

The “Discard Ban Package” – Norwegian experiences in efforts to improve fisheries exploitation patterns

by
Peter Gullestad
Specialist Director
The Norwegian Directorate of Fisheries

1 Introduction

In order to improve exploitation patterns and reduce the problem of discards, Norway has over the years established a set of regulations and management measures. The main objective is to promote an exploitation pattern where recruits and undersized fish are spared, and where unwanted by-catch can be minimized. This is being achieved through several interconnected measures which could be referred to as the "Discard Ban Package".

Minimizing unwanted by-catch that might otherwise be discarded is relevant in relation to conservation as well as economical or distributional aspects of fishing activities. The term unwanted may in this context encompass by-catches of threatened species as well as species without economic interest to the fisher, and also species for which that particular fisher or fleet group does not hold a quota or fishing right.

Norway introduced a discard ban on cod and haddock in 1987, for both economic and ethical reasons. The very existence of the ban has been beneficial in changing fisher's attitudes and discouraging the practice of discarding. The discard ban was gradually expanded to new species, and from 2009 an obligation to land all catches was introduced (with certain exemptions). It should be noted that the ban applies to dead or dying fish, viable fish can be released back to the sea. The discard ban was preceded by a program of real time closures of fishing areas (RTCs) which was developed from 1984 onwards.

Area closure is a well developed measure in fisheries as well as environmental management. In fisheries management closed areas may basically be grouped into two main categories, namely:

a) Permanently closed areas

Such areas may be closed all the year round or seasonally, for all or particular gears, and for a variety of reasons – nursery areas, coral reefs, trawler-free zones to prevent conflicts between gears, lobster habitats etc. etc.

b) Real time closures – RTCs

These are areas where the number of undersized fish, or level of by-catches, exceeds permitted limits and hence, are temporarily closed. Real time closures have turned out to be an effective tool in situations where unwanted intermixture vary from year to year and/or with respect to time and place. Seen from the fishers' perspective and that of economic efficiency, it is a flexible measure compared to permanent closures, allowing fishing to take place in a controlled and sustainable manner when not in conflict with economic and conservation objectives.

The program for closing and opening of areas on a real time basis in the Barents Sea was developed from 1984 onwards to avoid the catching of undersized fish and by-catches of protected species. Similar but less comprehensive programs are now emerging for the North Sea and Skagerrak, in a dialog between EU and Norway.

2 The Barents Sea program for Real Time Closures

The background for establishing this program was that after seven consecutive weak year-classes combined with a too high fishing pressure, the Northeast Arctic cod stock was in a very poor condition. Then, finally, in 1983 a strong year-class occurred. Experiences from the 1960s and 1970s showed that strong year-classes would be grossly reduced through excessive discarding, already in its first years of life in the trawl fishery for shrimp, and during the following years also in the trawl fishery for cod and haddock. The big issue at the time was: what if seven new, lean years were to occur after 1983? Immediate steps had to be taken to make sure that this precious year-class could survive and contribute to the spawning stock and to the economically important cod fisheries in years to come. The solution was the establishment of a program for temporary, real time closures of fishing grounds, a program which during 1984–1986 successfully contributed to the protection of the strong 1983 year-class through its most vulnerable juvenile phase.

2.1 Financing and operating of the Barents Sea program

Later on the program has been further developed, and nowadays the commercially most important fisheries of the region are covered by the program. Commercial fishing vessels are hired to investigate the fishing grounds, with specially assigned and trained inspectors on board; most of them have their professional background from fisheries. The financing of the program is twofold. The hiring of fishing vessels is financed by the industry, as a total of 4600 tonnes of cod, haddock and saithe is set aside from TACs and given as quota bonus/payment to fishing vessels participating in the program. The cost of 18 inspectors and the running of the program, approximately 20 million NOK or 2.7 million EUR per year, are funded by the government (all data refer to 2012). The program is operated by the Surveillance Service, a branch of the Directorate of Fisheries' regional office in Tromsø.

