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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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BOOK 1

Section **Page**

Part 2

3 Regional Advice

3.1 Northeast Arctic (Subareas I and II)

There are two major ecosystems in the Northeast Arctic: the Barents Sea ecosystem and the Norwegian Sea ecosystem. Only the Barents Sea ecosystem is addressed here. The main human use of the Norwegian Sea ecosystem is the exploitation of widely migrating fish populations such as Norwegian spring-spawning herring and blue whiting. These stocks are discussed in Section 4.9.

3.1.1 The Ecosystem

The ecosystem in the Barents Sea is a relatively simple ecosystem, with only a few fish species of potentially high abundance interacting in various ways. On the lower trophic level, invertebrate species such as krill, copepods, and amphipods are considered to be important food resources for the fish stocks in this area. Marine mammals play an important role as top-predators in this ecosystem.

Considerable effort has been devoted to investigating multi-species interactions. Some of these investigations have reached the stage where quantitative results are available for use in the assessments of fish stocks.

Herring predation on capelin larvae is believed to be partially responsible for the recruitment failure of capelin in periods when young herring are abundant in the Barents Sea. Growth and maturation of cod depends on availability of prey such as capelin. Cod are able to compensate only partially in their diet for low capelin abundance, by switching to other prey species. Low capelin abundance will cause high cannibalism on juvenile cod, and an increased predation on other prey species, such as juvenile herring and haddock.

Physical environment

The water temperatures in the Barents Sea have been relatively high during most of the 1990s, with a continuous warm period from 1989-1995. During 1996-1997, the temperature was just below the long-term average before it turned warm again at the end of the decade, and has remained warm until present. 2003 was warmer than average. The temperature in the beginning of the year was just above average, followed by a large increase in the spring and remaining warm for the rest of the year. In January and March 2004 the temperature was still 0.5°C above the average. The water temperature in 2004 is expected to be normal for spring/early summer and warm for late summer/autumn in most of the Barents Sea.

Climate conditions are predicted to be at the average long-term level, showing a slight trend towards warming. This is expected to have an effect to increase zooplankton production and survival of fish at their early life stages.

The inflow of Atlantic water was high in the first half of 2003, but with normal variation for the rest of the year.

Zooplankton

According to the data from a survey in August/October there was a marked increase in zooplankton biomass during the period 1991-1994. Though the biomass has decreased from 1994 to present, the average biomass values during 1995 to 2003 are still higher than in 1988-1992. In 2003 the zooplankton biomass was at an average level, with a slight decrease from 2002 to 2003.

In autumn-winter 2003/04 the mean annual indices of euphausiid abundance in the Barents Sea were about 50% higher than the long-term mean, both in the northwest and in the southern areas. However, this is less than in the previous year. The overwintering zooplankton biomass, slightly above the average will be the basis for an average zooplankton production in 2004. This is expected to lead to average feeding conditions for capelin and other pelagic fish and juvenile demersal species in the Barents Sea in 2004.

Trophic interactions

Capelin is the most important prey species for Northeast Arctic cod, and fluctuations of the capelin stock have a strong effect on growth, maturation and fecundity of cod, as well as on cod recruitment because of cannibalism. The biomass of capelin decreased from 2.2 million tonnes in 2002 to 0.5 million tonnes in 2003. The capelin biomass is expected to increase from 2003 to 2004, but the mature stock is expected to remain at a low level also in 2005. When the Norwegian spring-spawning herring stock produces rich year classes, the juveniles are distributed in the southern parts of the Barents Sea. They stay in this area for about three years before they migrate west and southwards along the Norwegian coast and mix with the adult part of the stock. The presence of young herring in the area has a profound effect on the recruitment of capelin, and it has been shown that when rich year classes of herring enter the Barents Sea, the recruitment to the capelin stock is almost blocked, and in the following years, the capelin stock collapses. This happened after the rich 1983 and 1992 year classes of herring entered the Barents Sea. Also, when medium sized year classes of herring are spread into the area there is a clear sign of reduction in recruitment to the capelin stock, as is currently the case. In this way, the herring impact both the capelin stock (directly) and the cod stock (indirectly).

The consumption of capelin by cod increased from 2002 to 2003 according to calculations by Norwegian scientists, but decreased according to calculations by Russian scientists. The consumption of herring, polar cod, haddock, shrimp, krill, and amphipods by cod increased from 2002 to 2003, while the consumption of blue whiting and cod decreased from 2002 to 2003. The consumption per cod is close to the long-term average.

Whales and harp seals are top-predators in the Barents Sea ecosystem. The annual consumption of herring and capelin by marine mammals (particularly harp seals and minke whales) has been estimated to be in the order of 5 million t.

Ecosystem impact on dynamics of fish populations

Recruitment

Predictions of the recruitment in fish stocks are essential for future harvesting of the fish stocks. Traditionally prediction methods have not included effects of climate variability. Models based on climate and fish stock parameters, for prediction of recruitment have been developed for the 0-group index and the number of three-year-old fish for Northeast Arctic Cod, for the number of one-year-old fish for Barents Sea capelin and for the number of three-year-old fish for Norwegian spring-spawning herring. The models are encouraging, and the models might at present prove useful as background information for stock assessment. In the future they may be incorporated as recruitment models in the assessments.

From these models, the 0-group index of Northeast Arctic cod is expected to increase to a medium strong level in 2004 and 2005. The number of recruits (age 1) of Barents Sea capelin is expected to be at a medium high level in 2004.

Maturity

The decrease in capelin stock biomass potentially impacts the maturation dynamics of Northeast Arctic cod by delaying the onset of maturation and/or increasing the incidence of skipped spawning.

Growth

Mean weight of cod is expected to decrease from 2003 to 2005. The most pronounced reduction in growth rate is expected for fish from the younger age groups (age 3-5). For 2004-2006 the mean weight of cod is expected to be lower than the long-term mean average (1984-2003).

Distribution and migration

The composition and distribution of species in the Barents Sea depend considerably on the position of the polar front, which separates warm and salty Atlantic waters from colder and fresher waters of arctic origin. Variation in the recruitment of some species, including cod and herring, has been associated with changes in the influx of Atlantic waters into the Barents Sea.

In recent years, there has been an expansion of the distribution of mackerel and blue whiting in the Barents Sea.

3.1.2 The human use of the ecosystem Fisheries

The fisheries

The major demersal stocks in the Northeast Arctic include cod, haddock, saithe, and shrimp. In addition, redfish, Greenland halibut, and flatfishes (e.g., long rough dab, plaice) are common on the shelf and at the continental slope, with ling and tusk found also at the slope and in deeper waters. In 2003, landings of 0.8 million t were taken from the stocks of cod, haddock, saithe, redfish, and Greenland halibut. An additional catch of about 100 000 t was taken from other demersal stocks, including crustaceans, not assessed at present.

The major pelagic stocks are capelin, herring, and polar cod. The highly migratory species blue whiting and mackerel extend their feeding migrations into this region. There was no fishery for herring in 2003 in the area. The capelin fishery in the Barents Sea in 2003 was 287 000 t. Species with relatively small landings include salmon, halibut, hake, pollack, whiting, Norway pout, anglerfish, wolffish, lumpsucker, argentines, grenadiers, flatfishes, horse mackerel, dogfishes, skates, crustaceans, and molluscs.

