Freshwater

Innholdsfortegnelse

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Norway's rivers and lakes provide a rich and varied freshwater environment, which is under less pressure from human activity than many countries in Europe. Challenges still remain as many rivers and lakes are affected by pollution, urbanisation, invasive alien species and hydropower regulation.

Norway has a huge variety of lakes and ponds, rivers and waterfalls. The freshwater environment is generally under less pressure than in most countries in Europe. Photo: Ib Aarmo, Flickr

A waterfall with its spray zone and surrounding mature boreal rainforest. This provides a suitable habitat for a variety of lichens and other species that require permanently moist conditions. Photo: Sigve Reiso, Naturarkivet.no

In many countries, groundwater is the main source of drinking water, whereas Norway has abundant supplies of surface water and takes only about 15 % of its drinking water from groundwater. Photo: iStockphoto.com

STATE

Conditions in rivers and lakes are generally good

Environmental conditions in Norwegian rivers and lakes are good compared with those in many other countries in Europe. For Norway as a whole, more than 60 per cent of all rivers and lakes have good or high ecological status. There are wide regional variations, and not surprisingly, environmental conditions are poorest where the population density is highest.

Norway has ten of the world's 35 highest waterfalls, but water flow in several of these has been affected by hydropower regulations. More than 70 per cent of Norway's largest rivers are regulated for hydropower production.

Only around seven per cent of Norway's fresh water is characterised as ground water, and accounts for a mere 15 per cent of the water consumption. This is very low compared to many other countries in Europe and is due to the country's abundant supply of surface water.

The map shows the water quality in the area around the Trondheim Fjord. You can zoom in to investigate further. You can click on each water body and read fact sheets (in Norwegian only). You can also click on "Explore maps" to see other topics, such as protected rivers and river regulation.

IMPACT

40 per cent of Norway's watercourses at risk

Around 40 per cent of Norway's water courses have less than good ecological status. Long range transboundary pollution still causes acidification and brings hazardous substances to lakes and rivers, most severely in the south and in the north eastern part of the country. Partly as a result of this, concentrations of mercury are so high that advice against consumption of fish by pregnant and breastfeeding women has been issued.

Despite the introduction of numerous measures in recent years, acidification, eutrophication, hazardous substances, altered water flow, migration stops and spreading of invasive alien species still pose a problem. In the future, climate change is likely to escalate the problems, particularly with regards to increased run off and the spreading of alien species.

The wild salmon is threatened

The Norwegian wild salmon is threatened by several pressures, the most severe being the increase in numbers of sea lice in coastal areas with extensive aquaculture industry and escaped farmed salmon invading the rivers. Extensive aquaculture industry has led to an increase in numbers of sea lice in the fjords, representing a threat especially to migrating smolts heading for the ocean. Escaped farmed fish enter the rivers, disturbing spawning wild stock both by damaging spawning areas and by genetic mixing as they participate in the spawning. The salmon stocks are specially adapted to each river, and genetic mixing interferes with this unique adaptation and result in lesser production of salmon in the rivers.

According to the Norwegian Scientific Advisory Committee for Atlantic Salmon Management, the invasive parasite *Gyrodactylus salaris*, acid rain, regulation for hydropower purposes and physical alteration of river systems are threats that have been brought under control. Several rivers are undergoing treatment to remove *Gyrodactylus salaris*, and treatment will continue for years to come. Due to acidification, liming is still needed to prevent stocks from extinction. Norway has an international responsibility to protect its stocks of wild salmon, and faces many challenges in this respect as pressure is increasing.

Threatened freshwater species

According to the 2015 Norwegian Red List, there are 147 endangered freshwater species. A major challenge in Norway is loss of species and habitats due to morphological alteration associated with watercourse regulation, dumping, dredging, embankments in littoral zones and infilling of ponds. In addition, water quality is affected by nutrient runoff, pollutants and acid rain etc, putting additional strain on species. Alien species represent a threat through the invading of habitats and spreading of parasites and diseases.

