

**The report presents results from the environmental monitoring programme in Norwegian coastal and ocean areas. The areas are divided into four large ecosystems: (i) the Barents Sea, (ii) the Norwegian Sea, (iii) Skagerrak and the North Sea, and (iv) the coastal zone including the fjords. Physical, chemical and biological properties of all these ecosystems have been monitored. For the Barents Sea and Norwegian Sea emphasis was put on the monitoring of ocean climate, zooplankton and fish larvae. This makes the basis for the consideration of the environmental conditions for growth, distribution and recruitment of capelin, cod and herring. In the Barents Sea the monitoring of organic contaminants and radioactivity was increased after 1991, and in 1994 started the investigations on organic contaminants in the Norwegian Sea. The monitoring of the Skagerrak and the North Sea, the coastal zone and the fjords has focussed on the anthropogenic nutrient loads, harmful algae and organic contaminants.**

## **The Barents Sea**

**Ocean climate.** The western and central areas of the Barents Sea have been relatively warm since 1998. A decrease in temperature was observed during the autumn 2001, and at the end of 2001 and the beginning of 2002 the temperature was about 0.1 °C above the mean. In the eastern Barents Sea the temperature was 0.5-1.0 °C above the mean in the first half of 2001, but at the end of the year the temperature decreased also here. In 2001 the ice cover was at its lowest since satellite observations started in 1970.

**Plankton production.** The highest biomass of zooplankton (mostly copepods, krill and amphipods) were observed south and southwest of Bjørnøya at the entrance to the Barents Sea. After a peak in 1994 the biomass has decreased steadily. In 2001 large quantities of jellyfish were observed and may partly explain the reduced zooplankton biomass.

**Capelin larvae.** In 2001 the larvae showed a wide distribution in the Barents Sea. The highest densities were, however, observed in coastal areas. The estimated number of larvae was around average, but lower than the three preceding years.

## **The Norwegian Sea**

**Ocean climate.** Since 1995 temperature has been relatively high in the Atlantic water flowing into the Norwegian Sea. The temperature in the Atlantic water off the coast of Norway has increased during the last five years and in 2001 the summer temperature was 0.2 °C above the mean. The inflow of Atlantic water to the Norwegian Sea off Norway in 2001 was the lowest since 1997. In the southern area the temperature in summer was 0.4 °C lower in 2001 than in

2000. In central and northern areas the salinity has been low for some years due to the strong influence of cold and fresh Arctic water through the East-Iceland current. Arctic water masses still dominate, but the influence of Atlantic water is increasing.

**Plankton production and herring.** An increased production of zooplankton in recent years has provided good feeding conditions for the herring, which resulted in high growth rates. In May 2000 the zooplankton biomass was the highest since 1995, and the herring had a high condition factor this year. In 2001 the condition factor was lower. This was expected since the zooplankton biomass was much lower in May 2001 than in 2000. However, the mean biomass of zooplankton in the Norwegian Sea in 2001 was about the same as in 2000. Due to the influence of Arctic water in the southern Norwegian Sea the herring migrated to the feeding grounds in the northern parts.

**Herring larvae.** Larvae were not registered south of Stad in April 2001 because the eggs hatch later in southern Norway. The highest densities were found between Buagrunnen and Træna, while considerable amounts also were recorded in the Lofoten area and off Tromsø. The total number of larvae was estimated to  $40.7 \times 10^{12}$ . This is considerably more than in 2000. However, there was a high mortality during summer and the year-class is now considered as weak.

## **The North Sea and Skagerrak**

**Ocean climate.** The circulation in the North Sea was a little weaker in 2001 than normal. The inflow of Atlantic water in the north was especially low in the first half of the year. The Atlantic water is rich in nutrients and a weak inflow results in a low import of nutrients. Modelled production in the North Sea indicates that the primary production was lower than average in 2001 due to the low inflow of Atlantic water. The surface temperature was around the mean in 2001.

**Plankton and nutrients.** The hydrographical conditions in 2001 hindered the inflow of water masses with high concentrations of nitrate from off Jutland and the German Bight. In March 2001 high concentrations of diatoms were recorded on the Norwegian coast and far out in Skagerrak. At the same time the concentration of algae along the coast of Denmark was low. The dominating diatoms were *Chaetoceros* spp., *Pseudo-nitzschia* sp. and *Skeletonema costatum*. After the diatom bloom and the bloom of *Chattonella* the situation was quite normal in Skagerrak. To sum up, the occurrence of algae in Skagerrak in 2001 was normal except for the bloom of *Chattonella*.

**Harmful algae.** Right after the spring bloom in March a bloom of the harmful *Chattonella* followed. The bloom hit the Swedish west coast and the eastern part of Skagerrak and the coast of southern Norway.

## **The coast and fjords**

**Coastal climate.** Along the whole coast the temperature was above average in 2001, except in July/August when bad summer weather and upwelling resulted in cold water. In 150 m depth the temperature along the whole coast was higher than normal. Inflow of dense Atlantic water in Skagerrak renewed the basin water in the easternmost fjords. The temperature in the deeper water layers along the coast of Skagerrak was close to normal in 2001.

**Plankton.** The spring bloom of diatoms in southern Norway was quite modest in 2001 with a peak in March. Right after the spring bloom *Chattonella* bloomed and thus the peak in chlorophyll consisted of a mixture of diatoms and *Chattonella*. On the coast between Rogaland and Finnmark the spring bloom started in March in Rogaland and then spread northwards. At the end of the summer a bloom by *Emiliania huxleyi* occurred in Finnmark, which is quite unusual that far north.

**Organic load.** The consumption of oxygen below the sill depth in a fjord basin indicates the organic load in the system. In the Risør basin in southern Norway the consumption of oxygen was still high during 2001. This also applies to a number of similar environments on the south coast of Norway. In the outer part of the Oslofjord the nutrient loads are classified as “not good”, e.g. too high. During 2001 the basin water in the Oslofjord and other fjords in the region were completely renewed by inflowing Atlantic water.

**Harmful algae.** Species of *Chattonella* and *Heterosigma* caused considerable death among farmed salmon on the

Skagerrak coast in 2001. The occurrence of *Dinophysis* species, which cause diarrhetic poison, was normal in 2001. Paralytic poison was recorded in the inner Oslofjord, but caused no problem. No fish were killed by algae on the coast between Rogaland and Finnmark. Species of *Dinophysis* were recorded along the whole coast, but they caused no problems. No serious problems with paralytic poison occurred in 2001 along the coast of western Norway although it was detected several places.

## **Pollution**

**Oil contamination in fish.** Muscles of haddock were analyzed from ten areas along the coast. The goal was to investigate if haddock contained components of oil originating from the offshore oil industry. The fish were tested for selected hydrocarbons and C<sub>0</sub>-C<sub>5</sub> alkylated decalines. Only insignificant amounts of these substances were found in the fish, except for one sample from Sleipner oil field which contained C<sub>0</sub>-C<sub>5</sub> alkylated decalines.

**Radioactivity.** In 2001 radioactivity was monitored in the North Sea and a considerable number of fjords. Samples were taken from the bottom sediment, water and fish. In addition the sunken Russian submarine “Komsomolets” southwest of Bjørnøya was monitored. The results from 2001 derive mainly from the monitoring of another Russian submarine “Kursk”. These show that the marine environment was not contaminated by radioactivity neither when the ship went down nor in connection with the rescue. The discharges of technetium-99 from Sellafield in UK have raised the levels of this radioactive contaminant in Norwegian waters and accumulated in algae and invertebrates. However, the levels in the organisms are below levels of concern.