

**Contribution to the symposium
Management Strategies for Fish Stocks in the Barents Sea**

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**OVERVIEW OF FISH STOCKS IN THE BARENTS SEA
AND ADJACENT AREAS**

by

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Abstract

The papers deals in short with the stock and catch history of the most important fish stocks in the Barents Sea and the adjacent area.

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1. INTRODUCTION

Fish stocks in the Barents Sea and adjacent waters include abundant straddling and highly migratory fish species, which are target species for both Russia and Norway. Heavy fishery and other anthropogenic activities necessitate a rational exploitation and effective management of these stocks, which is possible only when a reliable information about the status and probable dynamics of the stocks is available.

The Barents Sea is situated at the border between the boreal and the arctic zoogeographic zone. One effect is that relatively few fish species are found there and, of these, only a few constitutes the bulk of the total biomass. Another effect is that climate and changes in climate play an essential role for the biology of the species living there. Borovkov and Loeng have dealt with the climate in a paper to this symposium, and the biology and interactions between species will be dealt with by, among others, Hamre in another paper. The present paper deals in short with the history of stock and fishing for the most important fish stocks in the area, and can serve as a basis for further discussion of management strategies for these stocks.

2. OVERVIEW OF IMPORTANT FISH STOCKS

2.1 Pelagic fish

2.1.1 Capelin (*Mallotus villosus*)

The history of the Barents Sea capelin stock is poorly known before 1970. The knowledge of the earlier history is fragmentary and partly of anecdotic character. Although both the Norwegian and Russian capelin fishery have a long history, this fishery was of relatively minor importance. The capelin were fished with beach seines at the coast during the spawning season, and mainly used as bait, fertiliser or animal food (Nitter-Egenæs 1967; Prokhorov 1965). From 1916 capelin were used for meal and oil production in Finnmark, but it was not until the 1930s that a fishery for industrial purposes became important (Møller and Olsen 1962). From the late 1960 an oceanic fishery with pelagic trawls and purse seines developed rapidly when the fishing fleets, following the rapid decline in the herring stocks focused their effort on the capelin. In the early 1970s the catches rose to a record level of 3 million tonnes, surpassed by few other fisheries in the world (Figure 1).

From 1972 there are stock size estimates from annual acoustic surveys conducted during autumn (Figure 1). It is seen that the stock size has fluctuated considerably during this period, with two stock collapses in 1983-86 and in 1992-94. There are various apprehensions of the reasons for the collapses but, obviously, the

main mechanism involved was recruitment failure (Hamre 1991; Tjelmeland and Bogstad 1993; Gjørseter 1995; Gjørseter 1998). During the last phase of the first collapse (autumn 1985 and winter 1996) the exploitation may have played a role by reducing the spawning stock beyond a critical level. However, the main reason for the observed recruitment failure was probably a heavily predation pressure on the larvae from the large stock of young herring residing in the Barents Sea from 1984-1986 and from 1992-1995. The ecological role of the capelin and the interaction with other stocks are further discussed in the paper "Capelin and herring as key species for the yield of cod" by J. Hamre, presented to the present symposium. During the three last years, the capelin stock has been found to increase rapidly, and in winter 1999 the stock was sufficiently large for the Russian-Norwegian Fishery Commission to open for a capelin fishery of 80 000 tonnes.

2.1.2 Herring (*Clupea harengus*)

The herring of the Norwegian spring-spawning stock also plays an important role in the Barents Sea, although it is not always present there, and the year classes spend maximum 4 years there.

The recruitment to the stock of Norwegian spring-spawning herring is extremely variable; very numerous year classes emerges at about 10 year intervals, the recruitment in the intervening periods is variable but mostly poor (Hamre, 1988). When the larval survival of herring is good, most of the larvae are transported into the Barents Sea and stay in the southern parts of the area until they reach about 25 cm length at age three or four. In years of poor herring recruitment practically no herring larvae enter the Barents Sea.

In periods when the herring is abundant in the Barents Sea this species may have a considerable impact on the ecosystem. The reason is that the young herring may consume considerable amounts of capelin larvae (see paper by J. Hamre to this symposium), thereby causing recruitment failure to the capelin stock. In addition, the herring may constitute an important contribution to the food for cod.

2.1.3 Polar cod (*Boreogadus saida*)

In the beginning of the 1970s both Russian and Norwegian fishermen landed considerable amounts of polar cod (Figure 8). During the rest of the 1970s and till present the catches were variable but mainly low. After 1975 only Russia has landed polar cod from the Barents Sea. The size of this stock is uncertain. From 1986, acoustic estimates were made during the joint capelin surveys in autumn (Figure 2). These

estimates probably represents a reliable index of stock size, but it is unknown whether they also give reliable absolute stock size measurements (Gjøsæter and Ushakov 1997).

