The Barents Sea Cod

- The last of the large cod stocks

WWF-Norway Report 4/2004

Published by
WWF, May 2004

Title
The Barents Sea cod - Last of the large cod stock

Date
May 2004

Version
First edition – May 2004

Report can be downloaded at
www.wwf.no/core/pdf/wwf_codreport_2004.pdf

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Supported by
Norgesgruppen and WWF

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Foreword

Fisheries worldwide are declining and cod is a sad example of how insufficient fisheries management can cause a total collapse in fish stocks. Cod was once important for people's livelihood and was very abundant in the North Atlantic marine ecosystem. Now, the large cod stocks in North America and European waters are almost gone. Today, the cod stock in the Barents Sea is the last remaining of the large cod stocks – and WWF fears for its future. Today's management of this stock is not sustainable in the long term.

Globally, the demand for seafood is growing, and diseases like mad cow and bird flu have pushed this trend even more. Consumers and markets are now showing an interest in where and how the food is produced and therefore, increasingly the question is asked if the fish comes from a sustainable fishery.

This report looks generally into the status of the world's cod fisheries, in order to take a closer look at the current status of the Barents Sea cod. In the conclusion, WWF gives recommendations for the future management of this cod stock.

WWF has worked for years with conservation issues in the Barents Sea, and this report is part of our expanding Barents Sea program. The cod stock in the Barents Sea is the worlds largest, and in addition to fishing, the stock now faces new threats from growing industrial development in its spawning and living area. The Norwegian Government is in the process of preparing a comprehensive management plan for the Barents Sea and WWF expects this to outline how to implement ecosystem-based fisheries management.

On one side, WWF compliments Russia and Norway for their ability over three decades to cooperate on fisheries resource management in the Barents Sea. This is an example to be followed by other fishing nations. On the other side, WWF urges the joint Norwegian-Russian Fisheries Commission to follow the recommendations given by ICES when setting the total fishing quotas. ICES's recommendations are based on the precautionary principle – and this is the only way forward for the Barents Sea cod.

The current request of key fisheries stakeholders to look into a possible certification of this cod fishery by the Marine Stewardship Council's standards is a great opportunity to have an objective, science-based evaluation of the fishery management systems and fishery performance. Such assessment will lead to improvements in today's somewhat failing management and can help secure the Barents Sea cod stock for future generations.

WWF thanks Norgesgruppen for funding parts of this report and we are also greatful for comments and input from several stakeholders.

Oslo, May 2004

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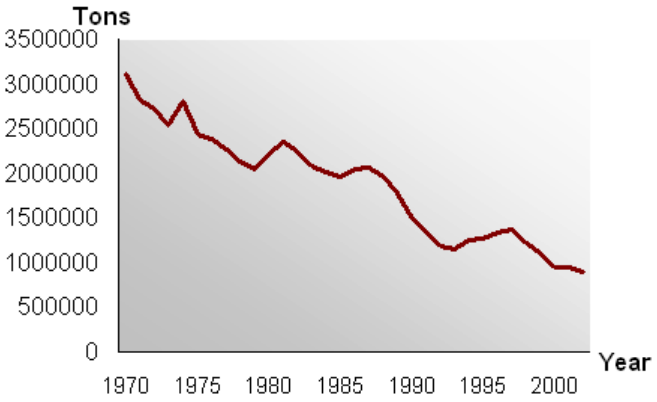
Summary

The world's cod stocks are in a dramatic decline and global catch of cod has gone down by more than 70% in 30 years. In 1970, the total global catch was around 3,1 million tons, while in 2002, the total catch was down to 890.000 tons. If such a trend continues, the world will have no more cod in less than fifteen years. This estimate is based on the assumption that cod stocks will continue to decline with the same intensity in coming years. The worst example of disappearing cod stocks is that of the North American fishery, where there is a decline by more than 90 percent since the early 1980s when catches where around 5-600.000 tons a year. In European waters the total catch of North Sea cod is now just 25% of what it was 15 years ago. In 1987, the North



Total global catch of Atlantic cod was in 1970 around 3.1 million tons. In 2002, total catch was down to 890.000 tons, a reduction of more than 70 %. (FAO Fishstats 2004)

Sea fishery gave around 180.000 tons of cod, while in 2002 it gave only 40.000. Also in the Baltic Sea, the cod stock is seriously depleted, where the catch is less than half of what is was 15 years ago. The only cod stocks that still support large fisheries are the ones outside Iceland with an annual catch around 200.000 tons and the worlds largest cod stock in the Barents Sea, with an estimated catch in 2004 of almost 500.000 tons. This fishery on the stock is managed by Norway and Russia through their joint fishing commission.

Despite the sad fact of continuously declining cod stocks over the last 30 years, overfishing of cod continues because of failing fisheries policies based on short-term economic interests. The codstocks on the east coast of Canada collapsed due to overfishing in the early 1990's – and there has been no recovery. The North Sea cod may be going the same way: Scientists have for several years called for a total stop in fishing. Despite these warnings, the involved countries, EU and Norway, continue their disastrous fishing. The same is happening in the Baltic where the coastal states allow a total catch that is twice the volume recommended by scientists from ICES (International Council for the Exploration of the Seas).

Even in the Barents Sea, where Russia and Norway manage the large fishery on the Northeast Arctic cod stock, scientists warn that the fishing pressure is not in line with the precautionary approach.

Fish stocks often have large scale natural fluctuations. Such changes, and what causes them, are not well understood, challenging both scientific methods of estimating stocks and managers of fish industry depending on a stable economic resource. It is a global problem in fisheries management that overinvestment in the fishing sector leads to short term economic demands not allowing for the flexibility needed when managing a resource that has significant natural changes. In addition, illegal fishing increases the pressure on fish stocks. Commercially exploited fish stocks often show trends towards earlier maturation and in Canada such change was clearly seen before the cod stocks collapsed.

Fisheries management has traditionally lacked transparency and public participation has been very limited. Such closed management without public interest and understanding has also lead to a lack of trust from the public and from politicians. Media have a focus on illegal activities and declining cod stocks. Such focus creates a seafood market that is increasingly sceptical towards the fishing industry. Retailers and consumers are increasingly interested in information on where the fish is caught and if the stock is sustainable. There are several consumer guides to sustainable seafood available, giving the recommendation: "Don't eat Atlantic cod because it is overfished".

Commitments to sustainable fishing

In 1982, the UN Convention on the Law of the Sea, UNCLOS was adopted, giving coastal states the sovereign right over resources in their waters, including a commitment to conserve and manage in order to avoid over-exploitation. After the Rio meeting in 1992, states realised that fishing activities is one of the major threats to global biodiversity. The U.N. Straddling Fish Stock agreement was developed to produce a methodology for practical use of the precautionary approach and represents a total shift in international fishery management, emphasising the need for sustainable fishing, ecosystem protection, conservation of biological diversity, and the use of the precautionary approach. The Norwegian Government has for years been committed to manage its marine resources sustainably and to reduce overall fishing capacity based on a broad political agreement. However, a new report from the Parliament's Auditor General (Riksrevisjonen) concludes that the Norwegian Government fails in their management, since the precautionary approach is not being followed and the overall fishing capacity has increased.

State of the cod stocks in the Barents Sea

The world's largest cod stock lives in the Barents Sea. Here, in the Arctic waters along the Norwegian and Russian coasts, cod still plays a vital role in the rich marine ecosystem. It's main prey are capelin and herring, fish species which utilise plankton. Northeast Arctic cod is the ICES official name for the oceanic cod in the Barents Sea. In addition, there is another , stationary cod stock named Norwegian coastal cod. The oceanic cod migrates to the coast of Norway for spawning, but lives in the Barents Sea for the rest of its life-cycle. The coastal cod is stationary and it and spawns and lives in the Norwegian fjords. At certain times of the year, these stocks can be situated in the same areas, resulting in a mixed fishery.

ICES collects and analyses data on fish stocks, and gives advice to governments on how they should manage fish stocks. Every year ICES evaluates the status of the Northeast Arctic cod and gives advice on how much fish can be taken, recommending quotas based on the precautionary approach. Earlier, some illegal fishing was calculated into ICES' models to avoid over-estimating the cod stock. However, illegal fishing is no longer accounted for, meaning that actual fishing is probably higher than what the scientific advice is based on.

State of the oceanic Barents Sea cod

The last ICES-evaluation of the oceanic Barents Sea cod came in June 2003. ICES concludes that the stock is growing and is within so-called safe biological limits, meaning that the spawning stock biomass (SSB) is well over the precautionary SSB limit set at 460.000 tons. However, ICES expresses serious concerns about high fishing pressures and illegal fishing. In November 2003, the joint Norwegian-Russian Fisheries Commission set the fishing quotas for 2004 to 486.000 tons, ignoring the scientific advice of a total catch of less than 389.000 tons.

Since 1998, the quota for cod has been significantly higher than the recommended limit set by ICES and the stock is therefore defined as being fished outside safe biological limits because the fishing pressure is too high. There are reasons for concern:

- The age structure of the stock has changed as a result of high fishing pressure over time. The majority of the spawning stock consists of first-time spawners. Eggs and larvae of first-time spawners are less viable than those of other mature fish and the overall spawning period is reduced when the spawning stock consists of fewer age groups. ICES address the need to rebuild the age structure of the stock.
- There are indications of large-scale discards and unreported landings. This problem could be widespread, with illegal catches estimated to be almost 100.000 tons annually. Control and monitoring systems are not sufficient to deal with such problems.
- Despite political will to reduce fishing capacity, overall capacity in Norwegian waters has grown significantly since 1990. The trawler fleet has increased its capacity by more than 70 per cent. Over-capacity contributes to an increased pressure on the cod stocks.

WWF urges the Norwegian and the Russian Governments to apply the precautionary approach and set cod quotas in accordance with scientific advice from ICES. Secondly, there is an urgent need for stronger control of all fishing activities in the Barents Sea, and WWF asks for immediate action from the two Governments to reduce illegal fishing. Thirdly, overall fishing capacity must be reduced to take away pressure on fish species such as cod.

State of the coastal cod

In June 2003, ICES recommended a full stop in the fishery for coastal cod in the Barents Sea. The stock is now declared to be outside safe biological limits because the SSB is dramatically low and fishing pressure is too high. The stock has declined continuously since 1994, and there seems to be no recovery. ICES urged for a recovery plan, and the Norwegian Government produced a plan that will come into force in May 2004. However, the plan is insufficient for protecting and rebuilding the stock, missing out on important means such as closed areas, time and fishing gear restrictions and further monitoring and research.

- At present, the biomass of the spawning stock is the lowest observed in the time-series extending back to 1984.
- Fishing pressure increased from 1991 to 1999, although the stock was already historically low. ICES advised a full stop in fishing in 2004. This was ignored by Norwegian fisheries authorities, who allowed a fishing quota of 20.000 tons.
- ICES asked for a recovery plan that should be developed and implemented as a prerequisite to re-opening the fishery. The plan has come, but fails to protect the coastal cod on several points.

WWF urges for a sufficiently strict and efficient recovery plan for coastal cod, where closed areas and clear restrictions on fishing are included. Until this plan is implemented, wherever possible, no fishing should take place.

New threats to the Barents Sea cod

Today, the main impact on the ecosystem in the Barents Sea is fishing. This can change, as there are major plans of increased industrial development in the area. Both the Russian and Norwegian Governments are planning petroleum activities in the Barents Sea and transportation of oil with ships is growing significantly. An oilspill from a ship or petroleum exploration in the spawning area or during the spawning season for cod could have a severe negative impact on the stock. There are indications of fish farming impacting local cod stocks by disturbing historical spawning grounds. A slowly growing cod farming industry could end up having an impact on wild cod, with troubles such as disease transfer or genetic interbreeding with escaped farmed fish. In addition, WWF

fears that future climate change can add a further pressure on fish stocks in the Arctic.

There is an urgent need for a true precautionary approach in the fishery management in the Barents Sea. It must take into account the uncertainty in research and stock estimates, the problem of unreported and unregulated catches and the growing threat from pollution and climate change. Both Norway and Russia are committed to adopt ecosystem based fisheries management, as defined by the UN code of conduct for sustainable fisheries. Simplified, some basic elements are that the management should:

1. Be based on the precautionary approach
2. Have clear goals and objectives
3. Have indicators and plans for monitoring
4. Have decisive rules for quota setting
5. Be a totally open and transparent process that includes all stakeholders and allows and encourages public debate

In chapter six of this report, WWF draws the conclusion that the fishery on the Barents Sea cod stocks are not managed in line with the ecosystem approach. It fails totally on point one and partly on point four and five, as the existing decision rule allows a higher fishing pressure than what ICES recommends and because the current management, despite improvements, still exclude stakeholders, such as NGOs, from the management process.

Conclusion

The examples from Canada and the North Sea show how vulnerable cod as a species is to overfishing. The cod stock in the Barents Sea is the last remaining of the great cod stocks and the fishing industry in the area is part of a thousand year old tradition. It is the Governments of Norway and Russia whom have the total responsibility for ensuring that there will be cod in the Barents Sea for the next thousand years also. Today's management is not sustainable in the long term. Scientists and the market express concern over today's failing management, and now is the time for a change.

Drying cod in Lofoten – This thousand year old tradition is now in threat.

Norway and Russia can succeed with their cod management in the Barents Sea. By doing so, they can help rebuild trust of the fisheries sector within the minds of the public and the politicians, and also in a highly sensitive seafood market.
WWF urges Norway and Russia to:

- Use the precautionary principle and set fishing quotas in accordance with scientific recommendations.
- Produce and implement a plan to reduce illegal fishing activities

WWF urges Norway to:

- Where possible, immediately close the fishing for coastal cod
- Produce and implement a sufficient recovery plan for coastal cod
- Reduce overall fishing capacity

WWF also challenges the Norwegian Government to use the forthcoming management plan for the Barents Sea to take a lead internationally in showing how ecosystem based fisheries management can be used to protect the worlds largest cod stock – and its ecosystem.

