Nordic Council of Ministers

Fish stocks in Skagerrak with management shortcomings

Contents

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Summary and recommendations

Skagerrak is a unique ecosystem with a rich diversity of habitats and species. However, it is also one of the most intensively trawled areas in Europe and, from a Skagerrak perspective, the management of its biodiversity and fisheries resources has shortcomings.

We identified a range of commercially valuable fish species that currently lack advice or full analytical stock assessments, or where the stock units are poorly defined, and the current advice therefore applies to an area far beyond the reach of Skagerrak. We describe the current management situation for these species and present the national and international red list indicators and recent trends in abundance and landings.

From a Skagerrak perspective, Norway, Sweden and Denmark should consider the possibility of developing a unified local management plan to underpin a sustainable utilization of Skagerrak's seafood resources, and to preserve Skagerrak's rich and productive habitats. However, the Nordic countries cannot decide on fisheries management in Skagerrak, which except for the Norwegian EEZ, is an EU concern. Instead, we recommend forming a regional advisory committee tasked with (1) supporting the International Council for the Exploration of Seas (ICES) in developing the best possible quantitative stock assessments based on scrutinized stock unit definitions, (2) mapping essential habitats, (3) mitigating bycatch of nontarget species, and (4) advising on how to best implement a holistic ecosystem-based approach to fisheries management and nature conservation in Skagerrak. This advisory committee consisting of scientists should target managers in Norway and EU and could be formed e.g. in association with ICES and the existing working group for Nordic fisheries (AG-Fisk).

Skagerrak, an exceptional sea between Norway, Denmark and Sweden

Skagerrak serves as a crucial maritime gateway linking the North Sea with the Baltic Sea. The region is characterized by a unique seascape with a deep channel known as the Norwegian Trench, which extends all the way to the Norwegian Sea (Figure 1). The Norwegian and Swedish coasts of Skagerrak are characterized by a narrow rocky plateau that descends via steep slopes into the trench, whereas the southern Danish side features shallow sandy slopes with sporadic rocky habitat. Strong currents transport water to Skagerrak from both the northern and southern North Sea, where upwelling brings deep cold and nutrient-rich water to the surface, whereas less saline surface water flows from the Baltic Sea. This mixture of diverse habitats and water bodies creates a unique and exceptional ecosystem with a high biodiversity, where the access to deeper and colder water may represent a climate refuge from marine heat waves in coastal and shallow areas. The management of Skagerrak's natural resources and conservation efforts are, nonetheless, challenged by the fact that the sea is shared between three nations with distinct governance systems, and of which two are members of the EU (learn more about the protection level of habitats in Skagerrak and the Norwegian trench in *Protecting the Skagerrak for biodiversity, food and climate*: pub.norden.org/nord2024-031).

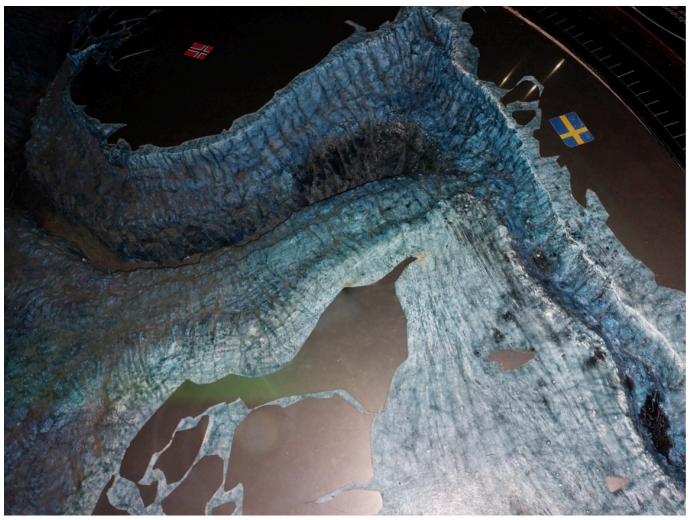


Figure 1: 3D view on Skagerrak below the surface

Sustainable fisheries and stock assessment

The International Council for the Exploration of the Seas (ICES) provides advice on fishing opportunities based on stock assessments for a range of fish stocks. This advice is instrumental not only in providing advice to fisheries management, but also in evaluating Good Environmental Status under the EU Marine Strategy Framework Directive (MSFD) and for consumer labelling by the Marine Stewardship Council (MSC).