The fishery on Norwegian coastal cod is conducted both with trawlers and with smaller coastal vessels using traditional fishing gears like gillnet, longline, handline, and Danish seine. The fishery is dominated by gillnet (50%), while longline/handline account for about 20%, Danish seine 20% and trawl 10% of the total catch. Norwegian vessels take all the reported catch. However, trawlers from other countries probably take a small amount when fishing near the Norwegian coast fishing for Northeast Arctic cod and Northeast Arctic haddock.

The fishery for Northeast Arctic cod is conducted both by an international trawler fleet operating in offshore waters and by vessels using gillnets, longlines, handlines and Danish seine operating both offshore and in the coastal areas. 60-80% of the annual landings are from trawlers.

Northeast Arctic haddock are harvested throughout the year. In years when the commercial stock is low they are mostly caught as bycatch in the cod trawl fishery, and when the commercial stock abundance and biomass are high haddock are harvested in a targeted fishery. On average approximately 25% of the catch is with conventional gears, mostly longline, which are used almost exclusively by Norway. Part of the longline catches are from a directed fishery.

Northeast Arctic saithe are mainly harvested by purse seine and trawl fisheries, which accounted for 60% of the landings in 2000. A traditional gillnet fishery for spawning saithe accounts for about 22%. The remaining catches are taken by Danish seine and handline in addition to minor bycatches in the longline fishery for other species. Some changes in recent regulations have led to fewer amounts taken by purse seine.

Greenland halibut fisheries are dominated by longline and gillnets and operate in relatively deep waters with minimum bycatch implication. Target trawl fishery has been prohibited and trawl catches are limited to bycatch only.

The only directed fisheries for *Sebastes mentella* (deep-sea redfish) are trawl fisheries. Bycatches are taken in the cod fishery and as juveniles in the shrimp trawl fisheries. Traditionally, the fishery for *S. mentella* was conducted by Russia and other East European countries on grounds located south of Bear Island towards Spitsbergen.

The fishery for *Sebastes marinus* (golden redfish) is mainly conducted by Norway which accounts for 80–90% of the total catch. Germany also has a long tradition of a trawl fishery for this species. The fish are caught mainly by trawl and gillnet, and to a lesser extent by longline and handline. The trawl and gillnet fishery have benefited from the females concentrating on the “spawning” grounds during spring. Some of the catches by Norway, and most of the catches taken by other countries, are taken in mixed fisheries together with saithe and cod. Important fishing grounds are the Møre area (Svinøy), Halten Bank, the banks outside Lofoten and Vesterålen, and Sleppen outside Finnmark. Traditionally, *S. marinus* has been the most popular and highest priced redfish species.

The recent developments in the stocks of cod, haddock, saithe, Greenland halibut, redfishes, herring, and capelin are summarized in the following:

Coastal cod is experiencing reduced reproductive capacity and is harvested unsustainably.

For Northeast Arctic cod, the spawning biomass is considered to be acceptable in relation to precautionary limits, but the stock is harvested unsustainably.

Northeast Arctic haddock has full reproduction capacity but, based on the most recent estimates of fishing mortality, is at risk of being harvested unsustainably.

Northeast Arctic saithe has full reproduction capacity and is harvested sustainably.

The stock status of Greenland halibut in Subareas I and II is not precisely known. SSB has been low since the late eighties but shows a slight increase in recent years.

The stock of *Sebastes mentella* is experiencing reduced reproductive capacity and is at present near a historical low.

The available information on *Sebastes marinus* is insufficient to assess the status of the stock properly, but the surveys indicate that the year classes in the last decade have been very low and declining. Also, both the coastal survey and commercial CPUE show a substantial reduction in abundance.

The capelin stock is experiencing a risk of reduced reproduction capacity, but is currently not harvested.

The Norwegian spring-spawning herring is classified as having full reproduction capacity and is harvested sustainably.

Most stocks are overfished, i.e. the current fishing mortality exceeds the level that would give a high yield in the longer term.

The state of individual stocks is presented in more detail in the stock Sections 4.1.1 to 4.1.8.

3.1.3 Assessments and advice

3.1.3.1 Advice regarding biota and habitats

3.1.3.2 Fisheries advice

Mixed fisheries and fisheries interactions

All fisheries should be considered in the management. The major fisheries in the area are:

1. Factory and freezer trawlers operating in the whole area all year round, targeting mainly cod, haddock, and saithe and taking other species as bycatch. The number of these vessels has been stable in recent years, at a lower level than previously.

2. Fresh fish trawlers operating in Subarea I and Division IIa all year round, targeting mainly cod and haddock, taking other species as bycatch. The number of these vessels has been reduced in recent years.

3. Freezer trawlers operating in Subarea I and Division IIb fishing shrimp. The number of these vessels has been stable.

4. Large purse seiners and pelagic trawlers targeting herring, mackerel, blue whiting, capelin, and polar cod in seasonal fisheries in this region. These vessels fish some of the same species in other areas as well.

5. Small fresh fish trawlers targeting shrimp and capelin in near-coast areas in Subarea I. The size of this fleet has decreased in recent years.

6. A fleet of vessels using conventional gears (gillnet, longline, handline, and Danish seine) mainly in near-shore fisheries, targeting various demersal species all around the year. This fleet, together with fleets 7 and 8, accounts for approximately 30% of the landings of demersal stocks. This share is maintained by quota allocation. When vessels in this fleet are modernised or replaced, there is a trend towards medium-sized (app. 15–20 m) multi-gear vessels with crews of 3–5.

7. Small purse seiners targeting saithe in coastal waters in a seasonal fishery, to a large extent vessels belonging to the group using conventional gears.

8. Longliners operating offshore, targeting non TAC-restricted species, mainly ling, blue ling, and tusk. These vessels are generally larger than those in the coastal fisheries and use technologically advanced auto-line systems.

9. Small vessels using gillnets, longlines, handlines, and Danish seine operating in near shore waters along the Norwegian coast north of 62^{o}N, exploiting coastal cod, and Northeast Arctic cod.

Some of these fisheries are mixed fisheries, with many stocks exploited together in various combinations. In cases where significant interactions occur, management advice must consider both the state of individual stocks and their simultaneous exploitation. Stocks in the poorest condition, particularly those having reduced reproductive capacity, necessarily become the overriding concern for the management of mixed fisheries where stocks are exploited either as a targeted species or as a bycatch.