WWF would like to see consumers around the world asking where the cod they buy is fished, ensuring that it comes from a legal and sustainable fishery. Consumers should also express their concern about decreasing cod stocks when buying cod.

1 Introduction

1.1 Cod – a basis for coastal life in the North

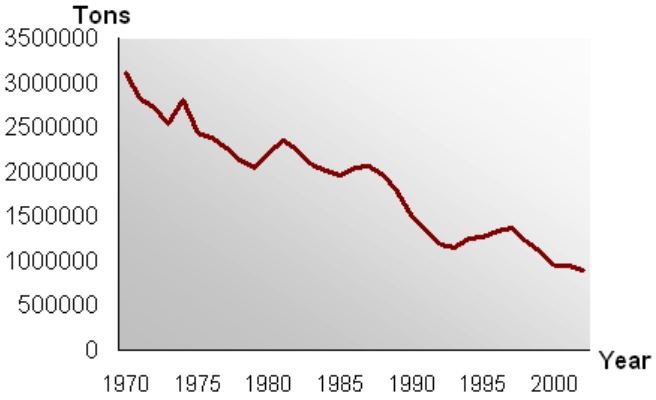
Cod was once the most important food fish in the North Atlantic. In coastal countries like Norway and Iceland, as well as in Newfoundland and Labrador in Canada the cod has been the sole source of livelihood for entire populations. The Atlantic cod, *Gadus morhua,* has been a staple food for the expansion of western civilization. The Vikings travelled to Greenland and Vineland, now America, between 985 ac and 1011a.c according to Icelandic sagas. And they were able to travel these distances because they knew how to preserve codfish by hanging it in the frosty winter air until it lost most of its weight and became a durable woodlike plank (Kurlansky 1998). Also further south, the cod has been an important fish in the exploitation and colonization that occurred from 1492 until the recent past. It is an interesting side note that there is good evidence that Basque fishermen were on the Grand Banks of Newfoundland well before Columbus, keeping their secret to protect this valuable fisheries for themselves. A dark chapter in the history of cod is the fact that the availability of cheap salt cod was crucial for the slave based sugar plantation economy in the 1600-1800 Caribbean.

Around the Lofoten Islands in Norway, on the brink to the Barents Sea, cod belongs to a thousand years old fishing tradition as a main source of income and an important export industry. First record of this fishery is found in Egil's Saga, dating back to the 9th century (Heino 2000). The fishery for cod in Lofoten is still based on the same resource, and is in many ways still practiced as it was 1000 years ago. This is so unique that the Norwegian Government is looking into proposing parts of Lofoten with its fishing industry, as UNESCO World Heritage Site. The migrations of cod still form the basis for the most important seasonal fishing activity in Norway, the Lofoten fishery, which takes place from January to April.

Stockfish, dried cod, is Norway's oldest export article, and the industry is today worth over 500 million NOK. Drying is the oldest known method of preserving fish and the production is without any use of additives. The fish is cleaned and then hangs outdoor for 2-3 months before it is packed and sold.

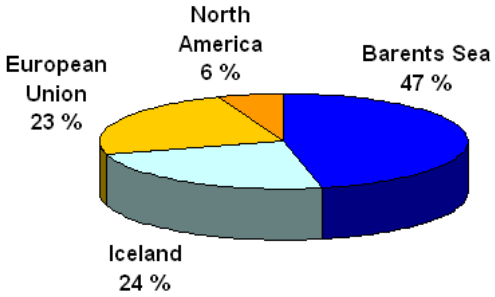
1.2 Cod stocks in decline

Today, the great cod fisheries, after centuries of sustained exploitation, are collapsing under the pressure of modern politics and the economics of fishing. Global catch of cod has been declining since the 1950s, and world catches of cod are still declining. The total catch of cod was in 1970 estimated to be around 3.1 million tons while in 2002 total catch was down to 890.000 tons, a reduction of almost 70% in 30 years (FAO Fishstats 2004). If such a trend continues, the world will have no more cod in less than fifteen years. This estimate is based on the assumption that cod stocks will continue to decline with the same intensity in coming years.

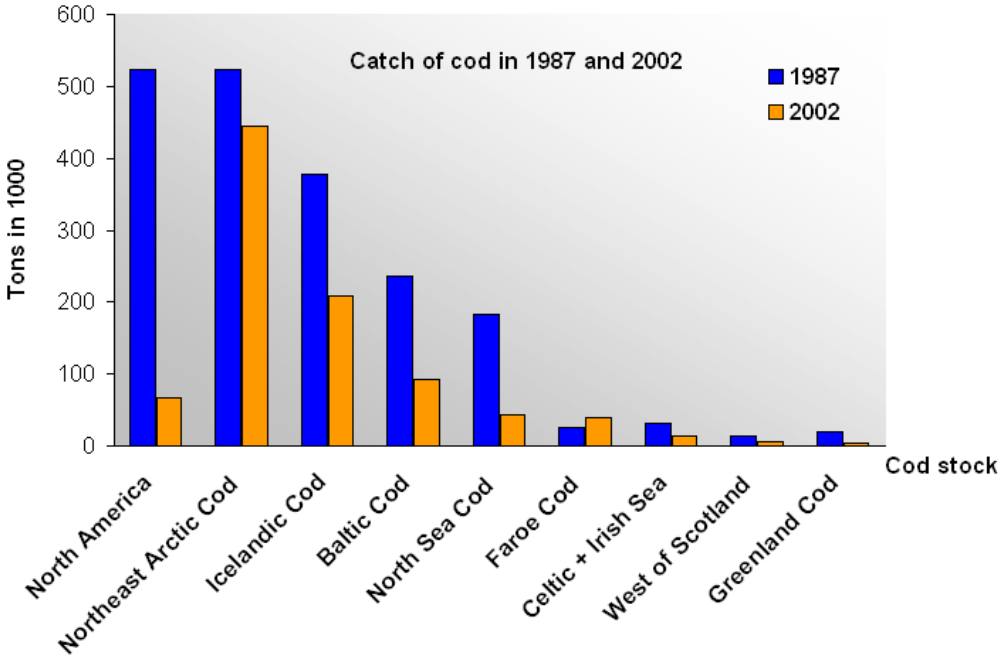


Total global catch of Atlantic cod was in 1970 around 3.1 million tons. In 2002, total catch was down to 890.000 tons, a reduction of more than 70 %. (FAO Fishstats 2004)

The most dramatic decline in cod catches is that of the Canadian fishery, where there is a decline by more than 99 percent since the early 1960s when record catches of up to 800,000 tons were harvested. The cod outside New Foundland in Canada collapsed due to over-fishing in the early 1990's – and there has been no recovery.



Global catch of cod in 2002. The graph shows that half of the cod in the world is caught in the Barents Sea. (FAO Fishstats 2004)



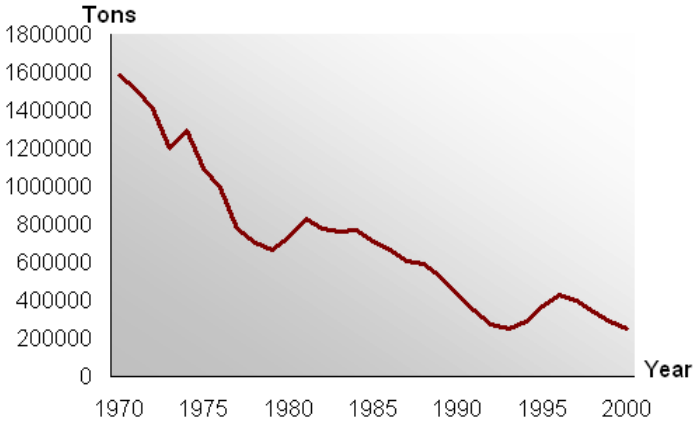
This graph shows how total catch of cod in European and North American waters have decreased from 1987 to 2002. (ICES 2003 & FAO Fishstats 2002)

The North Sea cod might be going the same way as scientist for years have called for a full stop in fishing – a warning ignored by the involved countries. In European waters, ICES official numbers tell that the catch of North Sea cod now is just 25% of the one 15 years ago. In 1987, the North Sea fishery gave around 180.000 tons of cod, while it in 2002 gave only 40.00. Also in the Baltic Sea, the cod stock is seriously depleted, where the catch is no more than half of what is was 15 years ago.

The only cod stocks that still support large fisheries are the one outside Iceland with an annual catch around 200.000 tons and the worlds largest cod stock in the Barents Sea, with an estimated catch in 2004 of almost half a million tons. The fishery on this stock is managed by Russia and Norway, and the two countries catch most of the fish themselves. This report focuses on the cod stock in the Barents Sea, assessing the present fishery.

1.3 European cod stocks in crisis

Today the warnings about the state of the cod stocks in the North Sea and Northeast Atlantic are dramatic. Cod stocks in European waters, managed by EU, are down to only 15 per cent of the level 30 years ago.



The graph shows how total catch of cod in EU-waters has decreased from 1970 to 2000, from almost 1,6 mis to 250.000 tons, a reduction of 85%. (FAO Fishstats 2002)

In 2000 the international Council for the Exploration of the Sea (ICES) – the body responsible for providing advice on the state of stocks to European governments – recommended a zero cod quota for 2001 for the North Sea cod stock, asking for a full closure of the fishery. The political answer was a 40% cut in quota, allowing a fishery of 50.000 tons. The same happened in 2002: the scientific advice was a zero quota but the involved parties, mainly EU and Norway, again allowed a catch of 50.000 tons. As seen in the box, there is today no cod fishery in Europe where ICES does not recommend reduced fishing.

European Fisheries are managed through the EU Common Fisheries Policy, CFP. WWF have for years criticised CFP for not dealing with the enormous over capacity and the use of subsidies, which are seen as key drivers behind the current problems in the EU fisheries sector. An assessment of EU fish stocks in 1999 found that 67% were overfished and in 2002,

From 2001 to 2003, WWF had a global campaign against overfishing in Europe, focusing on how to improve CFP.

the European Commission released its first package of proposals for a fisheries reform. In December the same year, a new CFP was adopted. So far, this has not led to any recovery of depleted European cod stocks.

In August 2003, the Commission published a proposal for a cod recovery plan (COM (2003) 237 final). WWF welcomes this proposal as it represents a significant improvement on previous plans. However, WWF found that there are a number of key concerns related to the plan which need to be addressed such as more focus on misreporting and discarding and a better adoption of the precautionary principle reflected in the probability of meeting targets (WWF 2003).

Recommendations related to European cod stocks (ICES 2003):

North Sea: Total stop in fishing is recommended
Barents Sea cod: Reduced fishing is recommended
Norwegian coastal cod: Total stop in fishing is recommended
Baltic Sea: Reduced fishing is recommended
Icelandic cod: Reduced fishing is recommended
Faroe Plateau cod: Reduced fishing is recommended
Faroe Bank cod: Reduced fishing is recommended
Greenland cod: Reduced fishing is recommended
West of Scotland: Total stop in fishing is recommended
Irish Sea: Total stop in fishing is recommended

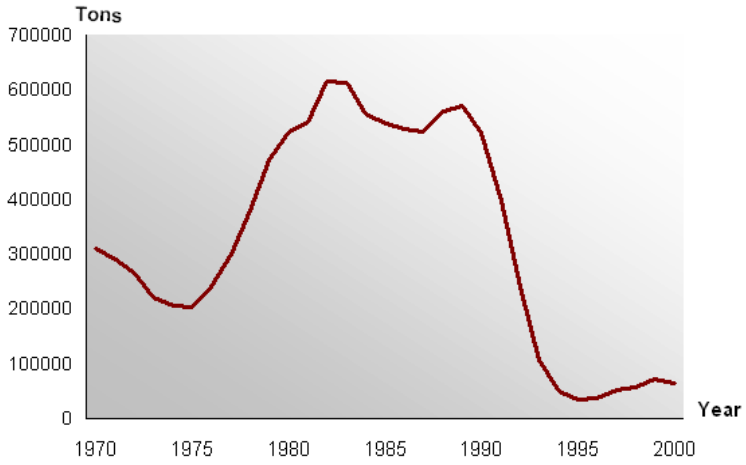
1.4 The Canadian cod collapse

Most cod fisheries on the east coast of Canada are still closed, after the collapse in the cod stocks in the early 1990s. There is a general consensus that this cod collapse was the result of overfishing (Meisenheimer, 1998, Hutchings, and Myers, 1994,). In 1990 there was an enormous pressure on the cod resources caused by the large fleet of Canadian and other international fishing fleets. The stock had been overestimated for years, and when scientists finally warned that the stock was declining and recommended major quota reductions, the Government was slow to respond. Declines became collapses and complete closures had to be implemented (Rice 2003).

The collapse of the cod fishery off the Atlantic seaboard of Canada meant financial ruin for tens of thousands of people, in some communities of Newfoundland over 90% of the employment ceased to exist almost overnight. 30,000 people lost their jobs. Subsequent to the collapse, the combination of annual emergency aid and annual income forgone from the lost fishery, probably amounted to the order of 1.75billion Canadian dollars (MacGarvin 2001).

Still, 11 years later, despite a complete ban on cod fishing on the Grand Banks, the stocks have not recovered. By the time the cod fishing was shut down, the age structures of the remaining populations were severely skewed. Until the moratorium, the cod continually shifted towards maturation at earlier ages (Olsen 2004). The last years fishing was mainly on young and immature fish MacGarvin 2001). Commercially exploited fish stocks often show trends towards earlier maturation, suggesting fisheries-induced evolution of maturation patterns (Olsen 2004). Overfished stocks can show a marked reduction in age at maturity as the selective pressure of fishing favours females who spawn at a young age (Heino 2000). Older and larger cod produce more and faster-growing offspring, with a higher probability of surviving. The fishery and the spawning stock in Canadian waters were both dependent on young animals, with a very small proportion surviving to ages that would produce viable eggs. The Canadian experience indicates that the northern cod stock is recovering slowly from the extremely low levels and skewed age distribution to which it was reduced.