The annual work plan of the Surveillance Service is based on a risk assessment where in addition to expected fleet activity, important input come from science with regard to expected changes in stocks and year-class strength. Based on the risk assessment, decisions are made with regard to how many days of different vessel categories should be hired for the next year. Rental of vessel days follow public tender procedures, and one important element in the selection is that the vessels are representative of the relevant segment of the fishing fleet with regard to gear technology, engine power etc.

2.2 Criteria for closures

Specific criteria relating to intermixture of juveniles and level of by-catches are laid down in the relevant fisheries regulations as basis for closure (Anon., 2012a). In the shrimp fishery the criteria are a maximum permitted number of cod, haddock, redfish and Greenland halibut respectively, per 10 kg of shrimp. The permitted numbers are presently 8 cod, 20 haddock and for redfish and Greenland halibut the number is 3 of each per 10 kg of shrimp. The criteria for cod and haddock are based on bioeconomic modeling where the value of present shrimp catches is balanced against future losses in economic yield of cod and haddock (Veim et al. 1994). The stocks of redfish and Greenland halibut have been in a precarious state for a long time, and for these species the criteria are more restrictive, based on the precautionary approach and biodiversity considerations. However, the situation for these stocks has been

gradually improving, and the criteria are therefore presently being revised. Also the bioeconomic criteria need to be revised from time to time, due to changes in relative prices and other relevant model parameters.

In the trawl fishery targeting cod, haddock and saithe a combined maximum per haul of 15 % of juveniles (fish below their respective minimum sizes) of the said species are allowed. The criterion is measured in numbers of fish, not kilos. For inspectors and for fishers (ref. section 4.3 and the move-on provision), it is operationally easier to count the fish than to weigh them. Furthermore, a limit measured in kilos instead of numbers of fish would have to be considerable higher than 15 % to provide the same level of protection of juveniles. The 15 % limit, based on biological considerations, was introduced together with the program of RTCs in 1984.

In addition to the criteria already mentioned, which are the most important with respect to triggering real time closures, several other by-catch criteria do exist related to specific fisheries or stocks, for example to minimize the intermixture of cod in capelin fisheries, or the intermixture of protected redfish in cod fisheries.

2.3 Procedures for closing areas – notification and communication to the fleet

Procedures are established with regard to sampling and delimiting the area to be closed. Accordingly, when investigations from the Surveillance Service reveal that one or more criteria are exceeded, the area will be closed. Delimitation is based on actual occurrence of juveniles or by-catches, not for example on a predetermined grid size. As a consequence, a closure may be quite extensive and non-rectangular in size. The formal decision on closure is made by the Head Office of the Directorate of Fisheries in Bergen in the form of legally binding regulation, based on advice from the Regional Office in Tromsø. Normally, the regulations will be adopted and enter into force within hours, not days, after sampling took place.

The regulations are communicated in Norwegian to the fleet through the Norwegian Radio (NRK) which has a daily service where short, important messages to the fleet may be distributed. In addition it is also communicated to the fleet from relevant coastal radio stations through channel 16. The regulations, in (Norwegian and English), are also published on web pages of the Directorate of Fisheries accompanied (in Norwegian) by a map of the closed area, the data on a haul by haul basis from the trial fishery leading up to the closure, and the Surveillance Service's summary/evaluation from the trial fishery. Furthermore, the decision is also published in Russian on the web pages.

When an area is closed it affects all fishing vessels immediately that have got the relevant information. With regard to foreign vessels, a formal notification procedure through diplomatic channels has to be followed. This may in practice take a week or more. In order to speed up the process, a copy of the decision is, by bilateral agreement, simultaneously but informally sent from the Directorate of Fisheries to fisheries authorities in Russia, EU, Faroe Islands, Iceland and Greenland. However, normally the Coast Guard or the Surveillance Service will inform vessels fishing in the relevant area directly by radio communication about the closure. If a foreign vessel continues fishing until it is notified by its own authorities, it is warned that it may be inspected, as continuation of fishing without violating the rules is probably impossible. Hence, the real time closures are normally respected immediately by all fishing vessels, irrespectively of flag and formal notification procedures. In situations with many fishing vessels present and a high fishing intensity, rapid closure and compliance are essential for the protection of juveniles.