Stock assessments are key to the management of fisheries and sustainable use of resources. The analytical stock assessment is the "gold standard" also referred to as a category 1 assessment. The analytical stock assessment utilizes both fisheries-dependent and fisheries-independent data obtained from catches and scientific surveys, respectively, and the output provides information on population demographics. The data is analyzed through mathematical models that estimate the stock status, for a given stock unit, relative to biological reference points indicating sustainable exploitation levels.

The concept of stock units is key in stock assessments. Ideally the stock unit reflects the biological entity of the stock and its geographical distribution. A well-informed stock unit is based on extensive biological data on population structure and connectivity, coming from e.g. genetics studies and tagging (learn more about "connectivity" in *Spatial population structure and connectivity among marine populations in the Skagerrak*: *implications for marine biodiversity conservation*: pub.norden.org/nord2024-033). Lack of such data often results in stock units covering vast areas that are biologically inaccurate, or stocks following national or economic borders. Failure to define the stock unit correctly can lead to erroneous management, where local populations or sub-stocks can be depleted under quotas applied to large geographical areas.

However, sustainable fisheries management extends beyond mere stock assessments and outtake regulation, stock-specific reference points, and catch levels aligning with biological advice. In the Common Fisheries Policy of the EU, it is now stated that an Ecosystem-Based Approach to Fisheries Management (EAFM) must be implemented (read more about EAFM in Fact Box 1).

Stocks with management shortcomings from a Skagerrak perspective

As part of SAMSKAG, a Nordic Vision Project supported by the Nordic Ministers Council, we identified various species with significant current or potential value for human consumption fisheries in Skagerrak. We also described the management shortcomings for these stocks from the perspective of Skagerrak. For detailed description of each species, please refer to Fact Box 2 (see also Fact Box 3).

For halibut, wolffish, lumpsucker, and skates and rays, ICES do not provide scientific advice. Nevertheless, wolffish fillets from Skagerrak and Kattegat are now available in supermarket coolers (Figure 2), and the lumpsucker, which is harvested because of its highly priced roe, has recently received a lot of attention in the media following indications that this species may be in rapid decline.

For others, such as anglerfish, pollack, roundnose grenadier, tusk, ling, blue ling, and greater forkbeard, ICES include Skagerrak in the stock unit definitions but provide advice as a so-called category 3 or 5, which lack an analytical stock assessment (28 June 2024, anglerfish moved from a category 3 to a category 1 assessment and catch advice has tripled, see Fact Box 2). While this type of advice does align with ICES's precautionary approach, it is suboptimal from the perspective of both fish and fisheries. Furthermore, for tusk, ling, blue ling, and greater forkbeard, the current stock units extend far beyond the Skagerrak region, covering the entire Northeast Atlantic, and the population structure and connectivity remain mostly unknown.

Lastly, we also included spiny dogfish (or spurdog), despite it having an analytical stock assessment. Following a benchmark assessment by ICES in 2022, advice changed from zero catch to allow for a targeted fishery. This advice applies to the entire North-East Atlantic and adjacent waters, while the population structure, in relation to e.g. Skagerrak, remains mostly unknown.

For more information about current stocks assessments and biological advice, see:

ICES adviceXplorer https://ices-taf.shinyapps.io/advicexplorer/

Fiskbarometern: https://fiskbarometern.se/rapport/2023

Figure 2: Picture of an anglerfish on ice at the fish store (left) and wolffish in the supermarket cooler (right).

Catches in Skagerrak

Over 12000 tonnes of the aforementioned species were landed from Skagerrak between 2013 and 2022, with individual species landings ranging from 10 to over 6000 tonnes. The largest landings for each of these select species were anglerfish and pollack (Figure 3).

While some of these species are targeted directly, others may be landed as bycatch or caught in highly mixed fisheries (e.g., mixed bottom trawl fishery for Norway lobster *N. norvegicus* as primary target species). Most are considered sensitive to fishing, due to vulnerable life histories, including reaching maturity late in life or producing few offspring (e.g., wolffish, dogfish, skates, and rays).