On May 2nd 2003 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed cod stocks in Northeast Newfoundland and Labrador as Endangered. The stocks in the northern Gulf of St. Lawrence and south coast of Newfoundland where listed as Threatened and the remaining Maritime and Arctic stocks on the Canadian coast listed as of Special Concern (COSEWIC 2003)



The fishing for cod in North America grew significantly in the mid seventies, and continued until the collapse of the Canadian cod stock in the early nineties. FAO Fishstats 2002

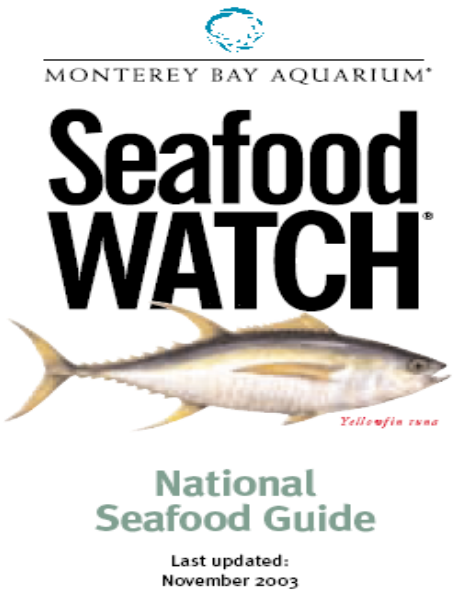
1.5 Are declining cod stocks affecting the market for cod?

Fishery and fisheries management is not of the top ten hottest political issues and rarely makes the big headlines in international press. However, if there is media interest, cod is often the species and issues like declining stocks, overfishing, dumping and bycatch are likely to be the focus. The fishing industry is vulnerable to such negative attention as it can influence the seafood marked. Consumers and retailers are now asking more and more about sustainable seafood, wanting information about where the fish is caught and the state of the stock. In addition to consequences in the market, negative focus can lead to less trust and a lack of political support when the public has a perception of an industry crowding with illegal fishing and failing management regimes.
For many years, WWF has been expressing concern for the condition of the world's oceans and coasts, with a special focus on overfishing. As an organisation promoting protection of the marine environment, WWF sees that markets and consumer awareness can contribute to changing unsustainable behaviour within industries. WWF believes that market incentives can be an important tool in promoting sustainable harvesting of fish. In reaction to the negative effects of overfishing on the marine ecosystem, WWF participated in the creation of the Marine Stewardship Council (MSC) in 1996. Today, MSC is an independent eco-label that guarantees consumers that a product originates from a sustainable fishery. The MSC criteria for sustainable fisheries are listed in the conclusion.

Several conservation organisations give recommendations to the consumer on what seafood they can eat without risking eating an overfished or threatened species. As the Monterey Bay Aquarium writes on their web page: *Your choice CAN make a difference!*

There are a few of these seafood guides in the market today, like for example The National Audubon Society Seafood Lover's Almanac and the Monterey Bay Aquarium Seafood Watch Program. However, they all make the same recommendation about Atlantic cod: *Don't eat it.*

The only guide so far that actually differs between the different stocks of Atlantic cod is the Swedish WWF seafood guide, giving a "yellow light" to Barents Sea cod, but keeping a "red light" on North Sea and Baltic cod. In Sweden, the sale of cod decreased significantly after much focus in the media on declining cod stocks. Three of the major Swedish seafood retailers, Coop, Axfood and ICA took different steps after the cod campaign. Such steps included educating customers about sustainable seafood, setting new criteria for where they source their cod and setting standards like minimum size and catch methods. Total export value of cod from Norway was in 2002 as high as 5,12 billon NOK, that is close to 1 billion Euro (FID 2003a), and it is clear that the growing awerness from consumers related to seafood in general and declining cod stocks in particular, can cause problems on the global marked for cod.



The Monterey Bay Aquarium Seafood Watch Guide recommends consumers to avoid Atlantic cod.

2 International fisheries management

After years of debate and negotiations, the UN convention on the Law of the Sea, UNCLOS, was adopted in December 1982, giving coastal states sovereign right to the natural resources within 200 nautical miles of their coastline (370km). The intention was that nations would manage the harvest of own fisheries resources without overexploiting them. Sadly, development since that has proven this assumption wrong. Overfishing is now one of the most serious threats to the marine environment.

Today, the majority of the world's fish stocks are exposed to intensive fishing, and it is estimated that 75 percent of known, global fish populations are fully exploited, overexploited, or severely depleted (FAO 2002, Pauly et al 2002). Serious concern has been raised about the ecological effects of industrial-scale fishing (Pauly, 2002, Olsen 2004). A recent study estimates that the remaining biomass of the oceans large predatory fishes, including cod, is only about 10% of pre-industrial levels (Myers and Worm 2003), and in many areas, whole populations of culturally and economically important fishes have been extirpated or reduced to such low levels they may not recover (Hutchings 1996, 2000).

2.1 Global conventions and agreements related to fisheries

In recent years there has been growing awareness that the traditional approach to managing fisheries, which considers the target species as independent, self-sustaining populations, is insufficient. It is being recognized that sustainable use can only be achieved if both the impacts of the ecosystem on the living resources and the impacts of the fishery on the ecosystem are explicitly identified and, as far as possible, understood (SOFIA 2003). Many stocks of living marine resources move between the zones of several states. Cooperation on their management is therefore essential to ensure their sustainable use.

UNCLOS

The 1982 UN Convention on the Law of the Sea (entered into force in November 1994) is the overarching body of law that covers every aspect of marine endeavour, from transportation, to pollution, to military issues, to scientific research. Its language relates to protecting living marine resources and sets out the rights and responsibilities of coastal states and flag states with regard to fishing. The Convention provides coastal states sovereign rights over resources out to 200 miles and provides the authority to conserve and exploit living resources within that jurisdiction. The Convention requires that coastal nations ensure, using the best scientific information available and conservation and management measures, that the living resources of the exclusive economic zone are not threatened by overexploitation. Further, UNCLOS adopts maximum sustainable yield as the goal for maintaining or restoring exploited populations. Article 61 requires that coastal states collect, contribute, and exchange scientific information, catch, and effort statistics with other concerned states.

The UN Code of Conduct for Responsible Fisheries

The UN recognised the need for further measures beyond those in the 1982 UN Convention on the Law of the Sea and recommended the formulation of a global Code of Conduct for Responsible Fisheries that should establish principles and standards applicable to the conservation, management, and development of all fisheries. The UN Code of Conduct for Responsible Fisheries was adopted by member states in November 1995, and is a volunteer set of guidelines for fisheries, trade in fish and aquaculture development. The Code reflects the ecosystem approach to fisheries and includes important ecosystem considerations that are of relevance to fisheries.

The Code covers both policy and technical matters in its 12 articles, including fishery management, fishing operations, aquaculture, coastal area development, research, and trade. The Code is voluntary and non-binding and should be adopted by nations through national implementation and legislation. However, some of its provisions are obligatory because of their relation to other legal instruments. The Code provides principles and standards for every aspect of fisheries, from capture, to research to fishing operations, and from processing to trade. And it is directed toward all persons concerned with conserving, managing or developing fisheries, processing, or marketing, or any "users of the aquatic environment in relation to fisheries."

> States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures
>
> *1995 FAO Code of Conduct for Responsible Fisheries*

The Code calls for using living marine resources "in a responsible manner so as to ensure effective conservation and management." Further, the code discusses intergenerational equity in the fishery context for the first time as well, calling for maintaining the diversity of fishery resources for present and future generations. The Code urges the use of effort controls, ecosystem based management, the precautionary approach, selective fishing gears, habitat protection, and the best

scientific information. Also, article 6.13 urges states to adopt transparent decision making processes.

UN Convention on Straddling Fish Stocks and Highly Migratory Fish stocks

The UN Convention on Straddling Fish Stocks and Highly Migratory Fish stocks, (UN Fish stock agreement) came into force in December 2001. The convention is legally binding and Norway signed up in 1996 followed by Russia in 1997 (FAO 2004). The 1995 UN Fish Stocks Agreement has been recognised as the most significant outcome of the fishery management directives from Rio in 1992. It represents a total shift in international fishery management. For the first time, focus is shifted from producing maximum food for humans, to sustainable fishing, ecosystem protection, conservation of biological diversity and the use of a precautionary approach to fisheries management (Freestone 1998). The Agreement developed a consensus on the need to use the precautionary principle in fisheries management, also introducing the concept of ecosystem-based management.

The UN Straddling Stocks Agreement outlines an actual methodology for the precautionary approach, by establishing reference points, targets and limits. The agreement further highlights the need for cooperation between states fishing on the same stock and focuses on control and regulations, addressing the problem with IUU fishing (Illegal, Unregulated and Unreported fishing). Other important principles stated in the UN agreement are:

- The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.
- The parties must assess the impacts of fishing, other human activities and environmental factors on target stocks and species belonging to the same ecosystem or dependent upon or associated with the target stocks
- Develop data collection and research programmes to assess the impact of fishing on non-target and associated or dependent species and their environment, and adopt plans that are necessary to ensure the conservation of such species and to protect habitats of special concern.

2.2 Ecosystem-based fisheries management

The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, provided the fundamental principles and the programme of action for achieving sustainable development. The definitions of biodiversity and sustainable use were set (See box). Also, the Convention on Biodiversity, CBD, refers to the ecosystem approach and defines it as "Ecosystem and natural habitats management that meets human requirements to use natural resources, whilst maintaining the biological richness and ecological processes necessary to sustain the composition, structure and function of the habitats or ecosystems concerned. Important within this process is the setting of explicit goals and practices, regularly updated in the light of the results of monitoring and research activities".

The 1995 Jakarta Mandate on Marine and Coastal Biological Diversity elaborated further the definition of ecosystem-based approach and a workshop in Malawi in 1998 identified 12 principles of such approach. The ecosystem approach for fisheries management was further developed at FAO (UN Food and Agriculture Organisation), COFI (Committee on Fisheries) meeting at the Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem in October 2001.

In August 2002, the second UN conference on sustainable development was held in Johannesburg. State leaders from all over the world were present and they expressed concern for the conditions of the world's oceans. The Johannesburg declaration urges states to adopt the ecosystem approach to fisheries by 2010 and calls for restoration of depleted fish stocks on an urgent basis and where possible not later than 2015.

2.3 General elements of ecosystem-based fisheries management

Ecosystem-based approaches have the potential to significantly enhance and evolve marine fisheries management (Busch, 2003). Defining and explaining the ecosystem approach or ecosystem based fisheries management is not an easy task. However, several useful publications attempts to set out some general principles like the FAO paper from 2003 (FAO 2003) and the WWF guidelines from 2002 (WWF 2003). Appendix II gives an overview of the differences between traditional fisheries management and the Ecosystem approach to fisheries management.

Biological diversity - means the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Sustainable use - the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

United Nations Conference on Environment and Development. Rio de Janeiro 1992

Simplified, ecosystem-based fisheries management would as a minimum be based on these elements:

1. Be based on the precautionary approach
2. Have clear goals and objectives
3. Have indicators and plans for monitoring
4. Have decision rules for quota setting
5. Be a totally open and transparent process that includes all stakeholders and allow and encourage public debate

The Principles of Ecosystem-Based Management are (WWF 2002):

1. Maintaining the natural structure and function of ecosystems, including the biodiversity and productivity of natural systems and identified important species, is the focus for management.
2. Human use and values of ecosystems are central to establishing objectives for use and management of natural resources.
3. Ecosystems are dynamic; their attributes and boundaries are constantly changing and interactions with human uses also are dynamic.
4. Natural resources are best managed within a management system that is based on a shared vision and a set of objectives developed amongst stakeholders.
5. Successful management is adaptive and based on scientific knowledge, continual learning and embedded monitoring processes.

2.4 Commitments to sustainable fisheries management

Norwegian fisheries are based on a broad political agreement that the main goal is to ensure a responsible management and harvesting of marine resources. The basic principles, as expressed by the Government and the Parliament, are (Riksrevisjonen 2004):

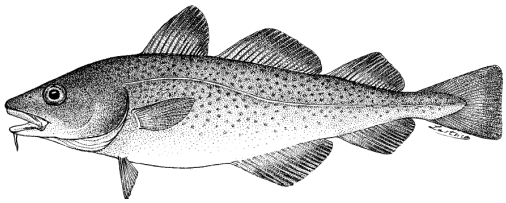
- Sustainable harvest
- Fisheries management should be based on scientific recommendations
- Implementation of the precautionary approach
- Implementation of the ecosystem approach
- Reduce overall fishing capacity

In addition, the Norwegian Government has in a Report to the Parliament in 2002, committed Norway to practice ecosystem-based management in the Barents Sea (MD 2002). In March 2004, The Norwegian Office of the Auditor General, Riksrevisjonen, published a comprehensive assessment of Norwegian fisheries management in the period from 1998 to 2002. (The report is now on circulations for comments) One of the focus species in the report was the Northeast Arctic cod stock. The conclusion of the Auditor General was that Norwegian fisheries management fails in sustainable management of fish stocks. Chapter five in this report on the fishery of the Barents Sea cod goes deeper into this, and the report from the Auditor General is also mentioned further in the conclusion.

In September 2003 the new policy document "The Concept for Development of the Fishery Industry of the Russian Federation until the year 2020" was approved by the Russian government. This document sets the following general aim for the fishery development in Russia: *"The aim of the development of the fishery sector of economy in the Russian Federation is sustainable functioning of the fishery industry on the basis of conservation, replenishment, and rational use of the aquatic biological resources".*

3 Atlantic cod

Cod got its scientific name, *Gadus morhua,* from Linnaeus in 1758. Common name in English is Atlantic cod, in Russian Treska, in Scandinavia its torsk, and Spanish its Bacalao del Atlántico.