The decisions on relevant areas to investigate are based on accumulated experience of the Surveillance Service and on updated information from scientists, the Coast Guard and the fishing fleet. Closed areas are re-examined after some time to control whether there is still a basis for keeping them closed. The time-lag between closure and reexamination is determined case by case based on experience from similar situations. If the intermixture of juveniles in the catches no longer exceeds the permitted levels, the closed areas are reopened for fisheries. In many cases the re-examination may justify an amendment to the extent of the closed area. The annual number of closures, amendments and re-openings depends first of all on the relative strength of year classes of relevant stocks, and may vary between 30 and up to 70 annually.

In advance of a closure the Coast Guard has the possibility, if present at the fishing ground, to establish a “Precautionary Area”. When set out in the map and communicated to the fleet present, this serves as a warning that fishing in the specified area most likely will imply violating regulations. The area is not formally closed, but it might never the less have legal consequences to fish inside it.

Figure 1 and 2 shows the large variation in size and extension of closed areas, and also the major changes over time, here illustrated by changes during 6 months in 2005.

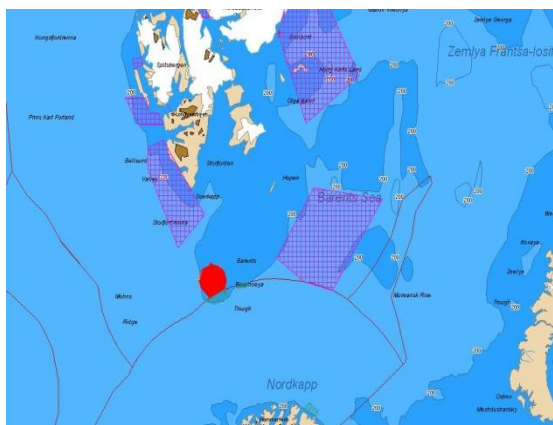


Figure 1: Closed areas in April 2005

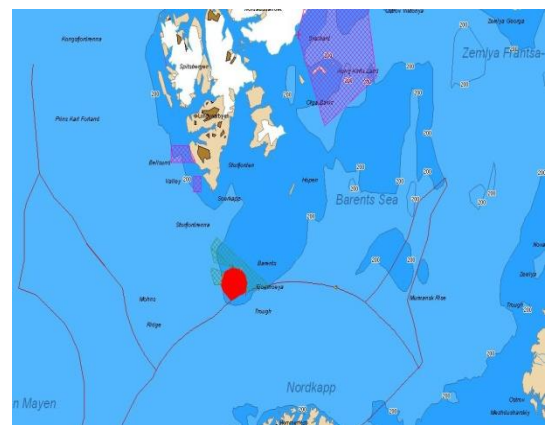


Figure 2: Closed areas in October 2005

2.4 Acceptance by stakeholders of real time closures

The concept of closure and opening of areas is generally regarded, including the industry, as an important instrument for achieving rational exploitation patterns in the fisheries in these areas. Seen from a conservation perspective, no negative side effects are observed with regard to the method of closing areas with undersized fish or to high by-catch levels. As a regulatory measure it is generally recognised and respected by fishers, with whom it has gained a fairly high degree of legitimacy. The reason for this is that closing of areas with small fish or too high by-catch levels creates a level playing field and prevents behaviour which is contrary to fishers’ professional code of conduct, as fishers in general accept that catching (and discarding) fish below accepted minimum size is unprofessional and morally wrong.

It has been argued that instead of formal closures one could rely on some sort of self-policing whereby fishers voluntarily would leave areas with large numbers of juveniles. Although a

move-on provision does exist, see section 4.3, experience shows that this is not enough in practice. The law-abiding fisher will experience that colleagues with a more relaxed attitude towards rules and regulations continue fishing and become the economic winners. Where high moral compete with economic return the moral tends to lose out. A formal closure policed by government does however, create the level playing field.