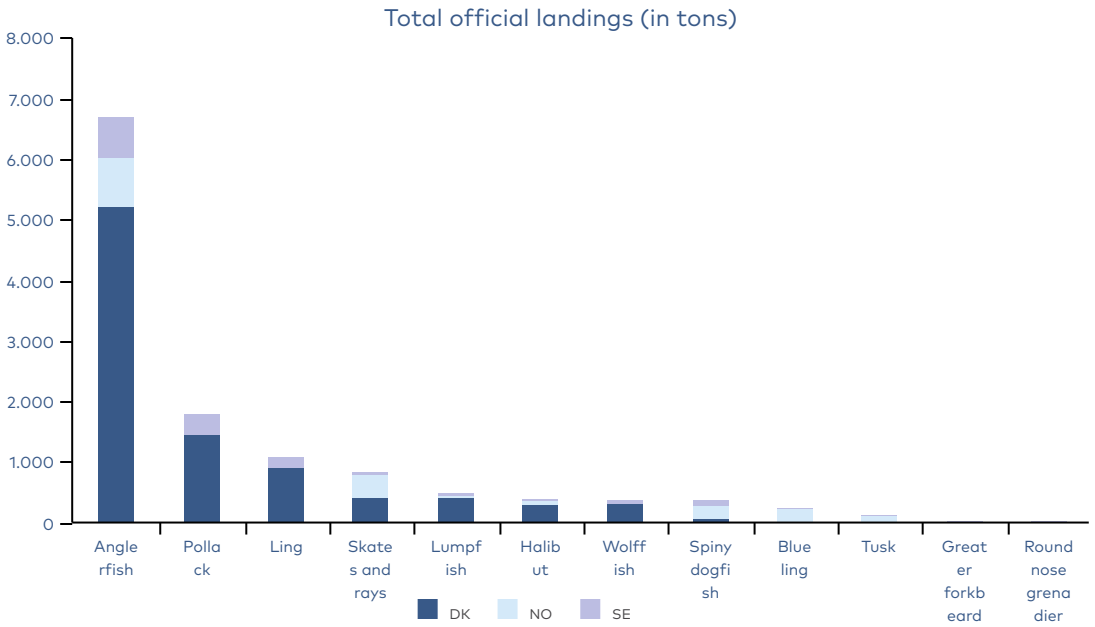


Figure 3: Bar plot showing total Danish (DK), Norwegian (NO), and Swedish (SE) official landing statistics. Total landings in tonnes for the period 2013–2022 by country.

A unique view of recent trends in the species abundance

A large part of Skagerrak, particularly its deep-sea areas, is not covered by the international bottom trawl survey (IBTS). To produce a comprehensive overview of trends in species abundance in Skagerrak, we therefore combined data collected from the IBTS (quarter 1) and the lesser-known Norwegian northern shrimp survey in a statistical model and estimated standardized catch rates for the period 2013–2022. The trends in the survey catch rates provide an indication of recent trends in species abundance (hereafter referred to as abundance indicator). By combining these two surveys, we achieved extensive and unique coverage of Skagerrak, except for near-shore, coastal areas. The trends in the abundance indicators were compared to trends in the combined commercial landings from Denmark, Norway, and Sweden (for the same period) and to the international and national red list status. An overview is provided in Table 1.

Skates and rays were excluded from the analysis because they are often not identified to species level as well as being wrongly identified in some cases.

Latin name	Common name	Trend in landings	Abund-ance indicator	IUCN (Europe)	DK red list	NO red list	SE red list
Anarhichas lupus	Wolffish	→	↗				
Brosme brosme	Tusk	↗	↓				
Coryphaenoides rupestris	Roundnose Grenadier	↑	↘				
Cyclopterus lumpus	Lumpfish	↘	↗				
Hippoglossus hippoglossus	Halibut	↑	↑				
Lophius piscatorius	Anglerfish	↑	↗				
Molva dypterygia	Blue Ling	↑	↑				
Molva molva	Ling	↑	↑				
Phycis blennoides	Greater Forkbeard	↑	↗				
Pollachius pollachius	Pollack	↓	↓				
Squalus acanthias	Dogfish	↑	↗				

Table 1: Overview table showing trends in total (DK, SE and NO) official landings over the period 2013–2022, trends in abundance modelled from scientific surveys (also for the period 2013-2022), and red list status from IUCN ratings (Europe), and national lists (green = least concern, grey = data deficient or not relevant, and red = near threatened, vulnerable, endangered, or critically endangered) vertical arrow pointing up = strong positive trend, vertical arrow pointing down = strong negative trend, diagonally arrow pointing up = weak positive trend, diagonally arrow pointing down = weak negative trend, horizontal arrow = no trend.