2.1.4 Other species

Other pelagic fish stocks of commercial importance in the Barents Sea are the lumpsucker (*Cyclopterus lumpus*) and the blue whiting (*Micromesistius poutassou*). The lumpsucker is fished with nets when it approaches the coast to spawn. Only the roe is used for caviar production. Blue whiting are found in the western parts of the Barents Sea. A large stock of blue whiting feeds in the Norwegian Sea and spawns to the west of the British Isles. It is not clear whether the blue whiting in the Barents Sea belong to this stock. No fishing takes place on blue whiting in the Barents Sea.

2.2 Demersal fish

2.2.1 Cod (*Gadus morhua*)

Northeast Arctic cod plays a key role in the Barents Sea ecosystem. It is the most important predator, which to a great extent defines interspecific interactions and, at the same time, is a major object of international fishery (Boitsov *et al.*, 1996).

In 1988-1989, the commercial and the spawning stocks of the Northeast Arctic cod were on the minimum level for the period from 1946 to 1997 (Fig.3). After that the stocks started to improve owing to the appearance of the year classes of high (1990) and medium (1989, 1991, 1992) abundance, high growth rate in 1992-1993 and cautious stock exploitation. Commercial (2.4 million tonnes) and spawning stocks reached their local maximum in 1993. This was followed by a gradual decline of stocks due to an intensive exploitation, lower growth rate and poor recruitment resulting from the limited food supply and increased cannibalism. By the beginning of 1998, the commercial stock biomass reduced to 1.6 million tonnes; by the beginning of 1999 to 1.4 million tonnes (PINRO, 1999).

In 1991-1999, the spawning stock biomass was higher than or close to the long-term mean (590 thousand tonnes) that was related mainly to the maturation of the strong 1983 year class. In 1998, the spawning stock made up 0.63 million tonnes, by the beginning of 1999 - 0.58 million tonnes (Overview, 1999). This stock also shows a downward trend and the results of the recent investigations give good grounds to believe it to be below safe biological limits (500 thousand tonnes).

The bulk of the commercial stock is at present made up by medium-sized specimens represented mainly by the 1995 year class (Fig.4), a major portion of which has not reached the commercial size. The abundance and biomass of older ages of cod

declined. Therefore fishery is based on smaller cod as compared to 1998 that causes higher mortality of these size groups. This will, in turn, result in the weaker recruitment to the spawning stock the decline of which will consequently be faster.

Considerable variations in cod catch by all nations were noted in the last decade (Fig.3). Minimum catch (212 thousand tonnes) was taken in 1990, maximum catch (771 thousand tonnes) reached the long-term mean for the period 1950-80s (780 thousand tonnes) in 1994 (Kovtsova et al., 1991). After that catches started to decline. However, in 1997 the second local catch maximum (755 thousand tonnes) was observed. By the preliminary data, in 1998 the catch sharply decreased by almost 100 thousand tonnes. A similar reduction in total catch of cod is also expected in 1999.

To slow down stock decline, fishing mortality must be lower. On account of the uncertainty in cod stock assessment during 1996-1998, ICES Advisory Committee for Fisheries Management (ACFM) proposed to apply the precautionary approach to stock exploitation, i.e. to set fishing mortality at the level not exceeding $F_{pa}=0.42$ and TAC at 360+40 thousand tonnes. However, the TAC approved at the 27th Session of Mixed Russian-Norwegian Fisheries Commission amounted to 480+40 thousand tonnes and was higher than that recommended by ICES. In case such fisheries regime is maintained, the spawning stock biomass of cod will decline in the coming years whereas the commercial stock biomass will remain at the previous level due to the recruitment by the year classes of high (1995) and medium (1996) abundance to the commercial stock, as well as due to an increase in the growth rate related to the improved food supply (Fig.3).

2.2.2 Haddock (*Melanogrammus aeglefinus*)

Stock size of Arcto-Norwegian haddock depends primarily on the variations in the abundance of separate year classes, which prevail over the influence of all other factors, including fishery (Kovtsova *et al.*, 1991).

The dynamics of haddock stocks over the 1990s resembled that of cod stocks and was associated with similar causes, with the exception that they reached their maximum later, the commercial stock in 1994-1995 and the spawning stock in 1996-1998, that was followed by a rapid decline (Fig.5).

By PINRO data, the commercial and the spawning stocks of haddock declined by the beginning of 1999 to 280 and 202 thousand tonnes, respectively. Thus, the commercial stock is below the long term mean for the period 1950-1997 (395 thousand tonnes) and the spawning stock is far above the long term mean (125 thousand tonnes).