FAO Species Catalogue 1990

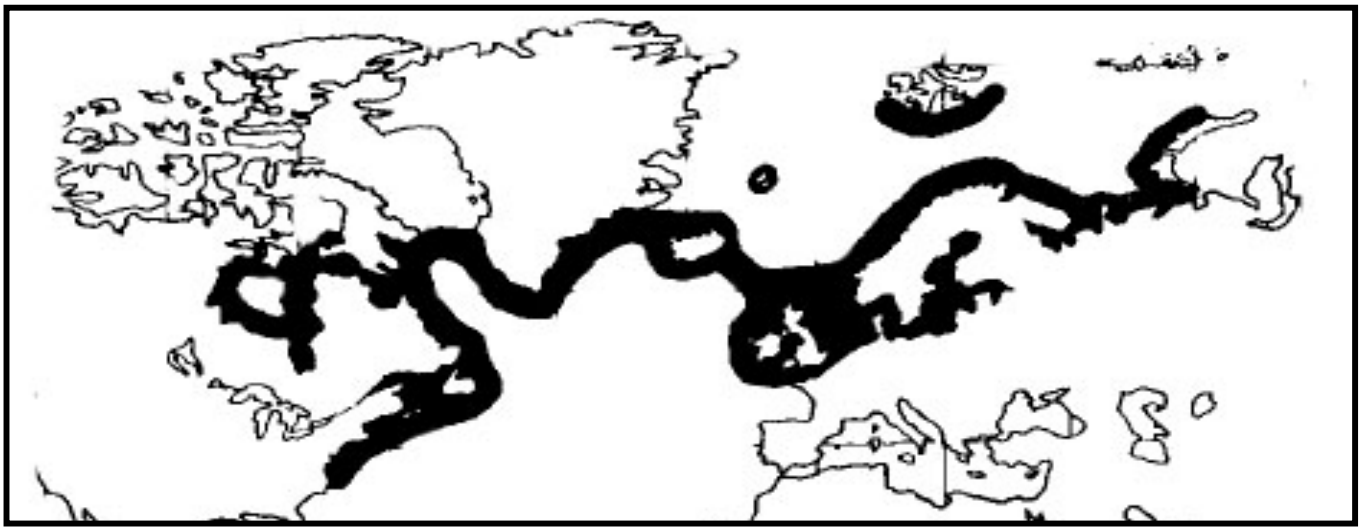
3.1 Abundance and some biology of Atlantic cod

The Atlantic cod, *Gadus morhua*, lives in the North Atlantic Ocean, and separate stocks are found in the waters of North America, Greenland, Iceland, the Faeroe Islands, in the Irish Sea, to the west of Scotland, and in the North Sea, the Barents Sea, the Skagerrak and the Baltic.

Atlantic cod is thus separated in a number of separate stocks with little or no interbreeding between stocks. In addition, there is a range of more or less unique local cod stocks. Cod are cold-water fish, moving away from the warming shore in summer. They are widely distributed in a variety of habitats from the shoreline to well down on the continental shelf, to depths of over 600 meters. Adult cod prey on fish species such as sand eels, whiting, capelin, haddock, young cod and squid, supplemented with a variety of worms, crustaceans and mollusks. Cod is one of the world's most fecund fishes with an average production of 1 million eggs per female. A 5kg female will produce some 2.5 million eggs with the maximum recorded being a massive 9 million eggs from one 34 kg fish.

Common name:	Atlantic cod
Latin name:	*Gadus morhua*
Maximum size:	200 cm
Maximum weight:	96.0 kg
Maximum age:	25 years
Depth range:	1-600 m
Climate:	0 - 20°C
Area of abundance:	78°N - 35°N

Cod has three rounded dorsal and two ventral fins. It has a distinct white lateral line running from the gill to the tail fin. Coloration varies with habitat. Coastal cod, living in kelp and algae, can be reddish while cod residing in rocky inshore regions can be dark brown.



Global distribution of Atlantic Cod (Gadus morhua) FAO Species Catalogue 1990

3.2 Cod in the Barents Sea

Production of plant plankton vary greatly, and large fish stocks are found in areas with high primary production. The Barents Sea is one of these areas, and supports large fisheries for haddock, capelin, herring, cod and saithe. During summer and spring, heated, nutritious seawater flows from the Atlantic into the Barents Sea. The Sea cools down in winter, and this creates good mixing of the water masses, bringing nutrients to the upper layer, providing good growth of plant-plankton. Zoo-plankton prey on plant plankton, for then to serve as prey for numerous fish like capelin and herring and young fish and fish larvae. These again become food for bigger fish like cod, seabirds and sea mammals.

The large cod stock in the Barents Sea is referred to as either Norwegian Arctic cod (Institute of Marine Research), Barents Sea cod (Ministry of Fisheries) or Northeast Atlantic cod (ICES). Along the Northern coast of Norway there is also another cod stock referred to as Norwegian coastal cod. The Northeast Arctic cod stock is oceanic and migratory and often called “skrei” in Norwegian. This is by far the majority of the cod biomass in the Barents Sea. The other cod stock is called coastal cod or fjord cod, consisting of several local stationary cod stocks (IMR 2002). While the Northeast Arctic cod is predominantly oceanic and make extensive migrations, coastal cod in the fjords and inner coastal areas is rather stationary. In addition there are some more offshore components of coastal cod, which makes seasonal migration along the coast. The two types are identified by analysing the “earstone”, otolith. By use of these identification criteria the catch statistics in Norway has back to 1984 been split between the two stocks, and ICES has provided a separate assessment for Norwegian coastal cod since 1989. Adults of “skrei” may migrate distances of up to 200 miles or more to their breeding grounds. Coastal cod live in coastal waters and their migrations are moderate. The migrating, oceanic cod grows up in the Barents Sea and comes to the Norwegian coast to spawn. Spawning season varies in different areas of the Atlantic but the majority in the Barents Sea spawn between February and April in water less than 180 meters deep. Oceanic cod reach maturity at around 6 to 10 years of age, while coastal cod mature earlier, around 4 to 6 years. The free-floating eggs are widely distributed by currents. The eggs hatch after twelve days, and the planktonic larval phase lasts for ten weeks, during which the cod will increase it’s body weight by 40 times, and be 2cm in length. During July-September, the young cod then move to the seabed, where their diet changes to small benthic crustaceans, such as small crabs. They grow to 14 - 18 cm by the end of their first year. In the Barents Sea, capelin (*Mallotus villosus*) is the most important prey for the stock of cod, and cod is also the most important predator on capelin in this area.

Northeast - Arctic cod - “Skrei”

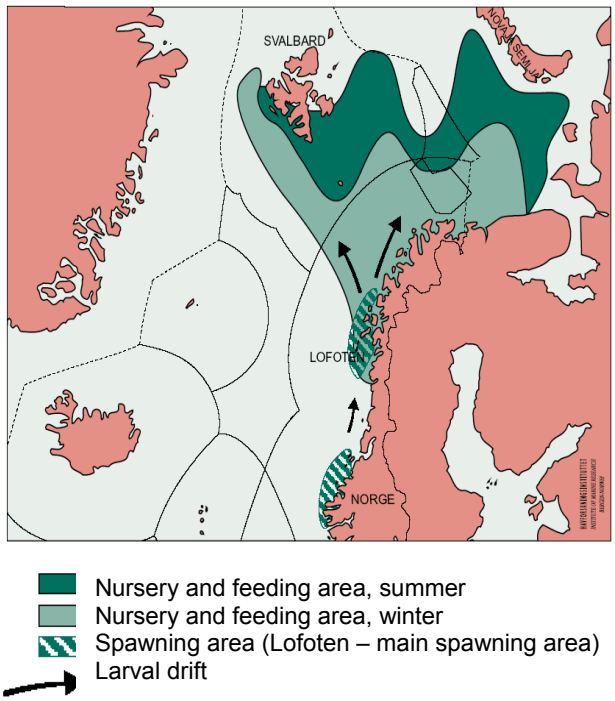
The oceanic cod stock is by far the largest. It spends most of its life in the Barents Sea, but migrates both as immature ”loddetorsk” and as mature ”skrei”. The Barents Sea cod stocks spawning grounds stretches from Finnmark to Stad. However, the most important spawning area is in Vestfjorden and inside the Lofoten islands.

Norwegian coastal cod

Norwegian coastal cod is the joint name of different coastal and fjord stocks of cod north of 62° latitude from Stad to Varanger. Most of these stocks have individual and defined spawning fields and can be separated genetically from Northeast Arctic cod. Coastal cod are similar to the cod found in the Barents Sea, but have adapted to the various local habitats along the coast. Coastal cod is found from the intertidal zone down to depths of approx. 600 meters. Coastal cod is often observed in quite shallow waters feeding in kelp areas. Results show significant differences between cod, and indicates that the coastal cod is divided in separate, local stocks where genetic interactions are very limited (IMR 2002).

Murmansk coastal cod

Coastal cod populations also occur further east of Varanger in the Kola Bay, in the Teriberka Bay and up to Seven Islands Archipelago. The status of these populations is disputed, and there has been little research on the coastal cod in Russia.

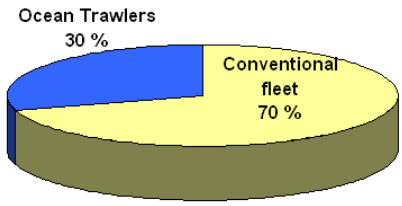


4 The cod fishery in the Barents Sea

In 1816, the Lofoten Act – Lofotloven – was passed. This act regulated the time when fishing could begin in the morning, and divided the seas off the shore of each fishing village into permanent areas for longlining and gillnetting.

4.1 Todays cod fishery

The trawl fishery for cod in the Barents Sea has existed since 1920, but the Norwegian trawler fleet did not significantly participate in this fishery until after the Second World War (Salthaug, 1999). Quotas were introduced in the trawl fishery in 1978 and for the fisheries with conventional gears in 1989 (ICES 2003). Since then, the ocean fishery for cod has been regulated both by quotas and access permits limiting the number of vessels. In 1990, there was a shift in Norwegian fisheries management, leading to conventional fishing methods, including most of the coastal fleet, also being regulated by access permits. Since 2002 all major fisheries are regulated with both a quota system (output control) and a limit of number and types of vessels (Input control). The fishery is conducted both by an international trawler fleet operating in offshore waters, and by a conventional fleet consisting of vessels using gillnets, longlines, handlines, and Danish seine operating both offshore and in the coastal areas.



Apportion between ocean trawlers and conventional fleet of cod quota in Norway (FID 2003)

Normally, the annual quota is overfished by the fishing fleet, with a few thousand tons. Since 2003, the quantity that is overfished will be subtracted from the next year quota. The Norwegian ocean fishery for cod in the Barents Sea takes place all year around, normally with the most intense fishing activity from November to May. According to the Norwegian Ministry of Fisheries, the apportion between the ocean trawling fleet and the coastal fleet was 30% and 70% respectively in 2002. In Northwestern Russia, the majority of the quota is taken by ocean trawlers. This fleet is mainly based in the city of Murmansk. Most of the Russian cod is landed in Norway (Hønneland 2003). However, there is now a trend towards more landing of Russian cod in Murmansk.

4.2 Regulations in the Barents Sea cod fishery

In addition to quotas, the cod fisheries in the Barents are regulated by mesh size, minimum landing size, a maximum allowable bycatch of undersized fish, maximum bycatch of non-target species, closure of areas with high densities of juveniles, and by seasonal and area restrictions. Since January 1997 sorting grids have been mandatory in the trawlfishery. The fisheries are controlled by inspections of the trawler fleet at sea, by a requirement of reporting to catch control points when entering and leaving the EEZs, and by inspections of fishing vessels when landing the fish. Keeping a detailed fishing logbook onboard is mandatory for most vessels, and large parts of the fleet report to the authorities on a daily basis (ICES 2003).

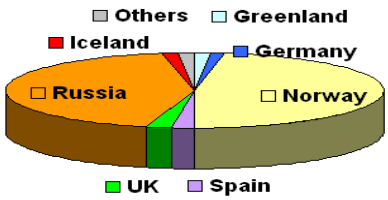
The program for closing fishing areas when undersized fish is present has been practiced for several years, and is one of the most efficient ways to protect small fish. The regime using closed areas is probably the single most important regulation in the management of the stocks of saithe, cod and haddock (DN 2004). It is the regional fisheries director who orders the surveys, and if an area has more than 15 per cent undersized fish, the area is closed. Satellite tracking of Norwegian fishing vessels has been operating since 2000 (Fiskeridirektoratet 2002) and obliges all vessels over 24 meter to send position, course and speed to the Norwegian Directorate of Fisheries once every hour. There are also agreements with EU, Russia, Faroe Islands, Iceland, Greenland and Poland that vessels of those nationalities report every second hour when in the Norwegian Economic Zone. Despite all this, there are indications of a large illegal and unregulated fishing in the Barents Sea, described further in chapter 5.4.

4.3 Joint Norwegian - Russian Fisheries Commission

In the mid 1970s, states started to adopt the principle of 200 n. miles exclusive economic zones (EEZs), and both Norway and the Soviet Union established EEZs in the Barents Sea. The two coastal states entered into a broader cooperation on fisheries management, formalised in two agreements of 11 April 1975 and 15 October 1976. The agreement of 1975 established the *Joint Norwegian - Russian Fisheries Commission*.

The commission meets every autumn to set the total allowable catches (TAC) for the three joint stocks for the following year, cod, saithe and capelin. At this annual session the parties also agree upon mutual access to fisheries in and their sharing between Norway, Russia and third countries. Various regulatory measures are adopted, such as criteria for the closure of areas with a large share of under-sized fish, the use of sorting grids in trawl fisheries etc. In 1992, a *Permanent*

Committee for Management and Control Issues was established under the Joint Commission. The members of the Permanent Committee meet several times a year. One of their main tasks is to work out concrete measures aimed at improving the fisheries control, such as routines for the exchange of information and for the exchange of inspectors at sea.