Recent negative and positive trends

When stocks show recent positive trends

Increasing abundance for several species are likely to be the positive result of an overall reduction since the 1990s in commercial trawl effort in the region. Hence, an increasing trend in the abundance indicator does not necessarily mean that a stock is in good shape. It could also be the first positive sign of recovery of a depleted stock. For instance, wolffish exhibit a slightly increasing trend between 2013 and 2022, despite being overall rare in survey catches between 2013 and 2022, compared to periods before 2013 (data not shown here).

When stocks are showing signs of recovery, local management actions can be vital for further recovery. For example, increasing availability may capture the attention of fisheries and what used to be small amounts caught as unintended by catch may be replaced by much larger landings in a targeted fishery. More so, when landings go up, but the abundance indicator is stable, or only weakly increasing as for anglerfish, this should trigger immediate attention, as this may indicate an increasing commercial interest.

Stocks with recent negative trends

Pollack shows declining abundance indicator and declining landings, suggesting a species in decline that should be fished with caution to prevent stock collapse or local depletion. Similarly, roundnose grenadier is showing declining survey trend, which is concerning given the large, and increasing, bycatch of this species in the shrimp trawl fishery. Lastly, also tusk has been in decline in recent years with stable landing amounts.

Red list status

Red list status from IUCN (Europe) and national lists (DK, NO and SE) is provided in Table 1.

The European IUCN red list ratings vary between the listed species. Four species are Least Concern (LC), and two are Data Deficient (DD), but five are either Vulnerable (VU), Near Threatened (NT) or Endangered (EN).

Table 1 further reveals that three species are categorized by IUCN as either NT, EN or VU, but are showing increasing stock trends, namely blue ling, halibut and dogfish. This is promising, but the landings follow the same pattern, which may be putting any further recovery of these species at risk unless managed carefully.

The IUCN list and the national lists show inconsistent patterns. The Swedish list provide the most pessimistic impression, whereas the Norwegian list is the most optimistic. Note that since the listed species are not common in the Baltic Sea, the Swedish status ratings are confined to Kattegat and east Skagerrak, whereas the Danish list also include information from parts of the North Sea and the Norwegian list and IUCN include data from a much larger area extending beyond Skagerrak and the North Sea.

In addition to the species presented in Figure 4, the skates and rays complex includes species that are classified by IUCN (Europe) as LC (i.e. *Rajella lintea*), Critically Endangered (CR) (i.e., *Dipturus batis*) and NT (i.e., *Raja clavata*). The national lists align more or less with IUCN, except for *D. batis*, which is rated regionally extinct (RE) by Denmark and Sweden and *R. lintea* is rated NT by Sweden. The SAMSKAG status indicator was not calculated for skates and rays because of species identification issues in the surveys.

Read more about the official red list status ratings here:

https://www.iucnredlist.org/

AU Ecoscience - Den danske Rødliste - Fisk

Rødlista 2021 - Artsdatabanken

Start - Artfakta från SLU Artdatabanken

NOTE

The Skagerrak focus of the study was given by the project outline. From a biological point of view another area division may have been more sensible. Furthermore, the recommendations given are common and not a direct result of this study, and they can be equally valid in other geographical areas.

The analyses presented are correlative only, they do not imply any causation or evidence for stock population dynamics. To gain a fully comprehensive understanding of the status of the stocks, more detailed studies, and ideally analytical stock assessments are required. Also, the list of species included is by no means exhaustive.

FACT BOX 1

ECOSYSTEM-BASED FISHERIES MANAGEMENT

"Fisheries are known to have unintentional effects on habitats and species which are not directly targeted by fishing activity. This can include the accidental capture (bycatch) of potentially sensitive species, as well as the potential disturbance of seafloor habitats." Quote from the homepage of the SEAWISE project on the implementation of Ecosystem Based Fisheries Management in the EU.