PRESSURE

Pollution, alteration and biological pressures

In the last 50 years, there have been major changes in settlement patterns and patterns of leisure activity in Norway. More and more people have moved from rural districts to urban areas, and major improvements have been needed in the way wastewater from towns and urban areas is managed and treated. The changes in settlement patterns have put more pressure on watercourses near the largest urban areas. However, Norway utilizes only one per mil of its water resources, and water extraction puts little pressure on water resources.

Environmental pressures on Norwegian rivers and lakes can be divided into three main groups:

- **pollution:** includes point sources, emissions, and long-range transboundary pollution, which may result in acidification, eutrophication and the spread of hazardous substances
- **physical alteration**: mainly as a result of hydropower developments, but other examples are transport infrastructure, which may act as a barrier to fish migration, and canalisation of rivers for agricultural purposes
- **biological pressures:** include the introduction of alien species such as minnows and pondweed, the escape of farmed fish, and parasites such as salmon lice.

The most important pressures on Norwegian water bodies are long-range pollution and morphological alterations of water bodies, followed by pollution from agriculture and wastewater and invasive alien species.

Climate change an important future driver

Climate change is expected to cause an increase in nutrient runoff and may reduce the effect of measures to alleviate this problem. The need for additional measures to achieve runoff reductions is thus expected to increase. Climate change will make our watersheds more hospitable to alien species, and can pose a threat to some freshwater species.

The infrastructure for wastewater treatment is not dimensioned for the increase in precipitation, which most likely will be caused by climate change, resulting in increased discharges of pollutants to water bodies.

RESPONSE

Integrated management of water resources

The EU Water Framework Directive is incorporated into Norwegian law. The Norwegian Regulation on a Framework for Water Management, normally referred to as Vannforskriften (The Water Regulation), provides the basis for a comprehensive and sound management of freshwater resources with the aim of achieving good ecological and chemical conditions in freshwater, coastal waters and groundwater.

The Water Regulation divides Norway into river basin districts managed by eleven river basin district authorities; they are responsible for each river basin district. We also cooperate with our neighbouring countries Sweden and Finland in six water regions, mainly located in Sweden and Finland.

1. Hazardous chemicals, fresh water

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Long-range transboundary pollution and local inputs result in the deposition of heavy metals and persistent organic pollutants into lakes. High levels of mercury have been found in fish. Therefore, the Norwegian Food Safety Authority has issued general advice about the consumption of fresh water fish throughout the country.

Lake Mjøsa. Photo: Sindre Wimberger, Flickr.com

STATE

Heavy metals and persistent organic pollutants in lakes

Norwegian lakes have elevated levels of lead, cadmium and mercury. Of these, mercury is the dominant metal found in fish.

Many lakes have been examined for well-known persistent organic pollutants such as PCBs, DDT and dioxins. In recent years the levels of brominated flame retardants, PFAS, chlorinated paraffins and Bisphenol A have been surveyed as well. Some lakes have high levels of PCBs and brominated flame retardants. These are mainly influenced by local point sources. However, most Norwegian lakes have low levels of persistent organic pollutants.

IMPACT

Mercury in fish results in consumption warnings

Due to high levels of mercury in fresh water fish, the Norwegian Food Safety Authority has introduced nationwide advice against consumption of pike, perch over 25 centimetres long and large trout and char (over one kilo). Pregnant and nursing mothers should not consume such kinds of fish at all. Other people should not eat them more than once a month. Heavy metals such as lead and cadmium are not easily transferred from sediments to the food chain, thus posing smaller risk for human consumption.

Environmental monitoring has shown that in some lakes, such as the mainland lake Mjøsa and Ellasjøen situated at Bjørnøya, concentrations of persistent organic pollutants increase in animals at the top of the food chain. Trout in both Mjøsa and Ellasjøen have high levels of PCBs. In Mjøsa, elevated levels of brominated flame retardants and chlorinated paraffins have also been detected.