Single-stock exploitation boundaries and critical stocks

The state and the limits to exploitation of the individual stocks are presented in the stock sections (Sections 4.1.1 to 4.1.8). ICES considers limits to exploitation of single stocks as follows:

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	in relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
Northeast Arctic cod	Full reproductive capacity	Risk of being harvested unsustainably	Overfished	The management plan implies catches of 485 000 t in 2005. Such catches are expected to result in unchanged stock size in 2006 compared with 2004.	The current fishing mortality, estimated at 0.46, is well above fishing mortalities that would lead to high long-term yields ($\mathbf{F}_{0.1}$=0.12 and $\mathbf{F}_{max}$=0.24). This indicates that long term yield will increase at fishing mortalities well below the historic values. Fishing at such a lower mortality would lead to higher SSB and therefore lower risks of observing the stock outside precautionary limits.		485 000 t
Norwegian Coastal cod	Reduced reproductive capacity	harvested unsustainably	Overfished		The current estimated fishing mortality is 0.62. There will no be no gain in the long term yield to have fishing mortalities above $\mathbf{F}_{0.1}$(0.22). Fishing at such lower mortalities would lead to higher SSB and, therefore, lower risks of fishing	No catch should be taken from this stock in 2005 and a recovery plan should be developed and implemented as a prerequisite to reopening the fishery. The recovery plan should include monitoring the development of the stock,	No catch

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	in relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
					outside precautionary limits.	clearly specified reopening criteria, and monitoring the fishery when it is reopened.	
Northeast Arctic haddock	Full reproductive capacity	Increased risk of being harvested unsustainably	Overfished	The catch rule agreed by the joint Russian-Norwegian Fisheries Commission implies that the TAC should be set at a level corresponding to the average of catches calculated from fishing at $\mathbf{F_{pa}}$=0.35 over 3 years. Following the agreed management plan would imply landings of 117 000 t in 2005.	In order to harvest the stock within precautionary limits, fishing mortality should be kept below $\mathbf{F_{pa}}$ (0.35) in any year. This corresponds to landings of less than 106 000 t in 2005.	The current estimated fishing mortality is 0.36. There will be no gain in the long-term yield to have fishing mortalities above $\mathbf{F_{0.1}}$ (0.18). Fishing at such lower mortalities would lead to higher SSB and, therefore, lower risks of fishing outside precautionary limits.	117 000 tonnes or less than 106 000 tonnes
Northeast Arctic saithe	Full reproductive capacity	Harvested sustainably	Appropriate		In order to harvest the stock within precautionary limits fishing mortality should be kept below $\mathbf{F_{pa}}$. This corresponds to landings of less than 215 000 t in 2005.	The current estimated fishing mortality (0.18) is just above the lowest fishing mortality that would lead to high long term yields ($\mathbf{F_{0.1}}$=0.12). There will be no gain in the long-term yield to have	215 000 tonnes

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	in relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
						fishing mortalities above $\mathbf{F_{0.1}}$ (0.12). Fishing at such lower mortalities would lead to higher SSB, and, therefore, lower risks of fishing outside precautionary limits.	
Greenland halibut	Unknown	Unknown	Overfished		The stock has remained at a relatively low size in the last 25 years at catch levels of 15 000–25 000 t. In order to increase the SSB, catches should be kept well below that range. Catches should not increase above the recent average of 13 000 t for 2005 to allow for continued increase in the spawning stock.	The current estimated fishing mortality (0.21) is above fishing mortalities that would lead to high long-term yields ($\mathbf{F_{0.1}}$=0.06, $\mathbf{F_{max}}$ =0.14). This indicates that long term yield will increase at Fs well below the historic values. Fishing at such lower mortalities would lead to higher SSB and, therefore, lower risks of fishing outside precautionary limits.	13 000 tonnes
Sebastes mentella	Reduced reproductive capacity	Unknown	Unknown		The measures introduced in 2003 should be continued, i.e. there should be no directed trawl fishery on this stock and the area closures and low bycatch limits should be retained, until a significant		No directed catch and stronger regulation to reduce bycatch

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	in relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
					increase in the spawning stock biomass (and a subsequent increase in the number of juveniles) has been detected in surveys. Furthermore, more stringent protective measures should be implemented such as an extension of the limited moratorium (for all fisheries except trawl) to the months where the highest catches of *Sebastes mentella* are achieved and further improvement of the trawl bycatch regulations.		
Sebastes marinus	Reduced reproductive capacity	Unknown	Unknown		ICES considers that the area closures and low bycatch limits should be retained, but stronger regulations than those recently enforced are needed given the continued decline in SSB and recruitment. The current measures are insufficient measures to rebuild the stock. More stringent protective	.	No directed catch and stronger regulation to reduce bycatch

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	in relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
					measures should be implemented such as an extension of the limited moratorium (for all fisheries except trawl) to the months where the highest catches are achieved and further improvement of the trawl bycatch regulations.		

Identification of critical stocks

The table above identifies the stocks that have reduced reproductive capacity, i.e. Norwegian Coastal cod and the two redfish species in Subareas I and II (*Sebastes marinus* and *Sebastes mentella*). These stocks are an overriding concern in the management advice.

ICES advice for fisheries management

The fisheries in the Northeast Arctic should therefore be managed such that the following rules apply simultaneously:

1. **For Norwegian coastal cod, there should be no catch.**

2. **For *Sebastes marinus* and *Sebasted mentella* in Area I and II, there should be no directed fishery and stronger regulations are advised to reduce bycatch.**

3. **The fishing of all other species should be restricted within the precautionary limits or according to the management plan as indicated in the table of individual stock limits above.**

Furthermore, unless ways can be found to harvest species caught in a mixed fishery within precautionary limits for <u>all</u> those species individually, then fishing should not be permitted.

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species when their reproductive capacity is reduced. If industry-initiated programmes aim at reducing catches of species with reduced reproductive capacity to levels close to zero in mixed fisheries, then these programmes could be considered in the management of these fisheries. Industry-initiated programmes to pursue incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of species with reduced reproductive capacity are fully and credibly reported.

At least the following fisheries are suspected of having significant interactions that deserve attention in setting up TACs applying to single stocks:

- Norwegian coastal cod are caught together with Northeast Arctic cod in some fisheries.

- For *Sebastes marinus*, some of the catches by Norway, and most of the catches taken by other countries, are taken in mixed fisheries together with saithe and cod.

- *Sebastes mentella* is caught as a bycatch in the cod fishery and as juveniles in the shrimp trawl fisheries.

- Shrimp trawl fishery with bycatch of redfish and Greenland halibut.

- Directed trawl fisheries where 20-25% catch of redfish is allowed.

The catch options that would apply if single stocks could be exploited independently of others are presented in the sections on individual stocks (Sections 4.1.1 to 4.1.8).

However, for the mixed demersal fisheries, catch options must be based on the expected catch in specific combinations of effort in the various fisheries, taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, but must also result in catches that comply with the scientific advice presented above.

Regulations in force and their effects

The fisheries in Subareas I and II are managed by TAC constraints for the main stocks and by allocation of TAC shares amongst states with established fishing interests. These Subareas consist mainly of waters within EEZs, but also contain some waters outside EEZs.

For the main species the fisheries in the EEZs are regulated by quotas at a variety of scales (vessels, fleets, species, seasons). Management measures also regulate minimum landing size, mesh size, and use of sorting grids. Since January 1997 the use of sorting grids in the trawl fisheries has been mandatory for most of the Barents Sea and Svalbard area. Minimum landing size is also a minimum catching size, implying that vessels have to avoid fishing grounds with small-sized fish. Discarding is prohibited in some EEZs. Time and area closures may be implemented to protect small fish.

Compilation of effort data relevant to the different species is difficult when the fisheries are regulated by vessel quotas. In some cases the effort targeted at the main species, e.g., cod, may be calculated, but it is almost impossible to calculate effort for non-target species.