From time to time fishers complain that the Surveillance Service is too slow in reexamining a closed area. This is first of all a question of finding the right balance between fishers' understandable impatience, and the concerns of government related to the cost/efficiency of the Surveillance Service. Automatic reopening of closed areas is considered not feasible in the Barents Sea as experience show that when intermixture of juveniles occurs, it may often prevail for a longer, indefinite period (often months rather than weeks). Accordingly, the occurrence of juveniles or by-catches must be assessed in each individual case.

The rules of RTC programs may differ, both due to differences in natural conditions as well as to objectives and ambitions set for the program. In the emerging RTC program for the North Sea and Skagerrak, EU and Norway have so far not managed to harmonize the relevant rules and criteria. Both parties do apply automatic reopening after 14 days, but agreement has not been reached with regard to the size (predetermined or not) of closed areas and whether limits should be measured in kilos or numbers.

2.5 Cooperation with Russia

Most stocks of the Barents Sea are shared and managed jointly between Norway and Russia. There is a common understanding between the parties that as a part of a responsible management, protection of juveniles is essential. The criteria and procedures for RTCs have been discussed and agreed in cooperation between the two parties. Both parties have a ban on discarding in their legislation.

3 The introduction of a discard ban

Returning to the strong 1983 year-class of cod; in late 1986 and early 1987 this year-class reached the then minimum landing size, and the basis for area closures was no longer present. However, alarming messages from both inspectors and the fishing fleet indicated that a practice with extensive high-grading was now emerging. Fishers would fill their quotas with the largest, best paid fish and discard the smaller but still legally sized fish. What they were doing was perfectly legal under the existing laws and regulations.

As described above, a considerable effort had already been put into saving this particular year-class, and subsequent year-classes were reported to be poor. The Minister of Fisheries at that time, Mr. Bjarne Mørk-Eidem, was naturally very upset: "This is terrible", he said, and his experts answered, "Yes, Minister, it is really terrible." And he went on, saying, "We must do something, we have to ban this practice." But the experts said, "Ah, well – no, Minister, that is not possible. There are all sorts of legal problems, not least internationally. But first and foremost, a discard ban is more or less impossible to enforce." However, the Minister would not give in: "This practice is both economic madness and morally wrong – I know it, you know it, and so do the fishers. Even if it is hard to enforce, at least it should not be legal to do what they are doing. Therefore, no more discussion, make me a discard ban!" And subsequently the ban on discard of dead or dying cod and haddock came into force in April 1987.

This story is an example of political leadership. When his experts were stuck in conventional thinking, the Minister pointed out the direction for a new and sustainable policy in this field.

Over the next twenty years the ban on discarding of dead or dying fish was gradually extended to include new species, and by 2008 a total of 18 species were comprised by the no-discard policy. On January 1, 2009 the old Act relating to Seawater Fisheries was replaced by a new Marine Resources Act (Anon., 2008), and at the same time the discard ban was made the general norm. The preceding act related only to fisheries and focused mainly on the exploitation of commercial stocks, whereas the new act applies to all living marine resources. After initial adjustments the following years, by 2012 the ban comprises approximately 55 species. Some further adjustments for low value species could be expected in order to adapt the discard policy to some of the practical realities that encounters the fishing fleet.

3.1 Enforcement and sanctions of the discard ban

Discarding is an offense which may be difficult to detect. Annually the Coast Guard and the Directorate of Fisheries do however detect some cases. Both the master of the vessel and the owner may be fined. In severe cases, for example if it is revealed that discarding is an integral part of the vessels “ordinary” production process, the fishing licence may be withdrawn for a period, in addition to considerably higher fines than for the minor cases. In severe cases the total catch onboard may, depending on the evidence, be considered illegal and its value confiscated by the prosecuting authority or by the court, in a separate decision. The Coast Guard in cooperation with the Public Prosecutor have over the years succeeded with how to collect evidence in discard cases to satisfy the Norwegian judicial system, so that it is possible to get convictions in the Court of Law. This implies that approximately half a dozen skippers/companies are fined yearly. The level of fines are around 15 – 25000 NOK for the skipper and in addition up to 150.000 NOK to the company which owns the vessel.