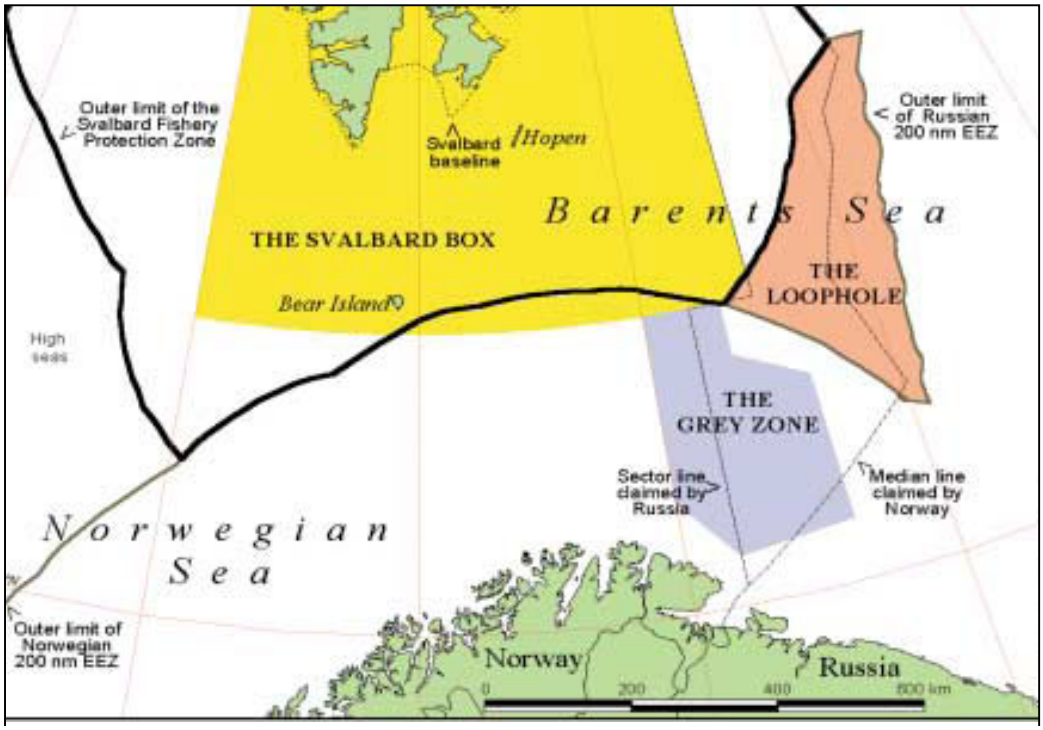
Countries fishing for North-East Atlantic cod in 2002, ICES 2002

Russia and Norway catch most of the cod in the Barents Sea, and only very limited quantities are given to other countries. The graph shows the different countries fishing for cod in 2002.

One issue that might come up in the near future is what will happen to the joint Norwegian-Russian fisheries commission if Norway joins the European Union.

Traditionally, Norwegian fishermen have a negative attitude to a possible membership, though this has changed the past years as the market situation for seafood is becoming more difficult when Norway is staying outside the Union. If Norway becomes a member, national fisheries management will be part of the EU's Common Fisheries Policy, mentioned in chapter 1.4.

The CFP has a bad history of fisheries management, and there could be reasons for concern if the Barents Sea cod stock falls under EU's somewhat failing fisheries policy.



The Svalbard treaty from 1920 gives Norway sovereign right over Svalbard with some exceptions, and jurisdiction of the Svalbard Fishery Protection Zone. The Grey Zone represents an area where Russia and Norway have a fishery agreement, regulating parts of the disputed area on the coastal border between the two countries.

4.4 International Council for the Exploration of the Seas

ICES (The International Council For The Exploration of the Seas) is the coordinating institution for marine research in the North Atlantic. ICES was formally set up in 1902 to provide scientific knowledge and advice to its member states.

The ICES Advisory Committee on Fishery Management (ACFM) is responsible, on behalf of the Council, for providing scientific information and advice on living resources and their harvesting. In formulating its advice on the fisheries management of around 135 stocks of fish and shellfish, ACFM utilises information prepared by numerous stock assessment working groups. Scientific information and advice about cod in the Barents Sea comes every year from the ICES Arctic Fisheries Working Group, mainly based on information from researchers at PINRO in Murmansk and IMR (Institute of Marine Research) in Bergen. The annual stock assessment and advice is published in June, at the ICES ACFM meeting.

4.5 Limits for minimum stock size and safe fishing – as defined by ICES

ICES recognises that "changes in fisheries systems are only slowly reversible, difficult to control, not well understood, and subject to change in the environment and human values". Therefore ICES agrees that a precautionary approach should be applied to fishery management, based on the definition from the Convention on biodiversity from 1992. ICES addressed the precautionary approach already in 1981, and it is now formally adopted. The concept of so-called safe biological limits was introduced in ICES' work in the 1980s. The term is explicitly referred to in the UN Agreement on Straddling Fish Stocks, where is says that: "Precautionary reference points should be stock-specific to account, inter alia, for the reproductive capacity, the resilience of each stock and the characteristics of fisheries exploiting the stock, as well as other sources of mortality and major sources of uncertainty". In some special years, some illegal fishing has been accounted for in the ICES' models to avoid over-estimating the cod stock. However, for most years, illegal fishing has not been taken into account, meaning that actual fishing is probably higher than what the scientific advice is based on (ACFM 2003b). If illegal fishing is as widespread as indicated, this can seriously affect the analysis and assessment of the cod stock in the Barents Sea.

Biological limits is a term used when ICES describes the status of fish stocks and gives recommendations on fishing quotas and fishing regulations.

ICES sets a limit for a fish stock giving as an indicator of how large the Spawning Stock Biomass (SSB) should be in order ensure that the stock maintains its possibility to stay healthy. In ICES terms, a healthy stock is classified as being within safe biological limits. Blim is a limit set by ICES, representing the minimum size of the fish species' SSB in order to sustain the stock.

However, ICES operates with a precautionary approach according to the UN fish stock agreement, meaning that there is a limit called Bpa representing a "safer" size of the SSB. To take account of the uncertainty in the stock estimates the ICES advise is to aim at an estimated SSB above Bpa, thereby obtaining a high probability that the real stock is above Blim, (See box about safe biological limits).

For fishing mortality, ICES uses the same terms. Flim is the maximum fishing that can take place without the stock decreasing below Blim. And since ICES operates with a precautionary limit for how large the SSB should be, ICES also operates with a precautionary fishing quota (fishing mortality rate) called Fpa.

So, in order to have a high probability to avoid the minimum thresholds of a stock, ICES advice takes account of assessment uncertainty and is based on the thought that management action must be taken before these thresholds are approached.

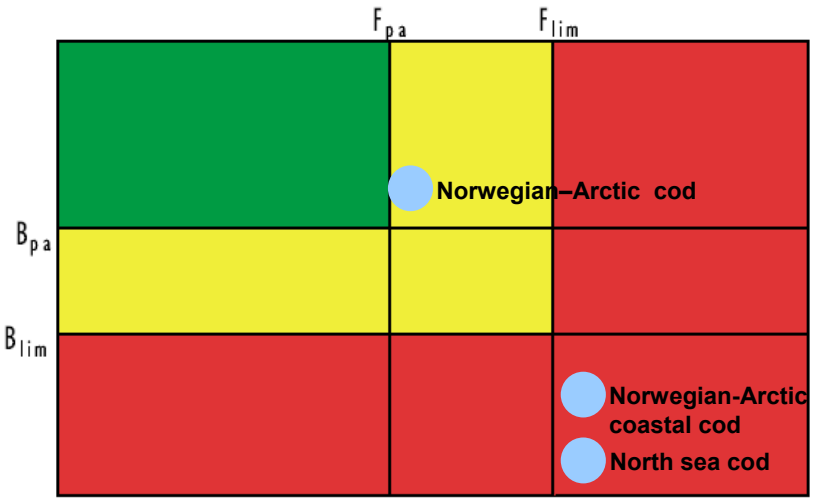
Safe biological limits
In order for a stock and a fishery exploiting it to be within safe biological limits, there should be a high probability that: The spawning stock biomass is above the threshold where recruitment is impaired (B_{lim}) and the fishing mortality is below that which will drive the spawning stock to the biomass threshold that must be avoided (F_{lim})

Biomass threshold/limit = B_{lim}
Fishing mortality threshold/limit = F_{lim}.
Biomass precautionary limit = B_{pa}
Fishing mortality precautionary limit = F_{pa}

Bpa and Fpa represent the precautionary approach!

Bpa and Fpa should be regarded as signposts giving information on the status of the stock in relation to predefined limits that should be avoided to ensure that stocks and their exploitation remain within safe biological limits. Advice from ICES will be based on Fpa and Bpa, using the precautionary approach. If fishery management decisions lead to Fpa being exceeded, then this would be regarded as overfishing and management would not be regarded as consistent with a precautionary approach. (Unless management has a plan for bringing the stock and fishing mortality back within acceptable levels on a short term perspective) That is what ICES calls "being harvested outside biological safe limits". In general, Bpa is the biomass threshold triggering advice for a reduction in Fishery to a value below the recommended fish mortality.

The ICES box shows how fish stocks can be plotted on different colours, indicating the status of the stock and exploitation levels (IMR 2003).
Green: The stock is safe, SSB is inside precautionary limits and the fishing mortality is within safe biological limits
Yellow: Awerness zone, either the SSB is lower than Bpa, or the fishing is higher than Fpa.
Red: The stock is not in a sustainable state, SSB is below Bpa and fishing is not in line with recommendations.



In this box, the state of three cod stocks in June 2003 are plotted. Northeast Arctic cod is harvested outside safe biological limits, but the SSB is well within safe biological limits. The situation is dramatic for both the North Sea cod stock and the Norwegian coastal cod stock. Both have a SSB far below a safe limit, and fishing quotas are higher than recommended. The two stocks are outside safe biological limits and are also harvested far outside safe biological limits.

5 State of the Barents Sea cod stocks

5.1 State of the Northeast Arctic cod stock (Barents Sea cod).

The last evaluation of Northeast Arctic cod (oceanic Barents Sea cod) came in June 2003 where ICES concluded that the stock is growing and that the stock is within safe biological limits, meaning that the spawning stock biomass is well over 460.000 tons. However, ICES expressed some serious concern. In November 2003, the Russian-Norwegian fisheries commission set the fishing quotas for 2004 to 486.000 tons, ignoring the scientific advice of a total catch of less than 389.000 tons.

- Since 1998, the quota for cod has been significantly higher than the scientific advice, and ICES defines the stock as being fished outside safe biological limits because the fishing pressure is too high.
- The age structure of the stock has changed as a result of high fishing pressure over time. The majority of the spawning stock consists of first-time spawners. Eggs and larvae of first-time spawners are less viable than those of other mature fish and overall spawning period is reduced when the spawning stock consists of fewer age groups. ICES address the need to rebuild the age structure of the stock.
- There are concerns about discards and unreported landings, and there are new indications that this problem could be widespread, with illegal catches of 100.000 tons annually, and that control routines are not sufficient.
- Despite political will to reduce fishing capacity, overall capacity in Norwegian waters has grown significantly since 1990. The trawler fleet has increased its capacity with more than 70 per cent. Over capacity contributes to an increased pressure on the cod stocks.

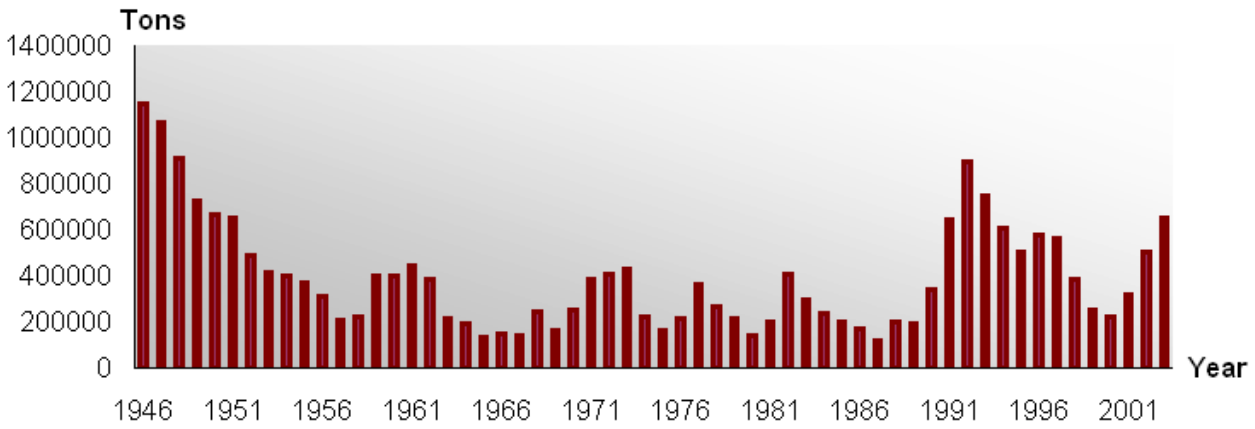
WWF urge for the Norwegian and the Russian Governments to use the precautionary approach and set cod quotas in accordance with scientific advice from ICES. Further, there is an urgent need for stronger control of all fishing activities in the Barents Sea, and WWF ask for immediate action from the Governments to reduce illegal fishing. Thirdly, overall fishing capacity must be reduced in order to reduce pressure on species such as cod.

5.2 Spawning Stock Biomass of the Northeast Atlantic cod stock

The graph shows the development of the SSB of the Northeast Arctic cod stock from 1946 to 2002. In 2000, the spawning stock of the Northeast Arctic cod was approaching historically low levels, as it was down to around 220.000 tons. This trend has now turned, and the SSB in 2003 was estimated to be well above the precautionary limit of 460.000 tons. However, for the whole period 1998 to 2001, SSB was below this threshold. The precautionary SSB limit was revised in June 2003 because the spawning biomasses associated with a number of historic recruitments where estimated to have been lower than previously assumed. Bpa was changed from 500.000 tons to 460 000 tons.