At the last meeting of the Joint Russian-Norwegian Fisheries Commission, the Parties agreed that a harvesting strategy for Northeast Arctic cod and haddock was adopted. An evaluation of the strategy in relation to cod is presented in Section 4.1.1.a. If the proposed adjustments to the management strategy are adopted ICES considers the rule to be consistent with the Precautionary Approach as implemented in the ICES advice. The management strategy has not been evaluated for haddock.

ICES has been asked to calculate management options for 2004 on the basis of the adopted harvest control rule. The calculated catches and SSBs are given in Sections 4.1.1.a and 4.1.2.

Quality of assessments and uncertainties

The unreported landings for Northeast Arctic cod have apparently increased sharply in 2002 and have remained at this level in 2003. The main mechanism used for avoiding quota control seems to be trans-shipping of fish from the Barents Sea. The assessment includes estimates of non-reported landings. The catch forecast refers to total catch, which would only be equivalent to a TAC if no unreported landings occur in the future. This has to be taken into account when using the results of the catch forecasts.

3.2 Northwestern Areas (Division Va and Subareas XII and XIV)

3.2.1 The ecosystem

The fish stocks considered in this report include the largest stocks in these areas: capelin, cod, and redfish. These and other species spawn in the warmer regions of Atlantic water, but their distribution patterns differ substantially during other periods of their life cycle. Greenland halibut and demersal *Sebastes mentella* are the only demersal deepwater species among the stocks considered. Saithe is migratory and migrations between Norway and Iceland have been observed. Pelagic redfish constitute a vast resource although increasing effort is directed towards it. A number of other demersal commercial stocks inhabit both the continental shelf, e.g. flatfish species, and deeper waters, e.g. ling, blue ling, and tusk. Most of these stocks are regulated by TACs.

Interaction between commercially valuable species is frequently observed but appears to be most pronounced for only a few species. The most important predator-prey relationships are the cod-capelin and cod-*Pandalus* interactions. Cod growth depends on capelin abundance, and cod predation influences the recruitment of *Pandalus*. The low abundance of deep-water *Pandalus* in Icelandic waters in recent years is considered to be a result of this interaction caused by some increase in the cod stock. Whales have not been harvested commercially for some time and an increase in the abundance of cetaceans may tend to increase natural mortality in stocks such as cod in Division Va.

The cod at Greenland and Iceland have four components spawning in different areas: A West Greenland offshore component spawning off Southwest Greenland (now virtually non-existent), an inshore component found in various West Greenland fjords, a component spawning off East Greenland, and a component spawning off Iceland. Eggs and larvae from the East Greenland-Iceland components are carried by the Irminger current to West Greenland. The in$\mathbf{F}_{low}$ of larvae varies from year to year but for some year classes, such as those of 1973 and 1984, this in$\mathbf{F}_{low}$ was very important.

Emigration of mature offshore cod from Greenland to Iceland is well known and most evident for year classes which were earlier observed as 0-group drifting from Iceland to Greenland.

3.2.2 The human use of the ecosystem

The fisheries and their impact

Since the mid-seventies stocks in Division Va have mainly been exploited by Icelandic vessels. However, vessels of other nationalities have also operated in the pelagic fishery on capelin, herring, and blue whiting, and a few trawlers and longliners targeting redfish, tusk, and ling have been operating in the region.

The fishery off West Greenland has traditionally consisted of an offshore trawl fishery and an inshore fishery mostly using poundnets and longlines. The cod catches have fluctuated substantially, but declined dramatically after 1989, and the offshore fishery has now ceased.

Cod catches off East Greenland have also fluctuated widely and decreased sharply in 1993, when the directed cod fishery failed totally due to very low catch rates.

The fishery for Greenland halibut in Subareas V and XIV is conducted by various nations but is still dominated by Icelandic trawlers in Division Va. The fishery in Divisions XIVb and Vb constitutes now about one third of the total fishery for Greenland halibut within Subareas V and XIV. Surveys have only recently been initiated for Greenland halibut.

Fisheries in Icelandic waters are characterised by the most sophisticated technological equipment available in this field. This applies to navigational techniques and fish-detection instruments as well as the development of more effective fishing gear. The most significant development in recent years is the increasing size of pelagic trawls and, with increasing engine power the ability to fish deeper with them. There have also been substantial improvements with respect to technological aspects of other gears such as bottom trawl, longline, and handline. Each fishery uses a variety of gears and some vessels frequently shift from one gear to another within each year. The most common demersal fishing gear are otter trawls, longlines, seines, gillnets, and jiggers, while the pelagic fisheries use pelagic trawls and purse seines. The text table below gives an overview of the Icelandic fleet composition as of May 2004, based on information from the Icelandic Directorate of Fisheries. The definition of type may be very complicated as some vessels operate both as large factory vessels fishing for demersal species and as large purse seiners and pelagic trawlers fishing for pelagic fishes during different times of the year.

Type	**No. of vessels**	**Gear type used**
Trawlers	79	(Pelagic and bottom trawl)
Other large vessels within the TAC system	253	(Purse seine, longline, gillnet, Danish seine, pel. trawl)
Small vessels within the TAC system	884	(Jiggers, longline, gillnet, Purse seine)
Vessels within the effort system	308	(Small jiggers)
Total	1561	

The total catch in Icelandic waters in 2003 was 1.7 million tonnes, of which pelagic fishes comprised 1.2 million tonnes. Discard is banned in the Icelandic demersal fishery, but is allowed in the pelagic fishery when the catch exceeds the capacity of the vessels. Table 3.1.2.1 provides an overview of the catches in 2003 by species and gear type. This is based on electronic logbook data, divided by gear as follows:

Gear type	**No. of hauls/sets**
Pelagic trawl	6 647
Bottom trawl	58 201
Longline	21 029
Purse seine	3 965
Jiggers *	17 674
Danish seine	39 371

* number of fishing days

Figures 3.1.2.1, 3.1.2.2, and 3.1.2.3 provide an overview of where the catches of most important demersal species were taken in 2003 by gear type. Figures 3.1.2.4 and 3.1.2.5 provide information on the distribution of effort by gear type. In general, the trawlers operate further offshore than do the longliners.

Pelagic fishery

The fishery for the main pelagic species, Icelandic summer-spawning herring and capelin in the Iceland-East Greenland-Jan Mayen area, is almost exclusively carried out by vessels operating with both purse seine and pelagic trawl. The pelagic fisheries mainly target capelin, herring, redfish (*S. mentella*) and blue whiting. Except for the summer fishery northwest of Iceland, the capelin fishery is mostly during the spawning migration, which goes clockwise around the country. The herring fishery is conducted from autumn until February the following year, both west and east of Iceland, using both purse seine and pelagic trawls. The blue whiting fishery has developed rapidly in recent years and is conducted off the southeast and the east coast, using large pelagic trawls. For further information on the blue whiting, see Section 3.9 (Widely migratory stocks).

The main fishing season of the pelagic redfish fishery takes place during the second quarter. The fishery starts in the northeast part of the Irminger Sea close to and within the Icelandic EEZ in early April at depths below 600 m. In July, the fishery moves into international and Greenland EEZ waters in the southwestern part of the Irminger Sea to continue fishing at water depths of less than 500 m. The distance between the two fishing areas is currently more than 500 km. The fleets participating in this fishery have continued to develop their fishing technology, and most trawlers now use large pelagic trawls ("Gloria"-type) with vertical openings of 80–150 m. Discard is at present not considered to be significant for this fishery.

