

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 antropogenic nutrient loads, harmful algae and organic contaminants.

The Barents Sea

Ocean climate. Since 1998 it has been relatively warm in the deep layers of western and central parts of the Barents Sea. During 2000 the temperature decreased, but at the turn of the year 2000-01 the temperature was still 0.4 °C above average. In the eastern part of the Barents Sea the temperature was 0.5-1.0 °C above average, and resulted in ice cover below normal.

Plankton production. In 1999 the zooplankton biomass in the whole Barents Sea was the lowest since 1994. From 1999 to 2000 the biomass increased, except in the easternmost part.

Capelin larvae. In 2000 larvae were registered from west of Malangsrunden to the Russian border in the east and northwards to 74 °N. The density of larvae was the second highest ever (maximum was observed in 1999). During the 0-group survey in the autumn 2000 the registrations were lower than the year before, indicating an average year-class strength.

Distribution of fish. The temperature in the Barents Sea Loophole was slightly higher than average and the availability of fish was at similar levels as in 1999. An easterly distribution of juvenile fish in the Barents Sea was correlated with comparable high temperatures in the surface layers during the summer 2000.

The Norwegian Sea

Ocean climate. Since 1995 the temperature has been relatively high in the Atlantic water flowing into the Norwegian Sea through the Faroe-Shetland channel. In 2000 the temperature was 0.3 °C above average. In the Atlantic water off the Norwegian coast the temperatures in the southern part in 2000 were higher than in 1999. In the northernmost parts, the temperature in the Atlantic water has been close to normal since 1996. The long-term trend in the central and western Norwegian Sea has been towards lower salinity and temperature. This is due to supplies of cold fresh Arctic water through the East-Iceland Current. This area is still dominated by Arctic water.

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 2000 the zooplankton biomass was the highest since 1995 and the herring overwintering in Vestfjorden and Ofotfjorden exhibited high condition index. For several years the herring has not migrated into the Icelandic zone due to low water temperatures and a collapse in the production of *Calanus* in the area. Also in 2000 the herring had a northerly distribution during summer.

Herring larvae. The herring spawned mainly off Møre, but also off Karmøy further south and at Røst in the Lofoten area. The numbers seem to have stabilised at a level below the strong years of 1997-98. A positive traith in 2000 was that the spawning was spread over a considerable part of the coast and that the larvae showed a good growth until April. The number of larvae beyond the egg yolk stage were four times higher than in 1992, which is considered a good year-class. However, observed survival in spring and summer was low so that the 2000 year-class is expected to be below average.

The North Sea and Skagerrak

Ocean climate. The upper layers of the North Sea were warmer than average in 2000, except for the summer months. A warm autumn, combined with an increased influx of water from the south, resulted in unusually high temperatures in the upper 100 m along the Norwegian coast. The temperature on the North Sea Plateau and of the inflowing Atlantic water in the Norwegian Trench has been above average the last years, but dropped to the average in 2000. The inflow of Atlantic water to the North Sea was close to normal in 2000.

Plankton and nutrients. During winter 2000 the nutrient concentrations in Skagerrak were considerably lower compared to the two foregoing years regarding the anthropogenic nutrient loads. This was due to strong and lasting northerly winds that blocked the inflow of water from the North Sea with the Jutland Current. During winter and spring 2000, the nutrient levels outside the Norwegian coast were at the average compared to the period 1980-95. Off Denmark the levels were even lower. But in April the chlorophyll concentrations along the Danish coast were extremely high. The most conspicuous feature of the situation in Skagerrak 2000 was the domination of *Guinardia delicatula* along the Danish coast in April-May. The unusual high loads of nutrients off Jylland and in the southern Skagerrak can be explained by the high fresh water runoff in the southern North Sea during winter and spring.

Harmful algae blooms were not registered offshore in Skagerrak in 2000. Along the west coast of Denmark very high concentrations of the flagellate *Chattonella aff. verruculosa* were observed.

The coast and fjords

Coastal climate. In the upper layers along the entire coast the temperature in 2000 was above average except in July and August due to upwelling of cold water. From September and on, the temperature was 1-2.5 °C above average. In the deeper layers (150 m) it was warmer than normal from Rogaland to Finnmark. The Norwegian coast of Skagerrak was characterized by inflowing Atlantic water from March through October and exhibited temperatures above average.

Plankton. The spring bloom was weak along the coast of Skagerrak, but quite normal along the rest of the coast. The bloom started in the fjords and later spread to the coast, as expected. *Emiliana huxleyi* showed an unusual late bloom in October in the inner Oslofjord. In 2000 the numbers of jellyfish, *Aurelia aurita* and *Cyanea capillata*, were lower than normal along the south coast of Norway. The occurrence of *Cyanea* was earlier than that of *Aurelia*.

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 the consumption of oxygen was high during 2000 and it is a clear indication of high organic loads. 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.

Harmful algae. Surprisingly, *Dinophysis acuta* appeared on the coast between Oslo and Rogaland earlier than usual and mussels accumulated diarrhetic poison above critical levels already in July. Poison in mussels causing diarrhoea thus became a problem from July to December 2000. Paralytic poison was recorded only a few times and caused few problems. From Rogaland to Stad more diarrhetic poison than usual was detected. From Stad to Finnmark diarrhetic poison was registered only a few places. No serious problems with paralytic poison occurred in 2000 along the coast of western Norway.

Pollution

Organic contaminants like PCB and DDT concentrate upward in marine food chains. High concentrations may give severe biological effects. The levels of contamination in fish from the Barents Sea and Skagerrak have been compared with samples from the Norwegian Sea (Faroës). All fish from the Barents Sea contain contaminants, although the levels are very low compared to the Skagerrak and the North Sea. The level of contamination in Skagerrak is, however, not expected to cause any toxicological risk to the consumer. It can be concluded that fish from Skagerrak and other Norwegian fishing areas are clean with very low levels of contaminants.

Radioactivity. The level of radioactive contamination in Norwegian areas is very low, as is the level in fish. The level in fish is far below limits set for human consumption. The Baltic and the Irish Sea have high loads with radioactive nucleids originating from Chernobyl and Sellafield, respectively. Fish from the area near the sunken Russian submarine “Kursk” have low values of Cesium-137. However, despite low levels of organic and radioactive contaminants the monitoring will continue to document the quality of fish in Norwegian fishing areas.