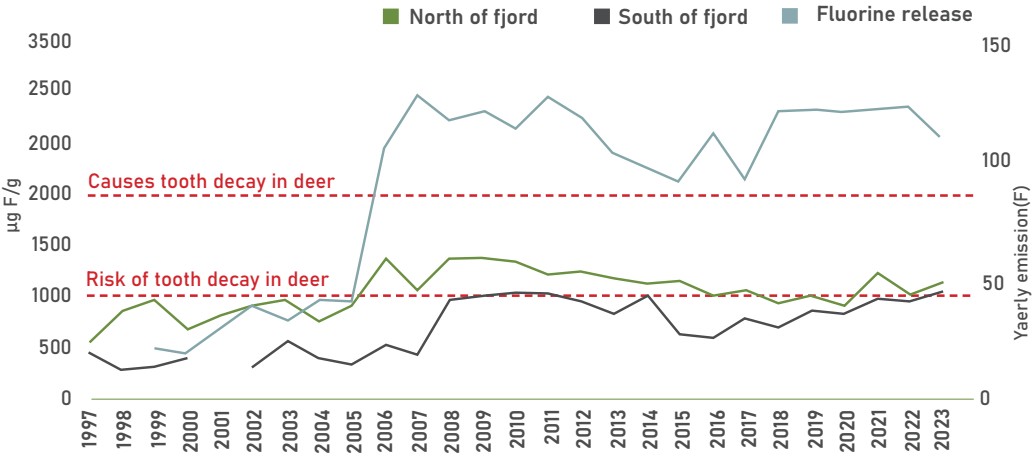
Lambs - North and south of Hvalfjord

Fluorine is measured in the jawbones of lambs from 10 farms north and south of Hvalfjörður. The average fluorine concentration in lambs north of the fjord in 2023 was significantly higher than that measured in 1997, but lower compared to 2007. South of the fjord, the concentration was higher than in 1997 but unchanged compared to 2007. In both regions, the average fluorine concentration was similar in 2023 to the one in 2022. Research is not available on the effect of fluorine on the teeth of sheep, so the results of a Norwegian study from 1990–1996 on young deer (1.5 years old) near an aluminum smelter are used as a reference. In 2023, there was no difference between the average concentration of fluorine in lambs north and south of the fjord.



Adult sheep - North and south of the fjord

Fluorine is measured in adult sheep (six years or older) from 11 farms north and south of Hvalfjörður. In 2023, there was no significant change in the average concentration of fluorine in adult sheep north of Hvalfjörður compared to 2007, but a significant increase compared to 1997. South of the fjord, there was a significant increase in the average concentration compared to 2007, but not compared to 1997. In 2023, there was insignificant difference between the average concentration of fluorine in adult sheep north and south of the fjord.



There is no detectable effect of fluorine on the teeth and joints of sheep and horses. The condition of the teeth of horses and sheep was assessed as normal, and no changes were observed in the joints of the animals that were examined.