Most of the landings of pelagic species capelin, herring and blue whiting are used for fish meal and oil production however, the proportion used for human consumption is increasing. While bycatch of other species usually do not occur in this fishery, juveniles of other species are taken in some cases. When this occurs, the fishing areas have been closed for fishing, temporarily or permanently. Figure 3.1.2.6 provides an overview of where capelin, herring, and blue whiting are caught with pelagic trawls and purse seiners.

Demersal fishery

Demersal fisheries in Icelandic waters usually target a mixture of roundfish species or a mixture of flatfish species, with varying amounts of redfish as a bycatch. Demersal fisheries in East Greenland (XIVb) only targets redfish and Greenland halibut. A fishery directed towards golden (*Sebastes marinus*) and demersal redfish (*S. mentella*) exists along the shelf edge from southeast to northwest of Iceland. The saithe fishery is conducted also along the shelf edge, often in the same areas as the redfish fisheries, and the fleets often target redfish during daytime and saithe during night. Therefore, the fishery for each of those species is relatively clean even though they take place in the same area. A directed Greenland halibut fishery also exists and this fishery has very little bycatch (see Table 3.1.2.2, Figure 3.1.2.7 and 3.1.3.1.2.). A targeted fishery for deep-sea species (mainly tusk) takes place from the southeast of Iceland to the southwest coast, often with cod and haddock as bycatch.

Demersal fisheries take place all around Iceland, deploying a variety of gears and boats of all sizes. The most important fleets targeting them are:

- Large and small trawlers using demersal trawl. This fleet is the most important one fishing cod, haddock, saithe, and redfish, as well as a number of other species. This fleet operates throughout the year; mostly outside 12 nautical miles from the shore.

- Vessels (< 300 GRT) using gillnet. These boats mostly target cod, but cod, haddock, and a number of other species are taken. This fleet operates mostly close to the shore.

- Vessels using longlines. These boats are both small boats (< 10 GRT) operating in shallow waters as well as much larger vessels operating in deeper waters. Cod and haddock are the main target species of this fleet, but a number of less important species are also caught, some of them in directed fisheries.

- Vessels using jiggers. These are small boats (<10 GRT), operating either within the TAC system or in an effort control system where each boat is allocated a certain number of days for each year. Cod is the most important target species of this fleet, with saithe following as the second most important species.

- Vessels using Danish seine (20–300 GRT). The most important species for this fleet are cod and haddock, but this fleet is the most important fleet fishing for a variety of flatfishes like plaice, dab, and witch.

In addition to those fleets a number of other fleets targeting invertebrates and pelagic fishes can affect demersal fish stocks, both through discarding and other hidden mortality.

Fisheries for redfish

Redfish in Division Va are mainly caught by trawlers using demersal and pelagic trawl. *S. marinus* is the predominant species down to depths of about 500 m, whereas deep-sea *S. mentella* contributes mostly to the catches at greater depths. The Icelandic fleet takes the major part of the catches, but vessels from Germany, UK, and Faroe Islands also fish in Division Va. In recent years the Icelandic fleet has also caught pelagic *S. mentella* in the deeper parts of Division Va using pelagic trawl.

In Division Vb**,** redfish are mainly caught by trawlers using demersal trawls. Down to about 500 m, *S. marinus* is the most important redfish species, and pair-trawlers are the most important fleet. Deeper than about 500 m, redfish catches consist almost exclusively of demersal *S. mentella* taken mostly by otter-board trawlers larger than 1 000 HP. The Faroese catches constitute more than 90% of the redfish catches in this division. Otter-board trawlers from Germany and France occasionally target these stocks. The remainder of the total catches is mainly bycatch in other demersal fisheries.

Redfish catches taken by several countries in Subarea VI are considered to be mainly bycatch in demersal fisheries**.** These catches are negligible in comparison with redfish catches in Subareas V, XII, and XIV.

Catches in Subarea XII are mainly pelagic *S. mentella* and are taken by trawlers using pelagic trawls. At least 13 fleets have joined this fishery mainly from Russia, Germany, Iceland, Faroe Islands, and Norway.

In Subarea XIV both *S. marinus* and *S. mentella* stocks are exploited. On the Greenland shelf and slopes, *S. marinus* dominates the trawl catches above 500 m, whereas demersal *S. mentella* dominates below 500 m. Most of the catches are taken by German freezer trawlers. In 1982 a pelagic trawl fishery started exploiting the pelagic *S.mentella* in the deeper parts of Subarea XIV. Since 1990 the main fleets are from Russia, Norway, Iceland, and Germany. In recent years, vessels from several other countries have joined this fishery, mainly outside the EEZs of Iceland and Greenland.

In Division Va and Subareas XII, and XIV, a pelagic fishery has developed at depths greater than 500 m to target *S. mentella*. In recent years, a substantial proportion of the pelagic *S. mentella* catch has been taken below depths of 500 m. Since autumn 2000, there is significant fishing effort extending from ICES Division XII into the NAFO Convention Area. There are indications of a significant amount of unreported effort, at least in recent years.

Stock status

Most of the largest stocks have been at low levels during the most recent decade. The pelagic *S. mentella* is now considered to be at a low level compared to the stock size in the early 1990s. The stock size of demersal *S. mentella* on the shelf also appears to be decreasing. Due to good recruitment in recent years, the haddock is expected to increase rapidly. Trends in Greenland halibut stock vary among areas. Indices from Subarea XIV and Division Vb suggest that the stock has stabilised, while indices from Division Va suggest a low biomass in recent years compared to the mid-1980s, and a recent decline. Further information on the demersal stocks at Greenland and Iceland is given in Section 3.1.3.1.

All available information confirms the severely depleted state of the cod stock off Greenland. The offshore stock may be considered to be almost non-existent at the present time. Strong year classes observed at Iceland as 0-groups in 1997–1999 only appeared as moderate at age 1 in bottom trawl surveys in Greenland waters. A rise in water temperatures at East and West Greenland may provide the basis for a higher recruitment to the West Greenland area. The inshore stock component has historically been small and available information suggests moderate recruitment in the northern part of West Greenland. In Icelandic waters the cod stock has shown signs of some recovery due to better recruitment of the 1997-2000 year classes after a long period of poor recruitment. The Icelandic haddock has for more than a decade been exploited at a very high fishing mortality. The stock is increasing from a low level in recent years. Several strong year classes are entering the fishery.

3.2.3 Assessments and advice

3.2.3.1 Fisheries advice

Mixed fisheries and fisheries interactions

The major fishery in Greenland is the shrimp fishery, with annual landings of about 100 000 t; this fishery is known to have bycatches of juvenile cod, redfish, and Greenland halibut. The magnitude of bycatches is not quantified but is expected to be reduced since the mandatory use of sorting grids (bar distance 26 mm) was introduced in this fishery. Large pelagic fisheries for *S. mentella* mainly southeast of Greenland are clean fisheries without bycatches. The only bottom trawl fisheries for fish are for Greenland halibut at depths from 500–1500 m; this fishery has some bycatches of roundnose grenadier and sharks. Small longline fisheries in East Greenland are rather clean with minor bycatches of roughhead grenadier, tusk, Atlantic halibut, and Greenland shark.