3.2 What about damaged fish etc. – are there any exemptions to the discard ban?

The regulations relating to seawater fisheries (Anon., 2012a) specifies the species for which the discard ban applies. Neither the act, nor the regulations include any formal exemptions from this ban. However, in practical life it is not possible to avoid all situations where fish is damaged to an extent where it is no longer fit for human consumption. Examples are fish stuck in meshes or fish partly consumed by other marine organisms. To retain such fish on board may result in practical problems. The amount of fish damaged for such reasons during a fishery conducted with due care to all applicable regulations is however very low. The authorities have thus acknowledged that these practical problems have to be dealt with. It is concluded not within reach to list all possible situations and set limits in a regulation that will give the desired result, hence a pragmatic solution has been found. Under the Norwegian legal system the enforcement agencies have the authority to decide whether an infringement shall be followed up. Based on this authority a customary practice has been developed whereby discarding of fish damaged in the fishing operation and unfit for human consumption, is not prosecuted by the enforcement agencies. This also applies to cut off according to legal conversion factors, and to the smallest juvenile fish not being sorted out by the sorting grid in shrimp trawl, as long as the number of juveniles pr. kilo shrimp caught is within the legal limit.

4 Accompanying measures to facilitate the discard ban

A commonly asked question with regard to the Norwegian discard policy is how to handle all the “illegal” catches that are now supposedly landed. Questions like this tend to overlook the fact that at the core of the policy is the combined set of measures; discard ban, obligation to

change fishing ground, RTCs, the tailoring of quota regulations, gear restrictions and minimum fish and mesh sizes, and the development of more selective gears – all aiming at reducing the amount of unwanted catches in the first place. The accompanying measures are discussed below.

4.1 Compensation to fishers for landing of “illegal” catches

Although there is no doubt that the extent of unwanted catches in Norwegian fisheries has been greatly reduced; it is a well substantiated fact that discarding still occurs. Sometimes it occurs deliberately and as a result of an intended and unlawful harvest strategy, but sometimes to dispose of an unintended by-catch. As an incentive to land the unintended catch instead of discarding it, fishers may apply for compensation for the extra work in handling and landing the fish. The “illegal” catches may be sold together with the rest of the catch and through ordinary market outlets. However, as all firsthand sales and all payments for fish by law are channelled through one of the six Norwegian fishermen’s sales organizations, the value of the “illegal” part of the catch is held back by the sales organization. Nevertheless, 20% of the value of the “illegal” catch may be paid to the fisher as compensation for his extra work. In purse seine fisheries for mackerel, herring and capelin this 20 % rule was abandoned as it turned out to be a too strong incentive for vessels to exceed their quota by “filling up” on the last trip.

The sales organizations are allowed to keep the confiscated 80 % of the value and use the money on their lawful duties related to fisheries control, which include the collection and revision of all data related to first hands sales of fish in Norway, among others.

Generally the landings of “illegal” fish do not represent a large amount of fish or a significant logistic problem. Some challenges have however been encountered by fishers complying with the discard ban and landing certain species of low or no market value. The occasional and unintended by-catch of polar cod in the shrimp fishery is an example in this regard.

4.2 From minimum landing sizes of fish to minimum fishing sizes of fish

Historically an important element when deciding on minimum mesh sizes in trawl have been the objective of utilizing the growth potential of the individual fish, and letting the fish spawn at least once before it is caught. The minimum landing sizes of fish have often been set at levels where on average 75 % of the fish below that size are supposed to swim through the meshes, whereas 25 % are captured (and discarded if the minimum landing size is enforced). The introduction of a discard ban led to a conceptual change with regard to the interpretation and function of allowed minimum sizes of fish. The minimum sizes of the fish actually fished have replaced the minimum landing sizes in technical regulations, for example being crucial elements in the decision rules for RTCs. The focus on reduction of potential discards has also been an invitation to revisit, and if possible harmonize or improve, the connection between mesh sizes, allowed minimum fish sizes and the actual commercial minimum market sizes. For targeted fisheries there is for example no evident reason why allowed minimum size of fish should be lower than the minimum size which is accepted in the commercial market. Hence, it should be considered to increase the minimum mesh size in trawl accordingly. For mixed fisheries the situation is, admittedly, more complex.