In June 2003, ICES said that the expectation of future SSB's is much higher than projected in 2002. All surveys indicate increased stock size. The uncertainties of the surveys, and thereby the uncertainties of the assessment, are considered to be larger than in previous years. This is emphasised by indications of a large illegal fishing, not being part of the official catch statistics.

In March 2004, the Norwegian Institute of Marine Research published the results from this years survey of cod in the Barents Sea. The results where as expected, and a further growth in the SSB is expected, however, less young cod were found.



Spawning Stock Biomass for Norwegian Arctic cod from 1946 to 2002. The red line indicates the precautionary limit, Bpa. (ICES ACFM 2003)

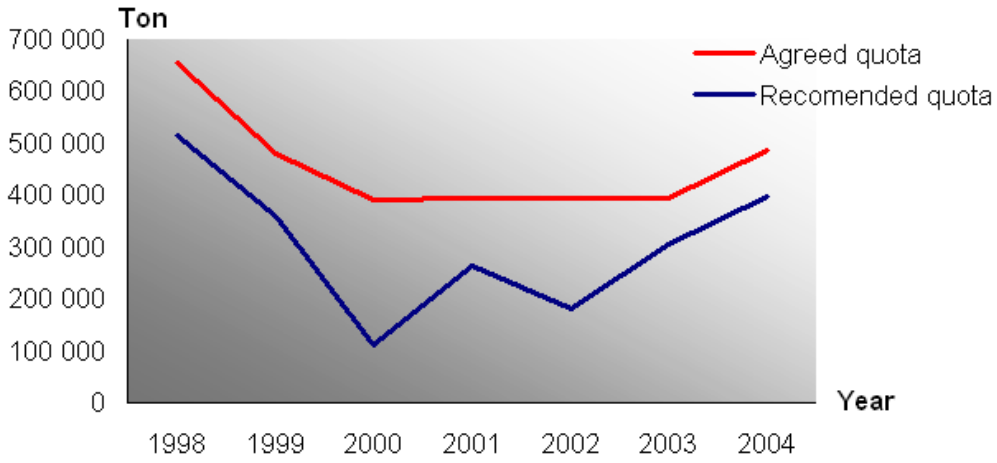
5.3 Cod quotas in the Barents Sea are too high

The fishery for cod in the Barents Sea has been higher than ICES has recommended since 1998. Based on the most recent estimates of fishing mortality and SSB, ICES classifies the stock as being harvested outside safe biological limits.This classification comes because the total allowable catch is far larger than the recommended quota based on a precautionary advice. The current stock is above the biomass precautionary limit, Bpa, but the stock is harvested above the precautionary fishing mortality, Fpa. Fishing mortality in the period 1997-2000 was among the highest ever observed and well above Fpa, even above Flim (ACFM 2003b). As seen on the graph, TAC has been higher than recommended since 1998. The joint Norwegian – Russian fisheries commission has adopted a new decision rule for setting the annual TAC. This is further described in Appendix III.

In order to harvest the stock within safe biological limits, ICES recommends a considerable reduction in fishing mortality to less than Fpa. This corresponds to catches in 2004 of less than 398 000 tons.

Year	Recomended Max Quota	Agreed Quota	Difference in Tons	Difference in %
1998	514 000	654 000	140 000	27
1999	360 000	480 000	120 000	33
2000	110 000	390 000	280 000	255
2001	263 000	395 000	132 000	50
2002	181 000	395 000	214 000	118
2003	305 000	395 000	90 000	30

The table shows that the agreed quota has been considerably higher than recommended for several years. In 2000 it was as much as 255% higher. (Riksrevisjonen 2004)



Recommended fishing quota from ICES and the agreed total allowable catch (TAC) from the joint Norwegian – Russian Fisheries Commission (ICES ACFM 2003)

5.4 Skewed age structure

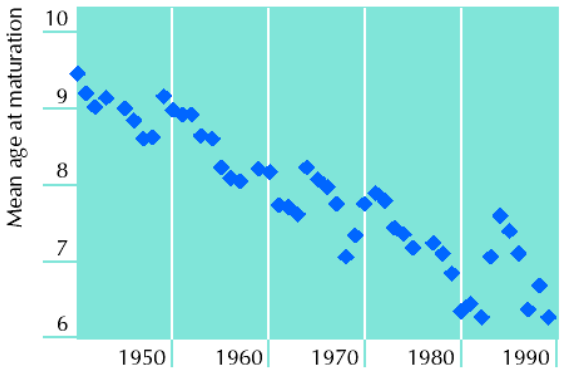
Historically, the Northeast Arctic cod has matured late, with a mean age at first spawning of about 10 years. However, the pattern of exploitation has changed drastically since the early 20th century. The development of modern ocean trawlers has enabled offshore fishing at the feeding grounds in the Barents Sea. Thus, the Northeast Arctic cod has undergone a change from a harvesting pattern that should favour late maturation to a pattern favouring early maturation. This hypothesis is in agreement with observations that show a clear trend toward earlier maturation of the Northeast Arctic cod, with a decrease of about three years in the mean age at first spawning from the 1940s until today. Because age at first spawning is a heritable characteristic, the data seem to support the hypothesis that the Northeast Arctic cod has responded evolutionarily to the altered exploitation regime (Heino et al 2000). Eggs and larvae of first-time spawners are less viable than those of other mature fish and the overall spawning period is reduced when the spawning stock consists of fewer age groups because younger cod spawn for a shorter period than older cod. In Canada, before the cod-collapse, there was a trend towards more young spawners and less old, from 1960 to 1980 (Hutchings & Myers, 1994). According to ICES, there is now a need to rebuild the age structure of the cod stock in the Barents Sea, as the majority of the spawning stock now consists of first-time spawners. Recent literature (Olsen 2004) warns that such fisheries-induced evolution can lead to lower yields and reduced stock stability.

The Norwegian Institute of Marine Research say in their status report for 2004 that such evolutionary effects of fishing is a new challenge for fisheries research and management (Heino 2004). IMR also emphasises that the precautionary principle should be used to address any uncertainty.

5.5 IUU – Illegal, unreported and uncontrolled fishing

ICES is concerned about under-reporting of cod catches and stress that both discards and unreported landings will reduce the effect of management measures. In late fall 2003, the Norwegian Ministry of Fisheries confirmed that there are indications of a large, illegal overfishing of cod in the Barents Sea (NRK 2003). The Norwegian Fisheries Newspaper, “Fiskaren” revealed that they had sources estimating that this overfishing of cod can be as dramatic as 200.000 tons for the last 2 years.

The capacity within the Norwegian fishing sector is significantly higher than what is necessary to catch the total Norwegian quotas. Over-capacity is one important factor that can contribute to increased illegal fisheries activities (Fiskeridirektoratet 2001). It has been a political aim for years in Norway to reduce total fishing capacity in order to have a fishing fleet actually matching the fishing resources. However, the recent report from the Auditor General (Riksrevisjonen 2004) concludes that total technical trawler capacity has



Decrease in the mean age at first spawning in the Northeast Arctic cod stock (Heino et al, 2000)

increased by 72 per cent from 1990 to 2002 and the conventional fleet has increased its technical capacity by 30 per cent in the same period. WWF fears that this will further increase the pressure on the cod in the Barents Sea.

In northwestern Russia, the new quota system auctioning fishing quotas is also thought to lead to more illegal fishing (Intrafish 2003). The financial cost for vessel owners can be so high that it is a significant incentive for illegal fishing.

Discards

By-catch and discard of fish is a world wide problem and it is estimated that the annual discard of fish may be close to 40 million tons every year (Alverson et al. 1994). Total, global catch of fish is around 90 million tons, meaning that discards add 1/3 to this. Fish often die when they pass through webbing or free themselves from hooks. Highgrading means fish that are dumped in order to increase the value of a catch. For example, large fish give better price leading to smaller fish being thrown away to free up space in the vessel or to comply with quota.

Disappearing cod

“Norsk Fiskerinæring”, a Norwegian Fisheries Magazine, estimated that in the period from 1995 to 1998, 300.000 tons of cod “disappeared”. The numbers where based on total recorded landing of cod compared to how much cod was sold domestically plus export. Also, calculations based on sale controls revealed several cases where the first hand turnover happens in the black market, but where second turnover suddenly is reported. Such sale controls found a significant difference of 20% (Fiskeridirektoratet 2001). Also, It was estimated that around 100 000 tons of cod "disappeared" every year between 1995 and 1998 (Nakken et al in IMR 2000)

Discard of cod is illegal in Norway, (FID, Saltvannsfiskeloven, 1983), however the problem exists in a large scale (IMR 2002). According to estimates from IMR, the total discard of cod from the Norwegian Arctic stock in the Barents Sea is annually between 10.000 to 30.000 tons. Discard is a well-known problem and unfortunately it seems to be widely spread (Fiskaren, 2004, Brennpunkt 2004). It is estimated that cod discards in the 1990s was around 10% of total catch (Dingsøyr 2001).

Estimated discard in tons from Norwegian cod-fisheries, also including some saithe and haddock (north of 62°)		
Fishery	**Min**	**Max**
Trawl Barents Sea	5.500	12.500
Danish Seine	1.400	2.800
Longline	1.640	6.150
Handline	720	1.500
Netfishing/gillnet	1.720	6.350
Total discard	10.980	29.300

It has been estimated that in the Russian bottom trawl cod fishery, annual discards in the period from 1993 to 2002 varied from 3 to 22 million individual cod. The least discards were noted in 1993-1994. During these years nearly 3 million cod individuals were discarded annually. The highest discards were observed in 1998 when about 22 million cod individuals were heaved overboard. From 1999 to 2002 a reduction in cod discards were observed (Solokov 2003). Roughly, this gives an estimated discard that vary from 6 000 tons to 60 000 tons. It should be noted that the obtained estimates of discards are most likely to be underestimates (Solokov 2003).

How to deal with IUU fishing

Solutions to the problem of illegal fishing and discards have been debated for years. Inspectors onboard individual boats is one out of many suggestion. Also, it should be noted that the Norwegian government has cut down on inspections and control and also shut down the tip-telephone used by fishermen who could anonymously call when illegal activities where observed. Since 2000, the Norwegian coastguard has caught 66 fishing vessels dumping fish, most of them Norwegian (20), Russian (14) and British (10). Up to 1997, there was a growth in resource control in Norway. However, this has been decreasing since, and the trend is still negative. The reduction in control activities is going down and today only 0.5% of the appox. 400.000 landings on Norwegian mainland every year is controlled (Fiskeridirektoratet 2001).

At the November 2003 meeting of the joint Norwegian - Russian fisheries commission, it was formally agreed that the permanent working group would analyse the existing regulation- and control regime looking into ways to improve the regime in order to reduce the problem with illegal fishing activities (FID 2003b). Several means where mentioned, such as establishing control points for reloading at sea and drafting guidelines for withdrawal of licences to boats that are found guilty at illegal fishing activities. This is likely to be adopted as early as in July 2004. Also, the system of buying and selling quotas in Russia has been changed,

In May 2004, the Norwegian “discard commission” published a report on how to deal with discards in Norwegian waters. The report gives some important recommendations, such as:

- Keeping the band on discard of commercial fish species
- Expanding the current system of closing areas with undersized fish.
- Increasing the use of inspectors at sea
- More control of fish vessels at sea
- More control when landing fish

WWF encourage the Norwegian parliament to ensure that this proposed plan receives sufficient funding.

5.6 Norwegian coastal cod in strong decline

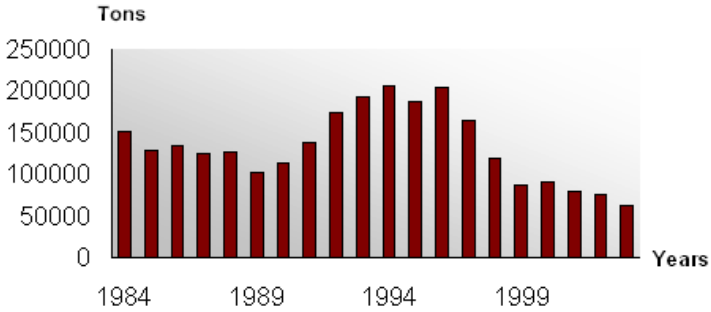
In June 2003, ICES recommended a full stop in the fishery for coastal cod along the Northern coast of Norway including in the Barents Sea. The stock is now defined to be outside safe biological limits because the Spawning Stock Biomass is dramatically low and fishing pressure is too high. The stock has declined continuously since 1994, and there seem to be now recovery. In 2003, the quota on coastal cod for 2004 was reduced, but the fishery was not closed, as ICES had asked for. ICES urged for a recovery plan, and the Norwegian Government produced a plan that will come into force in May 2004. However, this plan does not address all the issues ICES and IMR asked for, and WWF find this plan insufficient for protecting and rebuilding the stock. It misses important means such as closed areas, time restrictions on fishing and further research.

- At present, the biomass of the spawning stock is the lowest observed in the time-series extending back to 1984.
- Fishing pressure increased from 1991 to 1999 though the stock was already historically low. ICES advised a full stop in fishing in 2004, but this was ignored by Norwegian fisheries authorities.
- ICES asked for a recovery plan that should be developed and implemented as a prerequisite to re-opening the fishery. A so-called plan has come, but fails to protect the coastal cod on several points.

WWF urge for a sufficient recovery plan for coastal cod, where closed areas and clear restrictions on fishing is included. Until this plan is implemented, no fishing should take place.