Some of the species caught in Icelandic waters are caught in fisheries targeting only one species, with very little bycatch. An example of this is the directed Greenland halibut fishery (Table 3.1.2.2) which is fished in waters deeper than 500 m west and southeast of Iceland. Within the areas where it is fished (indicated in Fig. 3.1.2.7), 17 600 t of the total landings of 20 300 t were caught in 2003. The bycatch in the Greenland halibut fishery in these areas (Table 3.1.2.2) show that it is very clean fishery with Greenland halibut comprising over 90% of the total catches in the western area where over 16 thousand tonnes are caught, and with deep-sea redfish being the most important bycatch species comprising less than 9% of the total catch in that area. Other bottom trawl fisheries are more mixed. Figure 3.1.3.1.1 indicates to what extent the 2003 catch of different species is bycatch. The x axis indicates the proportion of each species in regard to the total catch in the setting or haul, and the y axis shows the proportion of the annual catch of the species coming from hauls where the proportion of the species is less than the selected proportion. From this coarse analysis one may conclude that the fisheries of cod, haddock, saithe, and *S. marinus* is a relatively mixed fishery. However, the Greenland halibut fishery is relatively direct. Thus any advice given for the Greenland halibut should not influence the advice of gadoid stocks.

At present, ICES only assesses a few stocks among those currently exploited in Icelandic waters. However, many of the species listed in Table 3.1.2.1 are assessed by the Marine Research Institute, Reykjavik, Iceland, and TACs are advised. The Icelandic management authorities set TACs for these species.

If a proper fishery-based advice taking mixed fisheries issues into account should be given for the Icelandic fishery ICES would need to evaluate the status of these bycatch stocks.

Single-stock exploitation boundaries and critical stocks

The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary considerations. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	in relation to precautionary considerations	in relation to target reference points	
Greenland cod	-	-	-	-	-	-	No fishery should take place until a substantial increase in biomass and recruitment is evident. (no PA reference points)
Icelandic cod	-	-	Overfished	205 000 t for 2004/2005	-	140 000 t if based on F-max	205 000 t for 2004/2005
Icelandic haddock	-	Increased risk	-	-	97 000 t in 2004/2005	-	97 000 t in 2004/2005
Icelandic saithe	Increased risk	Increased risk	-	-	69 000 t in 2004/2005	-	69 000 t in 2004/2005
Greenland halibut	-	-	-	-	-	Effort should be reduced to 1/3 of the 2003 level. This level of effort coincides with the lowest observed in the time-series (1998) at which time the stock increased	Effort should be reduced to 1/3 of the 2003 level ~ 15 000 t
Sebastes marinus	Acceptable (but based on fishable biomass)	-	Overfished		37 000 t	-	37 000 t, no directed fishery for *S. marinus* in Subarea XIV
Demersal *Sebastes mentella*	Unknown	-	-	-	Reduce catch to 2001 level (lowest since 1980). No directed fishery for *S. mentella* in Subarea XIV to protect nursery grounds .		22 500 t

Pelagic *Sebastes mentella* Irminger Sea	Unknown				Reduce catch to 1989-1992 level (the period of lowest observed catches, before CPUE declined and when biomass indices from acoustic surveys were stable).		41 000 t
Icelandic summer-spawning herring	Acceptable	Increased risk	Appropriate	Following the agreed management plan would imply catches of 106 000 t in 2004/2005 which is expected to lead to an SSB of 525 000 t in 2005.	The long-term target reference point of $\mathbf{F}_{0.1}$ is equal to both $\mathbf{F}_{pa}$ and to established practise. No additional long-term targets have been set.	Exploitation boundaries in relation to precautionary limits are the same as the exploitation boundaries in relation to existing management plans	106 000 t
Capelin	No immature fish found in autumn 2003 and in the spring 2004, suggesting a low 2005 SSB	-	-	The fishery should be stopped until new information on stock size, showing spawning stock biomass of at least 400 000 t in March 2005 becomes available.	-	-	The fishery should be stopped until new information on stock size, showing spawning stock biomass of at least 400 000 t in March 2005 becomes available.

Identification of critical stocks

The table above identifies the exploitation boundaries for single stocks in the area. The stocks which require closures or large reductions in fisheries are Greenland cod in the East Greenland area and capelin in the Iceland-East Greenland-Jan Mayen area, as well as pelagic redfish (*S. mentella*) and Greenland halibut in the Irminger Sea and adjacent areas.

Advice for fisheries management

The present advice does not cover all stocks taken in that area. If a proper fishery-based advice taking mixed fisheries issues into account should be given for the Icelandic fishery ICES would need to evaluate the status of all stocks listed in Table 3.1.2.1. For the stocks covered by the present advice ICES can provide the following advice:

For the area around Iceland Division Va, Subarea XII and the East Greenland area (Division XIV) the following apply:

1. **The advice concerning pelagic S. mentella: includes all parts of the unit which occurs in the NAFO Convention Area and in Division Va and subareas XII and XIV.**

2. **For deep-sea fisheries, see Section 3.10 on Deepwater species (included in the June 2004 extracts). There are widely migratory stocks that are fished in these areas including blue whiting and Norwegian spring spawning herring, see section 3.9 from June 2004 and section 3.9 in this extract. Management of these species must be holistic taking account of the exploitation which occurs in all areas where deep water fish are fished.**

3. **For capelin there should be no catch until new information on stock size, showing a spawning stock biomass of at least 400 000 t in March 2005 becomes available. As capelin is taken in a separate fishery there are no mixed fisheries concerns regarding protection of capelin.**

4. **Concerning the fisheries in the East Greenland area (Division XIV) in 2005 there should be no fishery on Greenland cod and** *S. marinus***;**

5. **For other species, fishing of each species should be restricted within the precautionary limits as indicated in the table of individual stock limits above. Many of these stocks are confined to only part of the areas under considerations and the advice only pertain to the stock area;**

Furthermore, unless ways can be found to harvest species caught in a mixed fishery within precautionary limits for all those species individually, then fishing should not be permitted.

Regulations in force and their effects

The Ministry of Fisheries is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year, including an allocation of the TAC for each of the stocks subject to such limitations.

A system of boat quotas was introduced in 1984. The agreed quotas were based on the Marine Research Institute's TAC recommendations, taking some socio-economic effects into account, as a rule to increase the quotas. Until 1990, the quota year corresponded to the calendar year, but since then the quota, or fishing year, starts on September 1 and ends on August 31 the following year. This was done to meet the needs of the fishing industry.

In 1990, an individual transferable quota (ITQ) system was established for the fisheries and they were subject to vessel catch quotas. The quotas represent shares in the national total allowable catch (TAC) for each species, and most of the Icelandic fleets operate under this system. Some of the smaller boats operate in an effort control system where the boats are assigned a certain number of fishing days.