4.3 Obligation to change fishing ground – the move-on provision when limits of juveniles or by-catches are exceeded

According to Norwegian legislation, it is prohibited to fish “illegal” fish, unlike a prohibition limited to the landing of such fish. This prohibition constitutes an obligation for fishers to

change fishing ground when the fishing operations contravene regulations. For instance, if by-catch limits or the permitted intermixture of undersized fish are exceeded, the fishing operation on the fishing ground in question must cease and the fisher must move to an area where, to the best of his knowledge, it is probable that the catch composition is within the limits of the relevant regulations. It is not expedient according to the Norwegian legal system to make this into a fixed rule, neither in depth nor distance in nautical miles. If the logbook or other sources of information reveals that the fisher has conducted more than one haul in the same area without moving, he will be subject to arrest/reporting to the police and the offence may be punished by fines. The catch in the relevant hauls is considered illegally caught, and its value confiscated by the prosecuting authority or the court in a decision separate from the fine. If illegal catch is mixed with legal catches on board the vessel, the total catch may be considered illegal and its value thus confiscated.

If the fisher has acted in compliance with the move-on provision, there is no offence. The value of the part of the catch being in excess of permitted limits will however be subject to confiscation through an administrative decision by the Directorate of Fisheries.

It should be noted that it is a crucial element of the anti-discard policy that fishing logbooks are required to be recorded and reported on a haul by haul basis.

4.4 Tailoring of national quota regulations

Different ways to regulate fisheries by means of quotas may provide different incentives with regard to discarding. As a consequence of the introduction of a discard ban the government was forced to re-think its practises, not only with regard to technical regulations, but also with regard to national quota regulations. Reducing inherent regulatory incentives to discarding, such as quotas per trip or week, was important. Weekly quotas face the fisher with a weekly temptation to discard excess catches in the last haul, whereas annual quotas limit that temptation to once a year.

Allocation of quotas to cover expected unavoidable by-catches in non-direct fisheries, before remaining national quotas are allocated to vessels licensed to target the said specie, is another important measure taken. In addition the by-catch allocation must be reconciled with the allowed by-catch limits, and the government must refrain from “solving” distributional issues by implicitly accepting fishers to discard excess catches. By-catch allocations are now common in many Norwegian fisheries; North Sea cod in saithe and shrimp trawling, saithe in Norway pout trawling, blue whiting in the herring fishery etc. etc.

Small coastal vessels fishing with passive gears have limitations with regard to mobility and the ability to change fishing ground. In some of the fisheries carried out by these vessels actual by-catches may vary considerably from setting to setting or from day to day. In such cases by-catch limits may be set for a longer period, for example a week, to reduce incentives to discard.

4.5 Development of selective gear technology

The focus on the discard problem and in particular the regulations introduced to minimize the problem, have had a beneficial influence on the research and development of more selective gears. The introduction of grid technology both in shrimp and cod trawls (compulsory north of 62N from 1991 and 1997 respectively) are examples of this spin-off effect created first of all by the real time closures. The industry took an active part in this development when large areas were closed due to too large intermixtures of juveniles. With sorting grids still at a test

stage, fishers could get an exemption to fish in closed areas provided they used sorting grid. To this end closures turned out to be far more effective and instrumental to innovation than years of traditional, publicly financed research on selectivity. The successful use of grids in the test phase paved the way for the agreement between Norway and Russia to make the use of grids compulsory throughout the Barents Sea.