DRIVING FORCES

Long-range transportation and local sources

Hazardous chemicals in Norwegian lakes are introduced through air currents or local sources. The advice against consumption caused by mercury is mostly due to long-range transported inputs. In contrast to most Norwegian lakes, Mjøsa has been influenced by local point sources which have discharged mercury, PCBs and brominated flame retardants into the lake.

The high levels of hazardous chemicals in Ellasjøen are mainly due to excrements from seabirds that have caught contaminated fish at sea. In addition, heavy precipitation over Ellasjøen is also considered a reason for the high levels of hazardous chemicals detected in the lake.

PRESSURE

Lower inputs of lead, no reduction in mercury

The long-range transportation of lead has decreased. This is due to a reduction in the use of leaded petrol. There is however little evidence of a drop in inputs of mercury. Analyses of mercury content in perch fish show a 63 per cent increase between 1991 and 2008.

Inputs of PCBs, mercury and brominated flame retardants from local point sources into Mjøsa have stopped. But due to the nature of these substances, it will take considerable time before these hazardous chemicals are reduced in the food chain.

1.1. Metals in lakes

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Lake sediments in large parts of Southern Norway are polluted by lead, mercury and cadmium. The overall human and environmental risk caused by these metals are considered low, however due to the detection of high concentrations of mercury the Norwegian Food Safety Authority has issued a nationwide advice against the consumption of some fresh water fish.

Perch. Photo: Wikimedia Commons

STATE

Southern parts of Norway most polluted

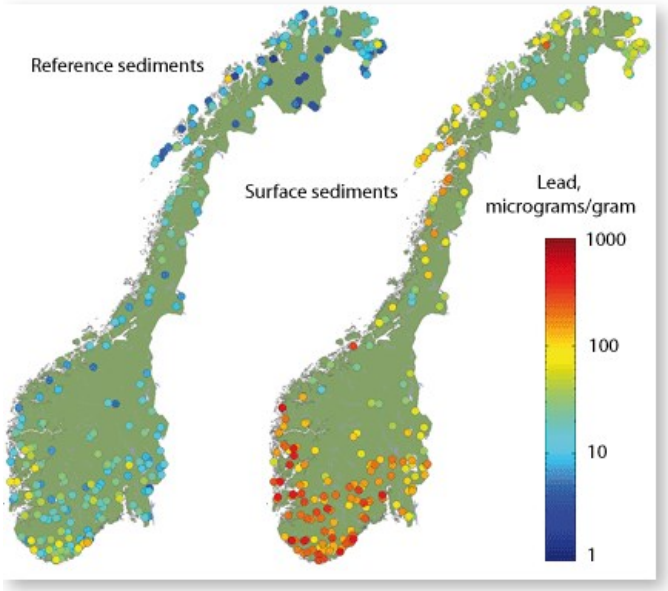
Metals such as lead, mercury and cadmium are transported to Norwegian lakes with air and precipitation. With time the metals will sink to the bottom of the lake where they can be found in the sediment layers. These sediments are therefore an important historical archive which reflects trends in emissions at different time periods.

A nationwide survey of sediments in 274 lakes has documented that lake sediments are polluted by lead, mercury and cadmium. This statement is based on a comparison of metal levels in sediment layers dated before the Industrial Revolution and sediment from the present time.

