

## State of the Barents Sea ecosystem

The warm climate in the Barents Sea favours cod, haddock and herring at the expense of capelin.

The temperature is higher than normal in the Barents Sea, but is expected to decrease during 2006. Partly resulting from this, large amounts of fry of cod, haddock and herring are now found in the area. Blue whiting, which is normally found further to the south and west, is observed to penetrate deeper into the Barents Sea. The stocks of redfish and capelin are at a low level, while cod and haddock stocks are in good condition. The most serious problem from a management point of view is large unreported catches of cod taken in recent years. The present ecological situation keeps the capelin stock down, but cod is seemingly doing well utilising alternative prey.

### High temperatures in a clean ocean

After a period where temperatures have varied considerably from year to year, a stable warm period started from 2004. Both volume and temperature of inflowing water from the Norwegian Sea regulate the heat content of the Barents Sea. This mechanism was well illustrated during 2005, when the volume flux increased towards the end of the year while the temperature decreased; from a record level of 1.12 °C above mean level in January to 0.5 °C above in September.

Consequently, it is difficult to give any forecasts for the temperature development during 2006. On the one hand, lower temperatures have been measured in the inflowing water, resulting in decreasing temperatures in the Barents Sea. On the other hand, this will partly be counteracted by the increased volume flux observed in late autumn 2005. The temperatures are, therefore, not expected to change very much from the high levels seen from 2003 onwards. Basically, the high temperature is favourable for the biological production. And high temperature is a prerequisite for strong year classes of cod, haddock and herring. However, high temperatures are not sufficient; they must be accompanied by good feeding conditions. And good feeding conditions are associated with high influx of Atlantic water during spring, when the currents contain a high content of zooplankton, serving as food for fish fry during spring and summer.

High temperatures also cause changes in the geographical distribution of various fish stocks. The best example is probably the blue whiting, which has penetrated more deeply into the Barents Sea in recent years.

The Barents Sea is by and large a clean ocean. However, the presence of relatively high concentrations of persistent organic pollutants like PCB in seals, whales and sea birds is closely monitored.

All analysed samples taken from biota have shown low radiance levels below 1.0 Bq/kg <sup>137</sup>Cs wet weight. For comparison, after the Tsjernobyl accident, a precaution level of 600 Bq/kg <sup>137</sup>Cs was set.

### Slight increase in the level of zooplankton

In 2005, the sampling scheme for phytoplankton was expanded in the Barents Sea, with aim to find both density and species composition. Hitherto, data does not exist enabling a comparison of production from year to year.

The results from the ecosystem surveys in 2005 show small changes in the density of zooplankton from the level observed in 2004. The level is slightly above the mean level observed during the previous 18 years.

Even though the amount of zooplankton in the Barents Sea has been stable for a number of years, grazing by medusas and planktivorous fish like capelin, herring and various species of fish fry is regulating the stocks. In periods, an inverse relationship between the stocks of zooplankton and capelin has been observed. Presently, the capelin stock is at a low level, while the stock of young herring during 2004 and 2005 is high. There is reason to believe that young herring grazes heavily on the zooplankton stocks, and that this is the reason why there is only a slight increase in zooplankton in spite of the small capelin stock.



Foto: E. Eriksen

#### **Mapping of benthic fauna has started**

The investigation of benthic fauna is becoming a regular part of the surveys carried out by the Institute of Marine Research. Preliminary results from the ecosystem survey during autumn show that crustacean have a wide distribution. Echinoderms dominate in the northern and north-eastern areas, while sponges are dominating the fauna on Tromsøflaket. Main tasks in the future will be to map various types of bottom communities, to establish reference areas, and to monitor these.

#### **Low stocks of capelin and redfish**

The Barents Sea stock of capelin is still at a very low level. In autumn 2005 the stock had continued to decrease from the low level observed in 2003 and 2004. The collapse is not caused by fishing, but is the result of low survival of larvae, and increased mortality among the mature fish. The recruitment failure is explained by heavy predation from large amounts of young herring on the capelin larvae. The increased mortality rate on adult fish is probably due to increased pressure from a growing cod stock on a diminishing capelin stock.

The stock of Northeast Arctic cod has grown since 2000, and the spawning stock is at a safe level. But the fishing pressure is too high to be sustainable in the long run. Information from the Directorate of Fisheries indicates that substantial unreported catches has been taken during recent years. If this problem is not solved within few years, it will cause substantial harm to the stock.

The stock of Northeast Arctic haddock is in good condition, which is also testified by large amounts of immature haddock and haddock fry.

For Greenland halibut the stock situation is unclear, because the stock assessment is uncertain. However, most of the results from scientific surveys show a positive trend for the stock.

Both redfish stocks are at historic low levels, and produce too few fry to renew the stock. The fishery must be reduced further and the offspring must be given maximal protection for several years if the stock can be rebuilt.

The deep-sea prawn stock has stabilized on a low level. An increase of adult prawns was expected in 2004–2005 due to strong year classes from the late 1990s, but high fishing pressure on small prawns has reduced their number considerably and the increase has not shown up. Since the prawn investigations have been transferred to the autumn ecosystem surveys, the stock indices from 2005 cannot be directly compared to previous years indices.

#### **Seals and whales**

A continuation of the present low catch level will cause the stocks of harp seals in the East and West ice to increase in the coming years.

Norway follows the management procedure developed by the IWC, but has set a lower management goal (62 % of virgin stock size) than that suggested by the IWC.

## State of the Norwegian Sea ecosystem

The large pelagic fish stocks, Norwegian spring spawning herring and the combined stocks of mackerel and blue whiting, which partly feed in the Norwegian Sea, are all in a fairly good state. There is altogether more than 10 million metric tonnes of pelagic fish migrating through and feeding in this area. During the last four years there has been an elevation of the temperature in the inflowing Atlantic water-masses ending up in the eastern parts of the sea. The flow of the Atlantic water-masses through the Norwegian Sea was in 2005 one of the highest ever observed.