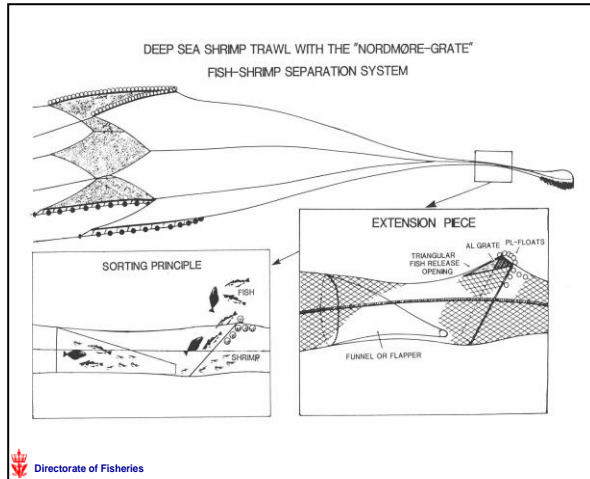


Figure 3

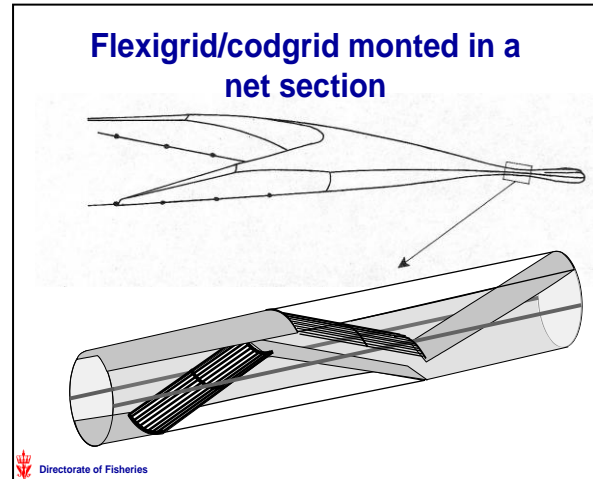


Figure 4

The introduction of the discard ban and RTCs has led to a creative pressure on science, management and industry to contribute to innovations in order to improve selectivity and reduce unwanted by-catches.

5 Gains from improvements in exploitation pattern

Below, Northeast Arctic cod is used to illustrate potential gains from improvements in exploitation patterns. Figure 5 shows the yield of Northeast Arctic cod as a function of age at catch. With an initial stock of 1000 three year old cod all caught immediately, the total yield amounts to 724 kg live weight. If catch is postponed until the fish is nine years old, many of the initial 1000 fishes have died from natural mortality but still, due to individual growth of the remaining fish, the total yield has nearly doubled to 1337 kg. The figure illustrates core issues with regard to potential gains from improvements in exploitation patterns.

Exploitation pattern – growth overfishing
Northeast Arctic Cod – Yield as a function of age at capture

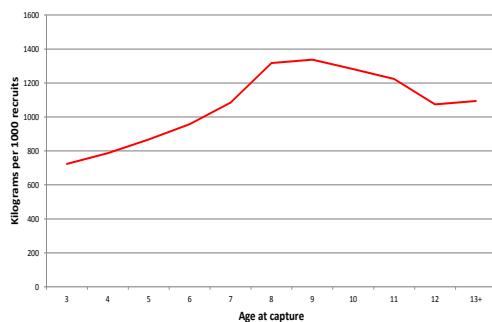


Figure 5

Cod – the benefits of increased average age at landing

Average age of landings

1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2010
5,84	5,30	5,03	5,35	5,64	5,64

The increase in annual long term yield when average age of landings improved from 5,03 to 5,64 is **6,3%**

Actual cod quota in 2012 : 772 000 tons
Quota reduced by 6,3% : 723 000 tons

Estimate of annual benefit: 49 000 tons x NOK 11,42 = NOK 560 million

Figure 6

Figure 6 illustrates how the selectivity of the Barents Sea cod fisheries deteriorated from the 1950s to the 1970s, but later improved thanks to the continuous and combined efforts to improve exploitation patterns since the 1980s. Important milestones in this regard are illustrated in figure 7.