5.7 Coastal cod spawning biomass

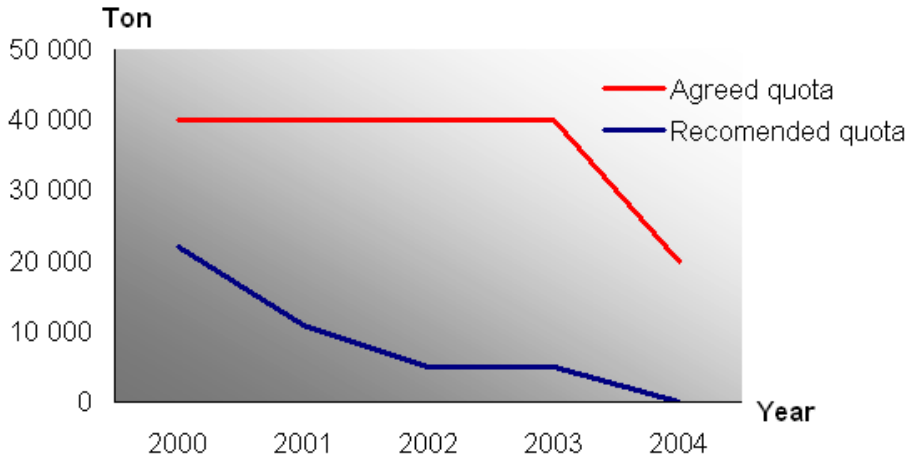
The fishery on Norwegian coastal cod is managed as part of the Norwegian Northeast Arctic cod fishery. The stock has declined continuously since 1994. At present, the SSB is the lowest observed in the time-series extending back to 1984. Recruitment in recent years has decreased rapidly to very low levels. A further decrease in the total stock biomass and SSB is expected in the short term (ICES 2003).



The SSB of Norwegian coastal cod North of 620 has decreased continuously since 1984 and a further reduction in biomass is expected. ICES ACFM 2003

5.8 Fishing quotas are too high

Fishing mortality for coastal cod increased from 1991 to 1999, then remained stable until increasing substantially in 2002 (See graph). The TAC for 2002 and 2003 was set eight times higher than recommended by ICES. This further decreased an already historical low SSB. In June 2003, ICES asked for a full stop in the fishery for coastal cod. This was not followed, and the quota for 2004 was set at 20.000 tons.



Fishing pressure on coastal cod has been significantly higher than recommended for many years, in 2002 and 2003 it was eight times higher. (ICES 2003).

5.9 Norwegian Government failing to draft recovery plan

ICES asked for a recovery plan for coastal cod to be developed and implemented as a prerequisite to re-opening the fishery. The plan should address ways to monitor development of the stock, clearly specified re-opening criteria, and monitoring the fishery when it is re-opened.

In response to the advice from ICES in June 2003, the Norwegian Ministry of Fisheries already two weeks after assigned a working group with the mandate to draft a plan of action on how rebuild the coastal cod. The working group came up with several recommendations in September 2003, and a slightly changed proposal was sent on public hearing from the Ministry. This included means to bring larger boats further out from the coast, and to avoid the use of Danish seine in coastal areas and to increase the knowledge of when and where different stocks spawn in order to protect important areas. In Finnmark county, there are already areas closed for Danish seine fishing established to protect the coastal cod. Originally, the working group was asked to draft a plan and find regulations that could be implemented from Januar 2004. However, the Norwegian Ministry of Fisheries has so far failed in taking the necessary steps to protect the coastal cod. In March 2004, the Ministry finally published the new regulations that will come into force in May 2004. WWF cannot see that these means are anything near what is necessary to rebuild the stock. There is no recovery plan, meaning that there is no plan of further research, nor is a sufficient number of areas closed for all fishing. Most fishing activities will continue without any change. Large boats are even allowed in the fjords fishing for other species, allowing by-catch of up to 25% of cod.

6 Conclusion

The Barents Sea cod stock, officially named the Northeast Atlantic cod, is now by far the worlds largest cod stock. The Canadian cod collapsed 14 years ago and the warnings about the North Sea cod are alarming. The cod stock in the Barents Sea is the last remaining of the world's great cod stocks and the fishing industry in the area is part of a thousand years old tradition. It is the Governments of Norway and Russia who has the total responsibility of ensuring that there will be cod in the Barents Sea also in the next thousand years. Scientists and the commercial market express concern over today's failing management, and now is the time for a change. WWF urge the two countries to take immediate action in order to sustain this stock for the future.

Compared to the disastourous management of the Candadian cod and the North Sea cod, Norway and Russia has to some degree succeeded in their management by avoiding such a dramatic decline. However, now there are warnings from the scientists about a too high fishing pressure, skewed age structure and a large illegal fishing. Steps need to be taken in order to rebuild the stock and find ways to deal with illegal activities. If the necessary steps are taken. It can help rebuilding trust to the fisheries sector within the mind of the public and politicians, and also in a highly sensitive seafood market.

6.1 Management of the Barents Sea cod violates international and national committments

The Norwegian Government is committed to follow up the parliaments instructions to keep Norwegian fisheries management in line with principles about sustainable harvesting based on scientific recommendations where the precautionary approach and the ecosystem approach are implemented. Furthermore, the Government is committed to reduce overall fishing capacity. Cod is one of the species used as an example in the assessment from the Norwegian Auditor General (Riksrevisjonen) published in March 2004. The Auditor has looked at Norway's national and international obligations related to fisheries management, and concludes that in the case of cod, the Norwegian Government is violating important principles such as the precautionary approach expressed in the Rio declaration and the UN straddling fish stock agreement. Also, the management is not in line with the principle from the Parliament to base quota setting on scientific advice. In addition, the Government fails in reducing overall fishing capacity.

In order to ensure the future of the Barents Sea cod stock, WWF urges Norway and Russia to:

- Apply the precautionary principle and set fishing quotas in accordance with scientific recommendations.
- Produce and implement a plan to effectively reduce illegal fishing activities.

WWF urges Norway to:

- Where possible, immediately close the fishing for coastal cod.
- Produce and implement an efficient recovery plan for coastal cod, with the aim of rebuilding the stock within 2010
- Reduce overall fishing capacity.

WWF also challenges the Norwegian Government to use the forthcoming management plan for the Barents Sea to take a lead internationally in showing how ecosystem based fisheries management can be used to protect the worlds largest cod stock – and its ecosystem.

WWF would like to see consumers around the world to asking where the cod they buy is fished, ensuring that it comes from a legal and sustainable fishery. Consumers should also express their concern about decreasing cod stocks when buying cod.

6.2 Is the cod fishery in the Barents Sea based on the ecosystem approach?

The concept of ecosystem based fisheries management has been adopted in several international conventions described in chapter 2. A question often asked is if the management of the Barents Sea cod lives up to the basic elements of ecosystem based fisheries management. Simplified, some of the basic elements are:

1. Be based on the precautionary approach
2. Have clear goals and objectives
3. Have indicators and plans for monitoring
4. Have decision rules for quota setting
5. Be a totally open and transparent process that includes all stakeholders and allow and encourage public debate

1) Is the current management regime based on the precautionary approach?

The precautionary principle and the way to implement it (the precautionary approach) is expressed in the UNCED Declaration from Rio. It is further emphasized for fisheries management in the UN straddling fish stock agreement and the UN Code of conduct for sustainable fisheries. ICES operates with quota advices based on the precautionary approach. As clearly showed in the graph and table under chapter 5.3, the cod quotas set by the Norwegian Russian fisheries commission are not in line with the precautionary approach, represented by the advice from ICES. The management of the Northeast Arctic cod stock is not following these recommendations.

Conclusion: No, because the current management regime does not implement the precautionary approach, as it continuously sets the quota higher than the precautionary limit set by ICES.

2) Does the current management regime have clear goals and objectives?

Within ecosystem-based management, one core principle is that you need clearly defined goals (Link 2002), or a set of objectives (Degnbol 2002) for the management. The objectives of the current management regime read:

- to attain high sustainable catches from exploited stocks in the ecosystems of the Barents and Norwegian seas without decreasing their productivity.
- to keep exploited stocks within safe biological limits while maintaining the biodiversity and productivity of marine ecosystems.
- to ensure sustainable development of the fisheries industry while exploiting the stocks within safe biological limits;
- to attain sustainable social development of maritime regions.

Conclusion: Yes, because the current management regime has clear objectives for the management.

3) Has the current management regime indicators and sufficient monitoring?

In order to measure whether a stock is overfished, a set of indicators, parameters or reference points are needed. Indicators needs to be sensitive to change, directional but at the same time general enough to be useful. They should be feasible to measure and able to incorporate uncertainty (Link 2002). A good regime should ensure monitoring of trends of key environmental factors, habitats, endangered species, associated and dependent species, etc (Link 2002). Research activities are addressed under section 4.2 of the new management regime for the Norwegian – Russian Fisheries Commission. It sets research activities as a basis for management decisions and lists in detail what research should take place, and how this shall be used to indicate state of the stock, and equally important, indicators to see the state of the wider ecosystem.

Conclusion: Yes, because the current management regime has a detailed list of research and monitoring activities and sets out how results should be used as indicators for the management.

4) Has the current management regime decision rules based on the precautionary approach?

Most fisheries are managed without using agreed decision rules. To implement EBM in fisheries, any TAC must be set in a precautionary way, and should always be based on a clear set of decision rules. A *decision rule* should specify exactly what management action is chosen under a given set of circumstances. Decision rules based on the precautionary approach is needed to cover knowledge gaps and natural cycles. Quota setting is now more political than scientific. In order to rebuild the cod stock, less controversy around the quotas is needed. The new management plan from November 2002 is a step in the right direction as it more or less binds the quota for the forthcoming three years, as the commission now has adopted a decision rule. However, the new plan still allows fishing that is on the maximum of what the stock can sustain, and the decision rule is not in line with the precautionary approach.

Conclusion: Yes, because the current management regime has a decision rule. However, this rule is not in any way sufficient for implementing the precautionary approach.

5) Does the current management regime include all stakeholders and allow and encourage public debate?

The ecosystem approach requires an open process that actively seeks interagency and public input and support (Busch 2003), and the process requires that all stakeholders shall be provided with an opportunity for input (Link 2002). Higher participation of stakeholders can be achieved through opening of institutions and improved transparency (FAO 2003). Credibility is achieved through transparency and participation from several stakeholders. According to the report from the Auditor General (Riksrevisjonen) the mandate of the Norwegian delegation within the Norwegian – Russian fisheries commission is not publicly available information. However, with the new decision rule, the TAC for the coming year is well known long before the Commission meets in November each year, improving transparency in the management. Still, the negotiations are closed, with only a few participants from selected fisheries organizations. No environmental NGO's (non governmental organisation) are allowed. Friends of the Earth (Norway) has applied several times for observer status, but this has been denied by the Norwegian Ministry of Fisheries.

Conclusion: NO, because the current management regime does not allow participation from environmental organisations as observers in the commission's meetings.

6.3 Marine Stewardship Council and the Barents Sea cod

On January 9th 2004, it was publicly announced that the Norwegian Fishing Vessels Owners Association (Fiskebåtredernes forbund) are applying for MSC certification of four large, whitefish fisheries, whereof one is the Northeast Arctic cod fishery. WWF in Sweden, Denmark and Norway has for several years actively promoted MSC-certification in our deliberations with retail industry, fishermen and government officials. WWF-Norway strongly supports a MSC evaluation of the Barents Sea cod. We see this as a major opportunity to get a throughout assessment of the fishery, an assessment that can lead to changes that will help secure the Barents Sea stock for the future.

The Marine Stewardship Council Principles for a sustainable fishery is included in appendix III.

7 External threats to the Barents Sea cod

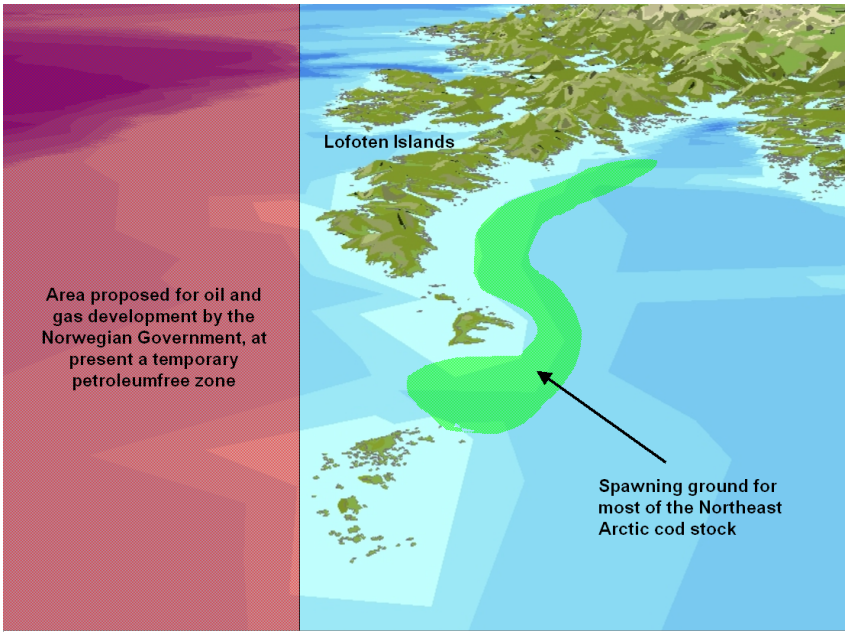
The cod stock in the Barents Sea is the worlds largest cod stock. Today the main impact on this stock is fisheries. However, in the near future also other man made activities will pose real threats to the cod in the Barents Sea. There are major plans for increased development in the area that potentially could be a threat to the cod. As oil companies are turning towards the Barents Sea extraction and transportation of fossil fuels is likely to become a major threat to the cod. Also impacts from shipping, aquaculture, pollution, tourism, climate change and introduced species are likely to increase in the coming years.