### High temperatures

The last years have been a warm period in the Norwegian Sea and the highest temperatures were observed in 2002 and 2004. The temperature in the Atlantic water-masses flowing through the Norwegian Sea has shown an increasing trend, and shows that the Atlantic water is about 0,7 °C warmer in 2005 than in 1978. However, in 2005, the temperature fell to the long-term mean. Since the mid 1990s, an increase in the area with Atlantic water-masses has also been observed in the Norwegian Sea, and warm Atlantic water has been observed further north than normal. For the first time since the 1950s these water-masses have also been observed north of Iceland during the last years.

### Low values of persistent organic contaminants and heavy metals in fish

Samples of fish, sediments and water from the eastern parts of the Norwegian Sea show that pollutants are present, but in relatively low concentrations. The sea water contains only low amounts of both oil hydrocarbons (THC) and of poly-aromatic hydrocarbons (PAH). The Norwegian Sea must therefore be characterized as a clean ocean.

### Significantly less zooplankton in 2005 compared to average levels

In major parts of the Norwegian Sea, lower abundances were measured in 2005 than the average for the period 1997–2005. The condition (weight per unit of length) of herring is related to the abundance of zooplankton. Therefore the condition in 2005 was

observed to be relatively low for herring in the open Norwegian Sea, while herring distributed in coastal waters and further north had a normal condition.

### The whale and fish stocks feeding in the area are in a healthy state

In the Norwegian Sea, there are relatively high abundances of pelagic fish and whales. In summer, there is a high production of zooplankton in the area, and large stocks of mackerel, horse mackerel, herring and blue whiting migrate into the area to feed on this zooplankton. Whales feed on both plankton and small pelagic fish. The state of the pelagic fish stocks is good. They are all characterized as having full reproductive capacity, which means that the spawning stocks are big enough to produce large year-classes when the environmental conditions are favourable. The fisheries are, however, too intensive for a few of the stocks, especially for the blue whiting. Of the demersal stocks, the Northeast Arctic saithe is an important element in the eastern parts of the sea, and the state of this stock is also good.

### Constantly, new coral reefs are discovered

In 2005, 36 coral reefs of the species *Lophelia* were discovered. Of these 25 was situated in the Træna trench south of the Røstbanken. The Institute of Marine Research is involved in studies of the relation between fish communities and coral reefs. Constantly, new reefs are discovered, and we are now talking about thousands of reefs rather than hundreds.

## State of the North Sea and Skagerrak ecosystem

The recruitment to the sandeel, Norway pout and North Sea cod and to some degree also to the North Sea herring stock has been poor for three to four years. This is probably caused by changes in the physical and biological conditions. The cod and sandeel stocks have been exploited that hard that the recruitment failure is probably mainly due to over-fishing. The fishery for North Sea cod should have been stopped several years ago. Illegal landings and discards create considerable problems in assessing some of the stocks, in particular the North Sea cod and mackerel stocks.

An unusual warm early autumn in 2005 resulted in quite extreme high temperatures in the North Sea during early 2006; about two degrees above the long term mean and warmest in 35 years. Both in the southern and northern parts of the North Sea the oxygen levels at the bottom were very low around the millennium. This may be part of the explanation of the poor level of the sandeel stock. For the time being the sandeel fishery is closed and will not be opened until an experimental fishery demonstrate a considerable increase of the stock level. Sandeel is very important as a prey species for several important fish species and whale. The recruitment to the sandeel, Norway pout and North Sea cod and to some degree also to the North Sea herring stock has been poor for three to four years. This is probably caused by changes in the physical and biological conditions. However both the cod and sandeel stocks have been exploited very hard and the recruitment failure is probably mainly due to this.

### **Low levels of oil related and radioactive pollutants in fish**

The levels of oil related pollutants in cod and haddock from areas with oil and gas production are still very low and similar to the levels in fish taken outside such production areas. Investigations of oil related pollutants were intensified in 2005. It also seems that the total areas with polluted sediments have decreased. The same has been observed for areas where the demersal fauna has been affected by pollutants.

The level of radioactivity in the seawater, sediments and organisms is still very low. The highest radioactivity in seawater was observed in the Skagerrak and was caused by water coming from the Baltic Sea carrying deposits from Tsjernobyl.

### **Good conditions for plankton feeders**

The zooplankton production in Skagerrak and in the North Sea during 2005 was similar to previous years. The species composition of phytoplankton and the hydrographical situation demonstrate that there has been a considerable inflow of Atlantic water to the Skagerrak. The zooplankton community in the North Sea and Skagerrak is dominated by copepods and krill, which is important food for several commercial fish stocks. The stock levels of typical plankton feeders as mackerel, herring and sprat are quite good. However, for some of the demersal stocks as plaice and cod, the situation is critical. The size of the cod stock is historic low and the fishery should have been stopped several years ago.

### **Poor quality of catch statistics**

The assessment of some fish stocks, in particular cod and mackerel, are very imprecise due to the low quality of catch statistics. This is caused by illegal landings and discarded catches.

### **Relatively new fisheries**

The fisheries for anglerfish and Norway lobster have developed over the last 20 years. The fishery for Norway lobster has declined, and the catches of young and immature anglerfish are too big. The Norwegian net fishery is the only fishery that targets big fish.

### **Mammals**

There are only three mammalian species in the North Sea: minke whale, harbour porpoise and dolphins. The porpoise stocks seem to be quite big, but many individuals are caught as by-catch in the net fisheries and might result in porpoise declining stock level.