Read more on https://seawiseproject.org/themes/

See also:

Protecting the Skagerrak for biodiversity, food and climate pub.norden.org/nord2024-031/

Spatial population structure and connectivity among marine populations in the Skagerrak: implications for marine biodiversity conservationpub.norden.org/nord2024-033/

New EU-project: Linking marine habitat status to predators | Institute of Marine Research (hi.no)

The implementation of ecosystem-based approaches applied to fisheries management under the CFP - European Commission (europa.eu)

https://doi.org/10.1093/icesjms/fsaa136

FACT BOX 2

FACTS ABOUT THE SELECTED SPECIES

Atlantic wolffish (*Anarhichas lupus*) prefers rocky habitats, where it lives in close association with the bottom and can grow to more than one meter. The role of Atlantic wolffish in the Skagerrak ecosystem is poorly studied, but wolffish species are known to play important ecological roles because of their strong jaws and specialized teeth that enables them to eat animals few other predators can. The meat is considered high quality. The species have internal fertilization, low fecundity and parental care. The male will guard an egg ball for 8 months from spawning until hatching. There is no ICES advice for this species in Skagerrak.

Roundnose grenadier (*Coryphaenoides rupestris*) is a relatively small deep-sea species. They are slow growing and mature at a relatively old age. The species undertakes vertical migrations and may play a role in the transport of biological production to the deep-sea ecosystems. Although the meat is tasty, it is mainly landed for industrial purposes. Among the species considered here, *C. rupestris* is occasionally caught in large numbers in the Norwegian shrimp survey, in the deeper areas of Skagerrak. The stock unit is Kattegat and Skagerrak, and the assessment is category 3. The stock was depleted by a directed fishery in 2000–2005, and recovery depends on a new strong year-class. High recruitment seems to occur rarely; the last recruitment pulse was in the early 1990s, The advice from ICES has been 0 for many years, but catches have been much higher in recent years.

Blue ling (*Molva dypterygia*) is a medium size deep-sea species that grows slowly and matures late in life just like most other deep-sea species. The meat is tasty and has often been selected for by consumption fisheries in the North

Atlantic, especially around Iceland. It feeds on other deep-sea fish and shrimps. The assessment is category 5, the stock unit stretches across the entire North-East Atlantic and the ICES advice is zero.

Dogfish, spurdog or spiny dogfish (*Squalus acanthias*) is a relatively small pelagic shark. They are highly migratory, are often found in schools and actively hunt pelagic fish species. They produce only a few, but large, eggs like most other viviparous (giving birth to offspring that develop within the mother) elasmobranchs. Among the species listed here, *S. acanthias* is one of the most common species to be found in both the IBTS survey and the shrimp survey in Skagerrak. In recent times, its meat has increased in popularity for human consumption. There is a category 1 assessment for the entire North-East Atlantic and adjacent water, and stocks size is estimated to have been within safe biological limits since 2013.

Halibut or European halibut (*Hippoglossus hippoglossus*) is the largest of all flatfishes. They can be found at all depths and are opportunistic top predators that can engulf large prey. Halibut is very tasty, and the meat is highly valuable. There is no ICES advice for this species in Skagerrak.

Pollack (*Pollachius pollachius*) is a "codfish" (a gadoid) and lives in the pelagic often close to rocky coastlines or around wrecks or offshore reefs. The meat is tasty and considered better than that of its relative, the saithe. Pollack has a category 5 assessment, the stock unit is the North Sea, Kattegat and Skagerrak and the advice has not been updated since 2022.

Ling (*Molva molva*) is a potentially large fish. It is an elongated gadoid, commonly found in relatively deep water, where they prefer rocky sea bottom or shipwrecks where they live a resident lifestyle hidden in caves and hollows. They are ambush feeders and prey mainly on fish and they are relatively old when maturing. It is an important species to consumption fisheries in some areas. The assessment is category 3, and catches currently match the ICES advice and the stock unit is the entire North-East Atlantic.

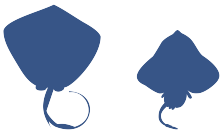
Greater forkbeard (*Phycis blennoides*) is a medium sized deep-sea species. The meat is tasty, but most catches are unintentional catches in bottom trawls and on long lines. Little is known about biology and distribution of spawning areas. The assessment is category 3, the stock unit stretches across the entire North-East Atlantic and adjacent waters and fisheries are catching about twice that of the ICES advice.