With the extension of the fisheries jurisdiction to 200 miles in 1975, Iceland introduced new measures to protect juvenile fish. The mesh size in trawls was increased from 120 mm to 155 mm in 1977. A mesh size of 135 mm was only allowed in the fisheries for redfish in certain areas. Since 1998 a mesh size of 135 mm is allowed in the codend in all trawl fisheries not using "Polish chaefer". A quick closure system has been in force since 1976 with the objective to protect juvenile fish. Fishing is prohibited for at least two weeks in areas where the number of small fish in the catches has been observed by inspectors to exceed a certain percentage (25% or more of <55 cm cod and saithe, 25% or more of <45 cm haddock, and 20% or more of <33 cm redfish). If, in a given area, there are several consecutive quick closures the Minister of Fisheries can with regulations close the area for longer time, forcing the fleet to operate in other areas. Inspectors from the Directorate of Fisheries supervise these closures in collaboration with the Marine Research Institute. In 2003, 113 such closures took place.

In addition to allocating quotas on each species, there are other measures in place to protect fish stocks. Based on knowledge on the biology of various stocks, many areas have been closed temporarily or permanently, aimed at protecting juveniles. In addition major spawning areas for cod, plaice, and catfish are closed during spawning time. Figure 3.1.3.1.2 shows a map of such legislation that was in force in 2003. Some of the closures were temporary, while other areas have been closed for decades. Furthermore there are regulations on the mesh size in the gillnet fishery for cod.

No evaluation of the effect of the measures above is available to ICES.

A group of vessels is regulated by limiting the number of hours at sea. This fleet catches 10-15 kt cod each year. The other fleets are allowed a TAC equal to what the catch rule permits, minus 2000 tonnes to account for the catch by the effort-regulated fleet. Hence the total catch every year is approximately 10 000 t cod higher than what is intended by the catch rule.

Since the implementation of the catch rule in 1995 realized reference fishing mortalities have been in the range of 0.56-0.76, in the last four years about 0.7. The expected long-term fishing mortality by the application of the catch rule was 0.4. One may therefore conclude that the objectives of the management system have not been realized.

Quality of assessments and uncertainties

The resources in the area have generally been managed on the basis of fairly long and detailed time-series of data. There are well-known difficulties with the assessments, for example age readings of slow-growing species such as redfish and Greenland halibut. The problems are the same in these areas as elsewhere. Greenland halibut, pelagic redfish (*Sebastes mentella*) in the Irminger Sea (Subareas XII and XIV), and demersal *S. mentella* on the shelf (Subareas V, XII, and XIV) are the stocks with the most apparent need for improvements in data analysis and in the gathering of auxiliary information. Such auxiliary information required is trawl abundance or acoustic stock indices. Comprehensive assessment of these large and widely distributed stocks is a challenging task, which requires full-scale international cooperation.

The assessments of Icelandic cod, haddock, saithe, and *Sebastes marinus* are all done as analytical assessments, using landings, catch-at-age data, and age-based indices from standardized scientific surveys. The quality of the sampling from the commercial fishery is considered adequate for all these stocks. However, accurate and long-term data on discarding and other illegal activities are not available, hampering a full evaluation on the quality of the assessments. The primary objective of the scientific survey is to obtain accurate stock indicators for cod and haddock. The uncertainties in the assessment of the gadoid stocks are thus largely a reflection of the different accuracy of the survey data for different stocks. Uncertainty estimates, although covering only a portion of the total uncertainty, are available for the gadoid stocks and could be used as a basis for the advice.

Table 3.2.2.1 Overview of Icelandic fish (+ shrimp) catches in Icelandic waters by gear type in 2003. The fishery for capelin, blue whiting, and herring are fished in both pelagic trawls and purse seine, but those gears are combined. Based on landing statistics from the Directorate of Fisheries. Landings are given in t.

Species	longline	gillnets	hooks	Danish seine	Bottom trawl	Pel. trawl	Lobster tr.	Shrimp trawl	Other gears	Total
Capelin	0	0	0	0	0	0	0	0	682178	682178
blue whiting	0	0	0	0	0	0	0	0	390068	390068
Herring	0	4	0	0	1	0	0	0	132123	132128
Cod	44629	37527	15917	13333	87016	315	1065	33	492	200327
Redfish	895	190	193	316	57795	2844	503	1	28	62765
Haddock	17269	1565	74	4789	35768		464	12	36	59976
Saithe	842	2204	2606	1097	44783	188	122	0	16	51859
Deepwater prawn						1		23235	0	23236
Greenland halibut	65	1383		0	18904		0	1	0	20352
Atlantic wolffish	8933	86	26	1398	5859	1	124	0	24	16451
Plaice	54	300	0	3579	1293		5	0	26	5257
Dab	7	22	0	4160	22		1		1	4213
tusk, cusk	3902	44	10	1	55		10		1	4024
Ling	2208	456	7	63	582	3	265		1	3584
Long rough dab	9	11		2496	199	0	119	0	0	2835
greater argentine,					2617	23			40	2680
spotted wolffish, leopardfish	757	5	0	12	1614	4	2	0	2	2397
Witch	0	0		1690	30		228		0	1948
Monkfish	10	891	0	248	180	0	345	0	11	1685
Norway lobster							1666		0	1666
Lemon sole	0	9	0	770	446	0	17		1	1245
blue ling	197	6	0	11	869	5	10		0	1098
Whiting	153	34	3	102	667	0	66		0	1026
Halibut	201	64	3	141	173	4	43	0	1	631
Dogfish	28	173	3	8	18		0		0	231
Others	0	119	0	8	14			0	0	141
Skate	24	15	0	32	43	1	6		0	120
Megrim		0		50	11	0	12		0	73
Greenland shark					61				0	61
roundnose grenadier,					57				0	57
Other species	0	40	0	3	6			0	5	55
roughhead grenadier					29	4			0	33
lumpsucker, lumpfish	1	17		2	1				4	25
shagreen ray	4	0		0	13		0		0	17
black scabbard fish					14				0	14
Other species	7	8	0	1	3	0	0	0	0	20
Grand Total	80196	45172	18842	34313	259141	3395	5074	23284	1205058	1674475

Table 3.2.2.2 Catches of Greenland halibut (in kg) within the areas given in Figure 3.2.2.7, as reported in the logbooks of the bottom trawlers. The data are also given as a percentage.

Species	Western	Eastern	Grand Total	Western	Eastern	Grand Total
Greenland halibut	16282551	1226180	17508731	90.13	62.03	87.36
Saith	7736	7889	15625	0.04	0.40	0.08
S. marinus	141420	22270	163690	0.78	1.13	0.82
Cod	34298	530203	564501	0.19	26.82	2.82
Haddock	0	6500	6500	0.00	0.33	0.03
Catfish	1001	325	1326	0.01	0.02	0.01
Plaice	5559	0	5559	0.03	0.00	0.03
Halibut	500	0	500	0.00	0.00	0.00
ling	6513	0	6513	0.04	0.00	0.03
Blue ling	7897	0	7897	0.04	0.00	0.04
S.mentella	1578693	183328	1762021	8.74	9.27	8.79