Both globally and in the Barents Sea WWF works with issues such as petroleum exploration, shipping, toxics, fish farming, introduced species and climate change. The Norwegian Government is in the process of drafting a comprehensive management plan for the Barents Sea. WWF follows this process closely. In the Barents Sea, WWF particularly works to promote a network of marine protected areas combined with a designations of vulnerable areas closed for fishing, petroleum, shipping, tourism and fish farming. In addition, good standards and regulations must be adopted for all sectors, minimising their possible environmental impact. Such means include a zero discharge policy for petroleum exploration, treatment of ballast water from ships and escape and disease prevention at fish farms. WWF promotes closure of vulnerable areas such as petroleum free zones and the establishment of a network of marine protected areas in the Barents Sea.

7.1 Petroleum activities and shipping

There is no petroleum production in the Barents Sea today. One gas field is under development and some oil fields have been found on the Norwegian side. On the Russian side around 10 significant discoveries of oil and gas have been found, and large scale production is planned.
The Norwegian Government has conducted an environmental impact assessment of petroleum activities in the Barents Sea (ULB 2003). The assessment shows that fish eggs and fish larvae are particularly vulnerable to toxic chemicals found in oil. Small amounts of oil in seawater have proven lethal to cod larvae.

Furthermore, chemical substances found in “produced water” (water extracted along with oil and gas from the reservoirs) has in laboratory testing shown to affect the reproductive capacity of cod. A common trait of several Barents Sea fish stocks, including capelin, cod and herring, is that huge concentrations of eggs and larvae are often found in relatively small areas. An oil spill affecting these areas could have severe impacts for fish and the wider ecosystem. Also seismic shooting used for petroleum exploration can disturb fish, especially in early stages like larvae and eggs (ULB 2003).



The pink area shows where the Norwegian Government established a petroleum free zone in December 2003. The cod spawning areas inside Lofoten was the main reason for closing the area for petroleum activities.

The impact assessment showed clearly that certain areas are more vulnerable to any type of oil exploration than others. The sea areas around Lofoten (See map) were assessed as particularly sensitive, because of its importance as spawning area for both cod and herring. If there is a large oilspill in the area, the assessment estimated that from 4% to 25% of a cod year class could be lost as a result, depending on weather, time of year, type of oil etc (ULB 2003). The Norwegian Pollution Agency and the Institute of Marine Research, recommends that there should be no petroleum activities in the sea around Lofoten. This area is now temporarily exempted from petroleum activities. The wider Barents Sea, however, might face extensive petroleum development in the near future.

Several factors will contribute to a significant increase in shipping activities in the Barents Sea in the near future.Transport of petroleum from existing inshore fields in Russia is increasingly being transported on ships from ports in North West Russia. and off-shore petroleum-development in the Barents Sea might take place within few years. The amount of oil exported from northwest Russia and shipped through the Barents Sea may increase from around 4.5 million tons in 2005 to as much as 15 million tons in 2010 (Frantzen and Bambulyak 2003). Shipping activity can affect commercial fish stocks by accidental spills of oils or chemicals, operational discharges of oils, chemicals, sewage and garbage and chemicals used as antifouling paints and introduction of alien species from the surface of hulls or in ship's ballast waters.
WWF calls for several means to protect the Barents Sea ecosystem from petroleum exploration and shipping activites:

- The designation of the most vulnerable areas as petroleumfree zones
- Establish the Barents Sea as a particularly sensitive sea area (PSSA) within IMO
- Mandatory treatment of ballast water
- Zero discharge from all petroleum operations

7.2 Fish farming

The fish farming industry in Norway has expanded the past15 years, and there are a significant number of fish farms along the Norwegian coast. The industry is expected to grow, and 60 new salmon licences were issued in late fall 2003, and there are now over 400 licenses for cod farming given out. There have been some conflicts between fishermen and fish farmers relating to whether or not a fish farm can have impact on local fish stocks, such as coastal cod.

Theoretically, there are several ways in which this can happen: Physical limitations to habitats, release of nutrients and chemicals and use of artificial light are all effects that could have potential impact on local stocks of for example cod. Experiments conducted in 2003 indicate that cod actually avoids seawater that have been "used" by farmed fish. At present, a research program is on-going in Tromsø (IMR 2003 and Fiskeriforskning 2003) to look at potential impacts of fish farming on marine fish, with focus on cod. It is also expected that the aquaculture industry on the Russian side of the Barents Sea can grow. Too meet the threats from a growing fish farming industry, WWF calls for:

- Fish farm free zones in sensitive areas
- Good operational guidelines preventing disease transfer and escapes

Cod farm - Norway

7.3 Climate change

The global average surface temperature has increased over the 20th century by about 0.6°C, and IPCC (Intergovernmental Panel on Climate Change) states that it is very likely that the 1990s was the warmest decade since 1861, when instrumental recording started. The Arctic is extremely vulnerable to climate change. The sea ice extent decreased by approximately 3% per decade the last 30 years and the last century saw temperatures over arctic land areas has increasing by 5 degrees Celsius on average. The Barents Sea is likely to be the scene of quick changes due to global warming. Almost all climate models project substantial warming and increases in precipitation for this sea area in the coming decades. Reduced sea ice cover is a likely consequence already being observed. As warming occurs and sea ice is melting, there will be changes in species composition. The seasonal distribution, ranges, patterns of migration, nutritional status, reproductively and ultimately the abundance and balance of species will be altered. Climate affect water temperature, salinity, nutrients, sea level, current conditions, and amount of sea ice, and fluctuations in fish abundance are related to such climate-ocean variations. Global warming will confound the impact of natural variation and fishing activity and make fisheries management more complex. Examples include periodic fluctuations in the climate and hydrographic regime of the Barents Sea, which have been reflected in variations in commercial production over the past 100 years. Similarly, in the northwest Atlantic Ocean results of fishing for cod during a period of 300 years (1600-1900) showed a clear correlation between water temperature and catch, which also involved changes in the population structure of cod over cycles of 50-60

years. Cod is affected by temperature, and an increase could potentially improve recruitment in some areas, however, increased temperature will also give an opportunity for new species to establish in the Barents Sea, and climate change will affect the whole ecosystem.

It is not possible to predict the effects of climate change on the Barents Sea cod with certainty, but some models indicate that the cod is likely to follow the colder water masses and move further north and east. What we do know, however, is that a strong and resilient cod stock is much more likely to adapt to climate change than an overfished and vulnerable stock.. Working globally and regionally against the threat from climate change, WWF urge for:

- Russia and US to ratify the Kyoto protocol
- Establishment of a network of marine protected areas reduce the impacts of other stressors on the marine ecosystem and to build resilience against climate change in the ecosystem
- Increased research on climate change impacts in the Arctic

7.4 Long-range pollution and introduction of alien species

The combined effects of ocean currents, atmospheric transport and river drainage result in the Barents Sea being a "sink" for long-range pollution, such as heavy metals, PCBs and other persistent organic pollutants (POPs). Pollution levels generally increase as one goes higher up in the food chains. The effects are most pronounced in marine mammals and seabirds, but high levels of toxics are found in cod liver. POPs are known to affect the reproduction of birds, fish and mammals, to weaken several parts of their immune systems, to cause brain damage and to decrease bone density.

There are several pathways for alien species in the marine environment such as ballast water, aquaculture, bait, trade, research escapes and fish processing plants. Potential consequences on biodiversity and industries can be enormous and irreversible. Native species can be displaced or eliminated; interactions between native species may be disrupted; hybridization with native species can result in loss of genetic diversity; and new parasites or diseases may accompany the alien species. The Kamtchatka king crab, which was introduced on the Kola coast in the 1960s, has spread westwards and is now found in vast numbers throughout the southern part of the Barents Sea and as far north as Svalbard. The population probably numbers more than 15 million individuals. The king crab is known to alter benthic communities and to consume capelin eggs, but it is unknown how and to what extent it affects the native fauna in the Barents Sea. Potentially, it could be a threat to coastal cod stocks.

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Appendix I

Comparison between traditional fisheries management and ecosystem-based fisheries management (FAO 2003).

Criteria		Fisheries management	Ecosystem management
Paradigm		Sector-based. Vertically integrated. Focusing on target resource and people.	Area-based. Holistic. Loosely cross-sectoral. Focusing on habitats and ecosystem integrity.
Governance	Objectives	Not always coherent or transparent. "Optimal" system output. Social peace.	A desired state of the ecosystem (health, integrity).
	Scientific input	Formalized (particularly in regional commissions). Variable impact.	Less formalized. Less operational. Often insufficient. Stronger role of advocacy science.
	Decision-making	Most often top-down. Strongly influenced by industry lobbying. Growing role of environmental NGOs.	Highly variable. Often more participative. Strongly influenced by environmental lobbies. Stronger use of tribunals.
	Role of the media	Historically limited. Growing as fisheries crisis spreads.	Stronger use of the media.
	Regional and global institutions	Central role of the Food and Agriculture Organization of the UN and regional fishery bodies.	Central role of United Nations Environment Programme (UNEP) and the Regional Seas Conventions.
Geographical basis		A process of overlapping and cascading subdivision of the oceans for allocation of resources and responsibilities.	A progressive consideration of larger-scale ecosystems for more comprehensive management, e.g. from specific areas to entire coastal zones and Large Marine Ecosystems (LME).
Stakeholder and political base		Narrow. Essentially fishery stakeholders. Progressively opening to other interests.	Much broader. Society-wide. Often with support from recreational and small-scale fisheries.
Global instruments		1982 Law of the Sea Convention, UN Fish Stock Agreement and FAO Code of Conduct.	Ramsar Convention, UN Conference on Environment and Development and 1992 Agenda 21, Convention on Biological Diversity and Jakarta Mandate.
Measures		Regulation of human activity inputs (gear, effort, capacity) or output (removals, quotas) and trade.	Protection of specified areas and habitats, including limitation or exclusion of extractive human activities. Total or partial ban of some human activities.

Schematic comparison between fisheries and ecosystem management (FAO 2003)

Appendix II
What are decision rules?

The global Code of Conduct for Responsible Fisheries calls for a precautionary approach to fishery management. According to Article 7.5.1 of the Code, when the best available scientific information is uncertain, unreliable, or otherwise inadequate, managers should proceed in a risk-averse manner. And the absence of adequate scientific information should not be used as a reason for postponing or for failing to take conservation and management measures. Despite general agreement on the need for, and basic principles of, a precautionary approach to fisheries management, practical implementation has been slow to develop internationally. Most fisheries are managed without using agreed decision rules that dictate, for example, the exact form of response when a target or limit s reached. Even where formal quantitative stock assessments are available, decisions about Total Allowable Catch (TAC) are often made taking into account a range of 'other factors', particularly economic and social considerations (such as the immediate impacts on profits, jobs and fishing communities). To implement EBM in fisheries, any TAC must be set in a precautionary way, and should always be based on a clear set of decision rules.

A *decision rule* should specify exactly what management action is chosen under a given set of circumstances. Decision rules can be simple, for example using a constant proportion of the current stock size; or more complex, for example taking account of uncertainty in the estimates of stock size. The most precautionary decision rules for setting TACs take account of uncertainty in estimates, and are flexible and responsive to different conditions in ecosystems and in the fishery.

In some cases, TACs for different species in a multi-species fishery may be linked (to avoid excessive discrepancies and 'dumping' problems). Fisheries may be closed if catch limits for particular bycatch species (especially protected or threatened species) are exceeded. The setting of cautious TACs could also relate to the requirement for a particular pre-determined species mix in the catch in a fishery, or to specific ecological performance objectives in a particular region. Although any decision rule is possible, it must be (1) clearly specified, (2) tested to ensure it meets agreed standards, and (3) formally agreed and implemented.

ICES has a very clear definition of the precautionary principle, and for the cod stock in the Barents Sea the quota advice is given according to this to allow for some uncertainties. The new agreement from November 2002 is meant to be based on the precautionary principle, but fails totally every year when setting the TAC much higher than what ICES defines as safe. WWF sees this new rule as an important step forward as some of the annual discussions and negotiations are easier when a decision rule applies. However, the rule keeps allowing an overfishing of the quota, and the possibility of changing the rule if the stock suddenly should drop, is very limited.

In the box is the current decision rule from the Norwegian-Russian Fisheries Commission.

Within Article 5.1 in the protocol from the 31st session of the Joint Norwegian-Russian Fisheries Commission, Norway and Russia have agreed upon the following procedure for the annual fixing of TACs for North-East Arctic cod from 2004:

- Estimate the average TAC level for the following three years based on Fpa. TAC for the following year is set on the basis of this average TAC level;

- The following year the estimation of the TAC level for the next three years is repeated based on updated information on stock development. However, the revision of TAC cannot be more than ±10% of the TAC level for the preceding year; If the spawning stock biomass falls below Bpa the Parties must consider fixing a lower TAC than the TAC set according to this procedure.

Appendix III

Marine Stewardship Council Principles for a sustainable fisheries

Stewardship Council Principle 1 requires that "A fishery must be conducted in a manner that does not lead to overfishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery."

Marine Stewardship Council Principle 2 requires that "fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which fishery depends."

Marine Stewardship Council Principle 3 requires that "the fishery is subject to an effective management system that respects local, national, and international laws and standards, and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable."

Earlier WWF publications in Norway:

2004
WWFs verneplan – for å bevare Norges fantastiske skognatur
The Barents Sea cod – The last of the large cod stocks
Vanndirektivet – et miljøløft med startvansker
Gaupejakta – forvaltningen bommer igjen
Biologisk mangfold – det levende grunnlaget for fattigdomsbekjempelse

2003
Defensiv norsk miljøpolitikk – i og utenfor EØS
The Barents Sea Ecoregion – A biodiversity assessment
En framtid for villreinen – en framtid for fjellet
Food for Thought: the Use of Marine Resources in fish Feed
Barentshavet – et hav av muligheter…. og trusler
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2002
Clean conscience consumption of seafood -
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Statsskog bygger "miljøhyttetun" som mangler miljøinnhold ved Lemonsjøen

2001
The Status of Wild Atlantic Salmon: A River by River Assessment

2000
Forest policy situation in Norway – mai 2000
Registreringer av hogster i Nidarå Tømmersalslag
Registreringer av nøkkelbiotoper for Borregaard Skoger AS.

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- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.