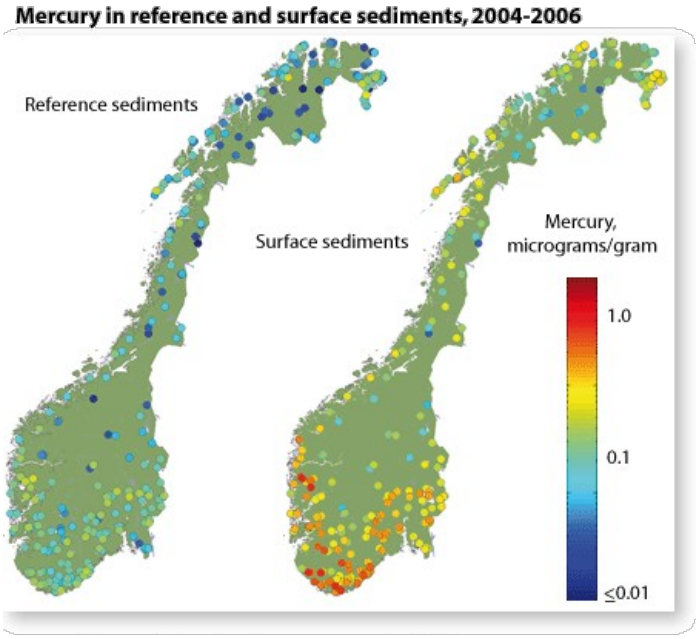
Decline in lead pollution, levels of mercury unchanged

Lead levels in lake sediments have declined during the last decades but is still the metal found in highest concentrations. When it comes to mercury no change has been detected since 1995.

Lead in reference and surface sediments, 2004-2006



Source: Norwegian institute for water research, 2008
www.environment.no



Source: Norwegian institute for water research, 2008
www.environment.no

Higher pollution levels in the South

Levels of most pollutants are generally lower in northern parts of Norway. However, several lakes in Sør-Varanger, close to the Russian border, are significantly polluted by copper and nickel.

IMPACT

Small threat to humans and animals

Since the levels of metals in lake sediments are comparatively low, the risk of harmful substances entering the food chain is small. Humans and animals are therefore not in immediate danger. However, one exception is mercury, which is able to transform to methyl mercury and then can be taken up by organisms.

Advice against consumption

Due to the detection of high concentrations of mercury the Norwegian Food Safety Authority has issued a nationwide advice against the consumption of fresh water fish. The warning concerns pike and perch larger than 25 cm. and big trout and char (>1 kg). Pregnant women and breastfeeding mothers should avoid eating such fish. Others should not eat such fish more than once a month.

DRIVING FORCES

Gradual reduction of emissions

Emissions of metals to the atmosphere take place when we burn coal and oil or incinerate waste. Manufacturing of iron and cement is another pollution source. Anthropogenic emissions of metals were generally insignificant before the Industrial Revolution, although lead emissions from German mining activities during the 18th century may have affected lakes in the southern parts of Norway.

Emissions of metals increased dramatically after the Industrial Revolution, especially from the Second World War and up to the 1970s. In the past 20-30 years European manufacturers have installed fume treatment facilities, and this has led to a gradual decrease in air pollution levels.

PRESSURE

Long-range pollution the most important source

Long-range air pollution is the main reason for the pollution of in lake sediments in Norway. Most long-range pollution is deposited in coastal areas and in Southern Norway, which is also where the sediments are most polluted. High levels of copper, nickel, cobalt and chromium pollution have also been registered in localities close to smelters and metallurgical industry.

Zinc and cadmium levels are highest in South and Southeastern Norway. This is probably a result of pollution from industrial activity in Eastern Europe. Emissions from local manufacturing have raised pollution levels in Arendal and Karmøy. Several lakes in Sør-Varanger in Finnmark are significantly polluted by copper and nickel emitted from Russian smelters.

RESPONSE

Use of unleaded petrol has improved the situation

Measures to reduce the use of leaded petrol has led to significant reductions in emissions. Road transport is the main source of lead pollution in Europe. Even though more and more unleaded petrol is being used, all types of petrol still contain small amounts of lead, which is naturally present in crude oil. Nevertheless, lead levels have decreased over the last twenty years.

In recent decades the installation of fume treatment facilities has led to a gradual decrease in metal pollution to air.