Anglerfish (*Lophius piscatorius, L. budegassa*) can grow large, but most catches consist of smaller individuals. It can be found in both relatively shallow water and in the deep sea. It is a ferocious ambush predator that eats about everything and both small and large prey. It can be relatively abundant in some areas and is therefore likely to have an important role in the food chain. They are spawning throughout their range of distribution. In 2024 the assessment went from a category 3 to a category 1 assessment and the catch advice has been tripled since 2022. The stock unit covers North Sea, Rockall and West of Scotland, Skagerrak and Kattegat and the stocks size is estimated to have been within safe biological limits since 2010, but far from the stock size in the 1980s.

Lumpfish or lumpsucker (*Cyglopterus lumpus*) grows to about the size of a football. Little is known about its biology, ecology, and distribution. It is found close to shore in shallow water during spawning season, where eggs are attached to hard substrate and guarded by the males. Outside the spawning season it is occasionally caught in the water columns all over the North Atlantic and at a wide range of depths. The roe is a highly priced delicacy, but the meat is considered of inferior quality. The lumpsucker has recently received a lot of attention in the Danish media because of indications that the species is in decline in some places. There is no ICES advice for this species.

Tusk (*Brosme brosme*) is a small to medium sized fish found on hard bottoms down to a depth of several hundred meters. The meat is tasty, and the species is targeted by commercial fisheries in many areas, and it serves as both predator and prey. ICES advice is aligned with catches, but Norway is allowed to take an additional large amount from area 4 UK zone, but haven´t done so. The stock unit is the entire North-East Atlantic. The assessment is category 3.

Skates and rays in Skagerrak consist of at least a handful of species (i.e., *Amblyraja radiata*, *Rajella lintea*, *Dipturus batis, and Raja clavata*), some of which are of commercial value and highly priced by restaurants, whereas others are considered game fish by anglers. Some are common and others classified as endangered or even extirpated. There is no species-specific ICES advice for these species since they are difficult to distinguish.



FACT BOX 3:

OTHER SPECIES

The redfish or rockfish (*Sebastes* spp.) include a small group of relatively small deep-sea species in Skagerrak. The most common species recorded in Skagerrak is *S. viviparus*. *S. norvegicus* is also found but the species are very difficult to distinguish and are therefore often registered as *Sebastes* spp. in landing statistics. They are slow growing and mature at a relatively old age, and *S. viviparus* give birth to live young (viviparous). The Norwegian shrimp survey encounter these in relatively large quantities in Skagerrak, but at present, they are only of marginal importance to the fisheries and less than 10 tonnes was caught in Skagerrak between 2013 and 2022. However, they are considered as table fish and the two larger species, *S. mentella* and *S. norvegicus*, are targeted by fisheries further north. There is no management of *Sebastes* spp. in Skagerrak.

Smaller individuals of *Helicolenus dactylopterus*, the Black belly rose fish, are common in the Norwegian shrimp survey in some years, but not recorded in the landing statistics. Due to the strong resemblance with *Sebastes* spp., any catches are likely to have been recorded as such.

American plaice (*Hippoglossoides platessoides*) are very common in the surveys and several tonnes are caught each year, for example as bycatch in the shrimp fishery, but the species is not considered of any commercial value (yet). There is no management of *H. platessoides* in Skagerrak.

Ratfish or rabbitfish (*Chimaera monstrosa*) is a cartilaginous deep-sea species (Figure 5). It is considered inedible, but in some parts of the world the species is becoming increasingly attractive to fisheries because of its large oily liver, which is used to produce dietary health supplements. Among all the species mentioned here, *C. monstrosa* is one of the most abundant fish species in the Norwegian shrimp survey in Skagerrak. There is no management of *C. monstrosa* in Skagerrak.

It should be emphasized that this list is not exhaustive and only fish was considered in the study (i.e. crabs, lobsters, bivalves and cephalopods were not included)

Figure 5: Rabbit fish (Chimaera monstrosa) Photo from https://www.hi.no/hi/temasider/arter/havmus

About this publication

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Nordic co-operation

Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland and Åland.

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