Exploitation pattern – the Northeast Arctic cod and haddock – jointly managed by Norway and Russia

- Ban on fishing with midwater trawl (1980)
- If total number of undersized cod and haddock in any one haul exceed 15 %, fishers have an obligation to move (1984)
- Real time closures of areas with a high intermixture of juveniles (1984)
- Discard ban for cod and haddock (1987)
- Mandatory sorting grid in shrimp trawl – 19 mm bar spacing (1991)
- Mandatory sorting grid in cod trawl – 55 mm bar spacing (1997)
- Agreement on common minimum mesh size 130 mm in trawl (2010)
- Agreement on common minimum size of cod 44 cm (2010)

Figure 7

Based on data from ICES Arctic Fisheries Working Group reports (Anon., 2012b) the average age at landing of Northeast Arctic Cod decreased from 5.84 in the 1950s to 5.03 in the 1970s, and then increased again to 5,64 in the period 2000-2010. The increase of 0.61 year in average age of landings since the 1970s represents all things equal, a 6.3% increase in annual yield. Applied to the 2012 TAC of cod of 772 000 tonnes, this amounts to 49 000 tonnes to a firsthand value of approximately NOK 560 million or EUR 75 million, based on average Norwegian first hand prices in 2011. Although this calculation is based on simplified assumptions, it illustrates the substantial gains which might accrue from improvements in exploitation patterns. Also note, as this calculation is based on change in average age of landings, it does not include the gains reaped from reduced levels of discards. In the absence of reliable data on historical discard levels these gains are not possible to calculate separately. It is however likely, with knowledge of the history of the Barents Sea fisheries, and with reference to similar fisheries where discard data do exist, that these gains no doubt have been considerable.

6 Development of spawning stock and total landings of Northeast Arctic cod and haddock 1980 – 2011

The development in spawning stock (SSB) and in total landings may however be used as indicators of the overall successfulness of management; SSB representing the stock fortune and total landings the annual yield or income from that fortune. The development of these two indicators is basically influenced by a combination of three factors; development in environmental conditions and variability, in exploitation pattern and in exploitation level. Management may control the two latter ones, but it is more than difficult to adequately separate the effect from each of the three factors. With regard to exploitation levels there have been a positive development for Barents Sea stocks over the last 5-10 years, both with regard to bringing an excessive IUU-fishing under control, and with the introduction of precautionary Harvest Control Rules, reducing fishing mortality levels from 2005 and onwards. The average annual spawning stock, landings and fishing mortality for Northeast Arctic cod and haddock for the two periods 1980-89 and 2007-2011 are given in the table below for comparison. The precautionary reference points B_{pa} and F_{pa} for SSBs and fishing

mortalities respectively are included as references. All data refer to ICES Advice 2012 (Anon., 2012b).

Northeast Arctic cod	1980-1989	2007-2011	B _{pa} and F _{pa} values
Mean annual SSB (1000 tonnes)	210	1160	460
Mean annual landings (1000 tonnes)	374	571	
Mean F ages 5-10	0, 82	0, 28	0, 40
Northeast Arctic haddock			
Mean annual SSB (1000 tonnes)	70	292	80
Mean annual landings (1000 tonnes)	71	215	
Mean F ages 4-7	0, 43	0, 34	0, 47

For both stocks a significant reduction in fishing mortality has been achieved since the 1980s. SSBs have increased four to fivefold giving room for large, but yet sustainable increases in TACs and landings.

In conclusion; the positive development in Barents Sea fisheries since the 1980s cannot be attributed to one or a few causes or measures. It is brought about by a suite of measures in combination with favorable natural conditions. The lesson learnt is that a prudent management regime should give attention to and investigate possible improvements both in exploitation patterns as well as in exploitation levels. Stakeholders' acceptance of the change of policy has grown over time, and it could be argued that it has led to changes in the perception on how the fisheries should best be exercised.

Anon., 2008. Act no. 37 of 6 June 2008 relating to the management of wild living marine resources. <http://www.fiskeridir.no/english/fisheries/regulations/acts/the-marine-resources-act>

Anon., 2012a. Regulation amending the regulations relating to sea-water fisheries (20120330) <http://www.fiskeridir.no/english/fisheries/regulations>

Anon., 2012b. www.ices.dk/Pages/default.aspx

Veim A.K, Sunnanå K, Sandberg P and Gullestad P. (1994) "Bycatch of Juvenile Fish in the Shrimp Fishery – Management based on Bioeconomic Criteria" ICES CM 1994/T:14