The bulk of the spawning stock (ca. 65% of the biomass) is made up by specimens from strong year classes (1989-1991) at age 8-10 years. Recent recruitment to the spawning stock is poor (Fig.6). Despite the fact that 1992-1995 year classes at age 1 yr. old were regarded as strong, by the moment of recruitment to the commercial stock they were less abundant than the average year classes because of high mortality. 1996-1997 year classes were below average or weak.

Actual exploitation level in 1998 was $F_{98}=0.226$. In the coming years, at any exploitation level, except F_{low} , the commercial and the spawning stocks, as well as catch, will show a downward trend. TAC on haddock for 1999 was established at 78 thousand tonnes that corresponds to a higher exploitation level ($F=0.249$) than F_{low} .

In 1990-1996, haddock catch by all nations increased steadily from 26 to 187 thousand tonnes (Fig.5). After that it declined reaching 98 thousand tonnes in 1998 (preliminary data) (PINRO, 1999). In 1994-1997 it exceeded the long term mean for the period from 1951 to 1998 (120 thousand tonnes). In 1999 a further reduction in haddock catches is expected.

2.2.3 *Sebastes mentella* of the Norwegian-Barents Sea stock

In 1984-1998, the commercial and the spawning stocks of *Sebastes mentella* stabilised at a low level, 160-240 and 60-90 thousand tonnes, relatively (Fig.7), that was twice as low as the long term mean. In the beginning of 1999 the commercial stock amounted to 225 thousand tonnes, and the spawning stock to 101 thousand tonnes (PINRO, 1999). This situation is expected to continue into the nearest future because, since 1991, all year classes of *S.mentella* have been weak (Fig.8).

According to ICES advice, in order to enhance the spawning stock and production capacity of the population, directed fishery on *S.mentella* should be reduced and bycatch of this species in other fisheries, including bycatch of young redfish in shrimp fishery, should be minimised.

In the period 1987-1991, catch of *S. mentella* by all nations increased from 11 to 49 thousand tonnes. In the subsequent years, as more stringent regulation measures were introduced for fishery on this stock in the Norwegian economic zone and quotas for directed trawl fishery were reduced, the catch of *S. mentella* decreased in 1996 to 8 thousand tonnes. In the recent years total catch of this species somewhat grew (by the preliminary data, to 11 thousand tonnes in 1998) owing to the increase of redfish bycatches (PINRO, 1999).

2.2.4 Greenland halibut (*Hippoglossus hippoglossus*) of the Norwegian-Barents Sea stock

ICES data show the commercial and the spawning stocks of Greenland halibut to have declined to respectively 80 and 60 thousand tonnes by the early 1980s. By 1992, when fishery restriction regulations were introduced for this species, biomass of the stock was estimated at 43 and 30 thousand tonnes (Fig.9).

According to the calculations of the ICES Arctic Fisheries Working Group, halibut stocks in 1992-1997 stabilised at a low level that contradicted the results of the trial trawl fishery, which was very efficient.

Owing to the absence of reliable fisheries and biological data, especially on age groups younger than 5 years old, the ICES Arctic Fisheries Working Group did not calculate the size of Greenland halibut stocks in the beginning of 1999. Nonetheless, 1998 investigations showed some positive changes in the status of this stock, including the enhanced recruitment to the commercial stock and the increased number of females in the spawning stock. The strength at age 5 of the year classes of Greenland halibut is shown in Figure 10.

Due to the uncertainty relating to the status of Greenland halibut stocks, it was agreed at the 27th Session of the Mixed Russian-Norwegian Fisheries Commission that the ban on the directed trawl fishery for this stock should be continued into 1999.

In 1980s, annual catch of Greenland halibut by all nations, due to a high fishing effort, remained at a relatively stable level at ca. 20 thousand tonnes (Kovtsova et al., 1991). In 1991, a record catch for the last two decades was taken - 33 thousand tonnes. After that the Mixed Russian-Norwegian Fisheries Commission imposed a ban on directed trawl fishery for halibut. As a result of this restriction, halibut catches in 1992-1998 varied between 9 and 14 thousand tonnes (Anon., 1999). The main portion of halibut catches is being taken by Norway.

2.2.5 Conclusion – demersal fish

Thus, the current tendencies in the dynamics of cod and haddock stocks arouse concern about the resources available for trawl fishery in the coming years. A suspended decline of *S.mentella* and Greenland halibut stocks and their stabilisation at a low level do not allow us to be too optimistic. Therefore the fisheries strategy for the Barents Sea and adjacent waters in the coming years should keep to strict regulation measures.

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