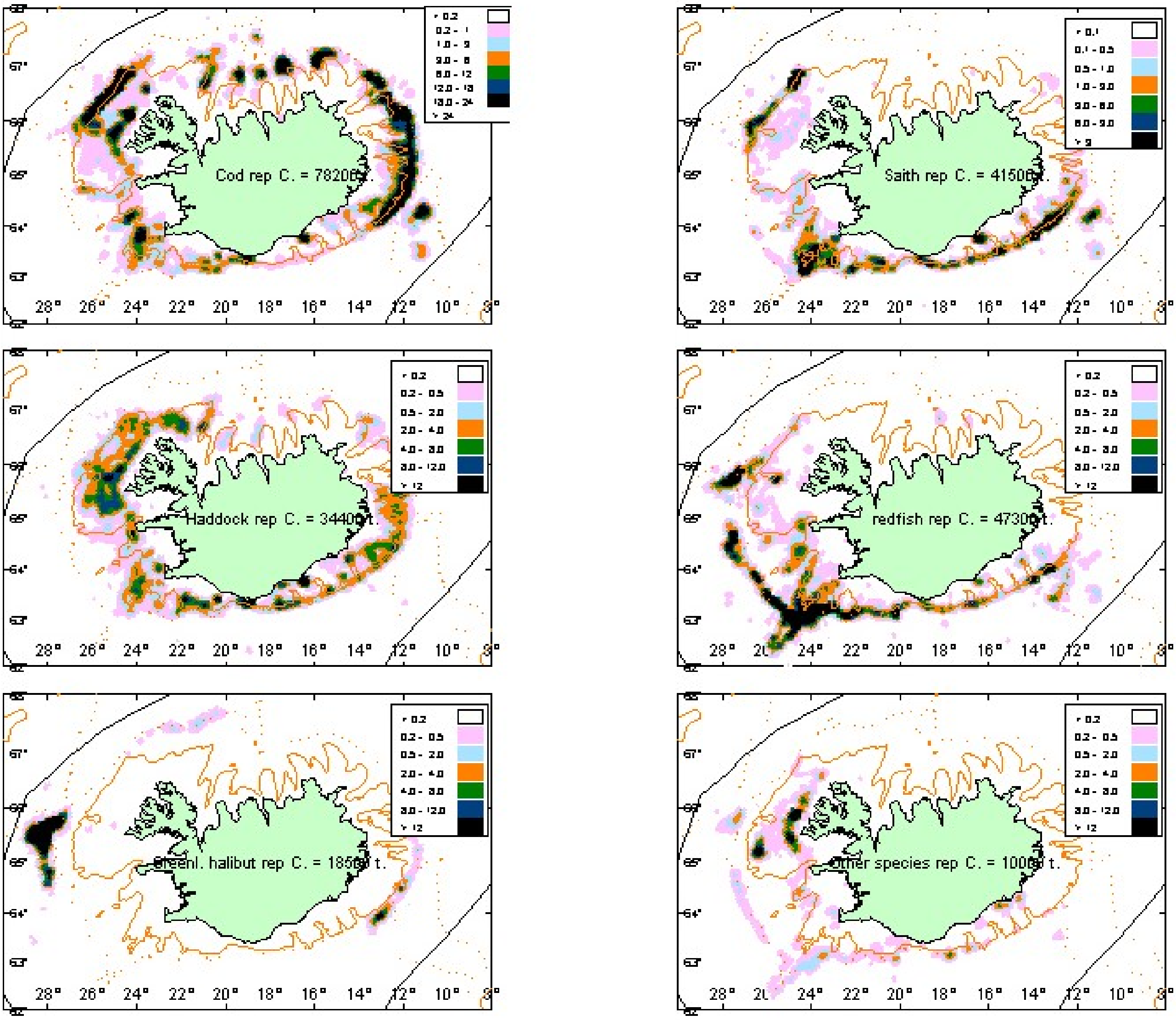

Figure 3.2.2.1 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with bottom trawl 2003.

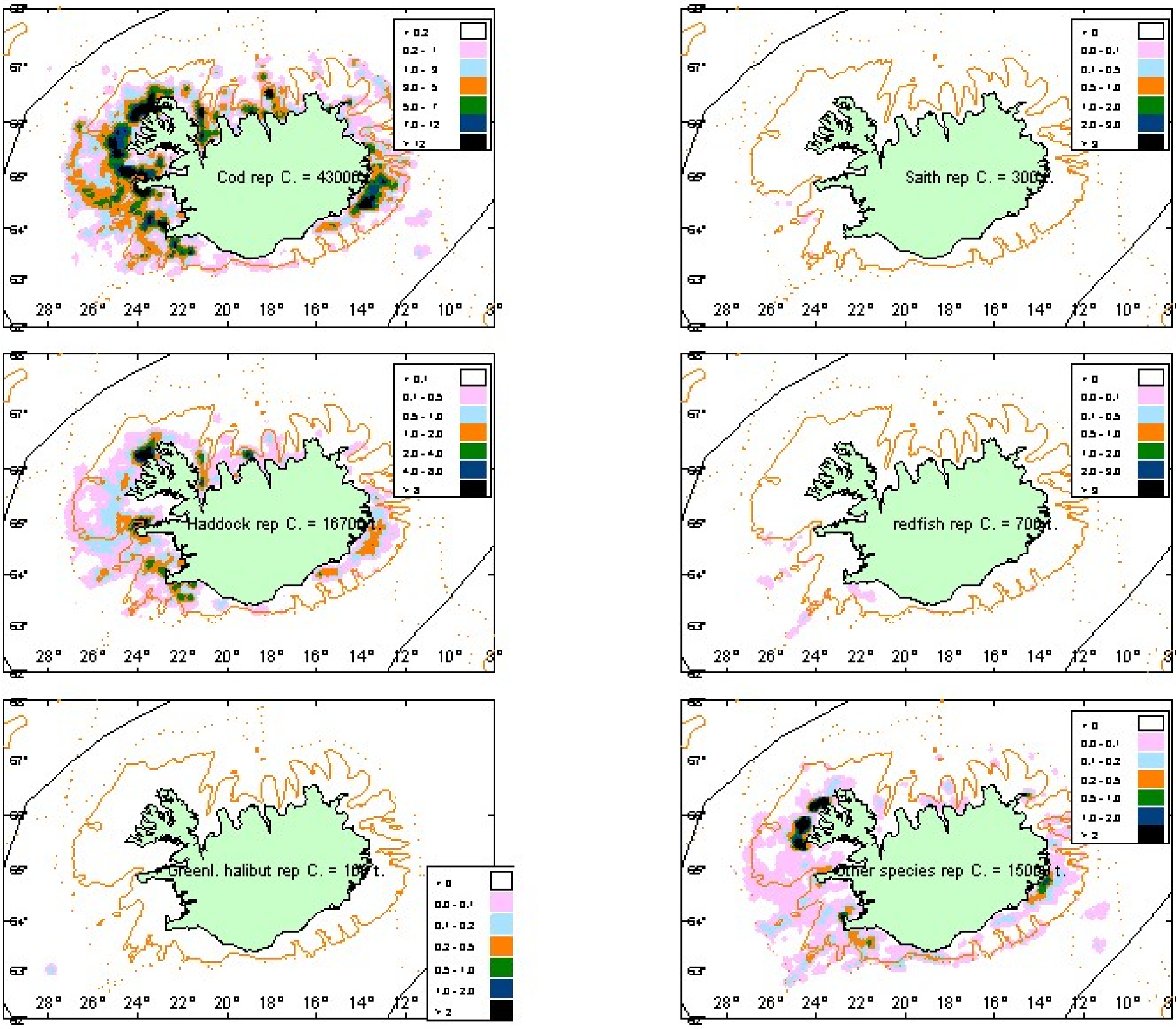

Figure 3.2.2.2 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with longline in 2003.

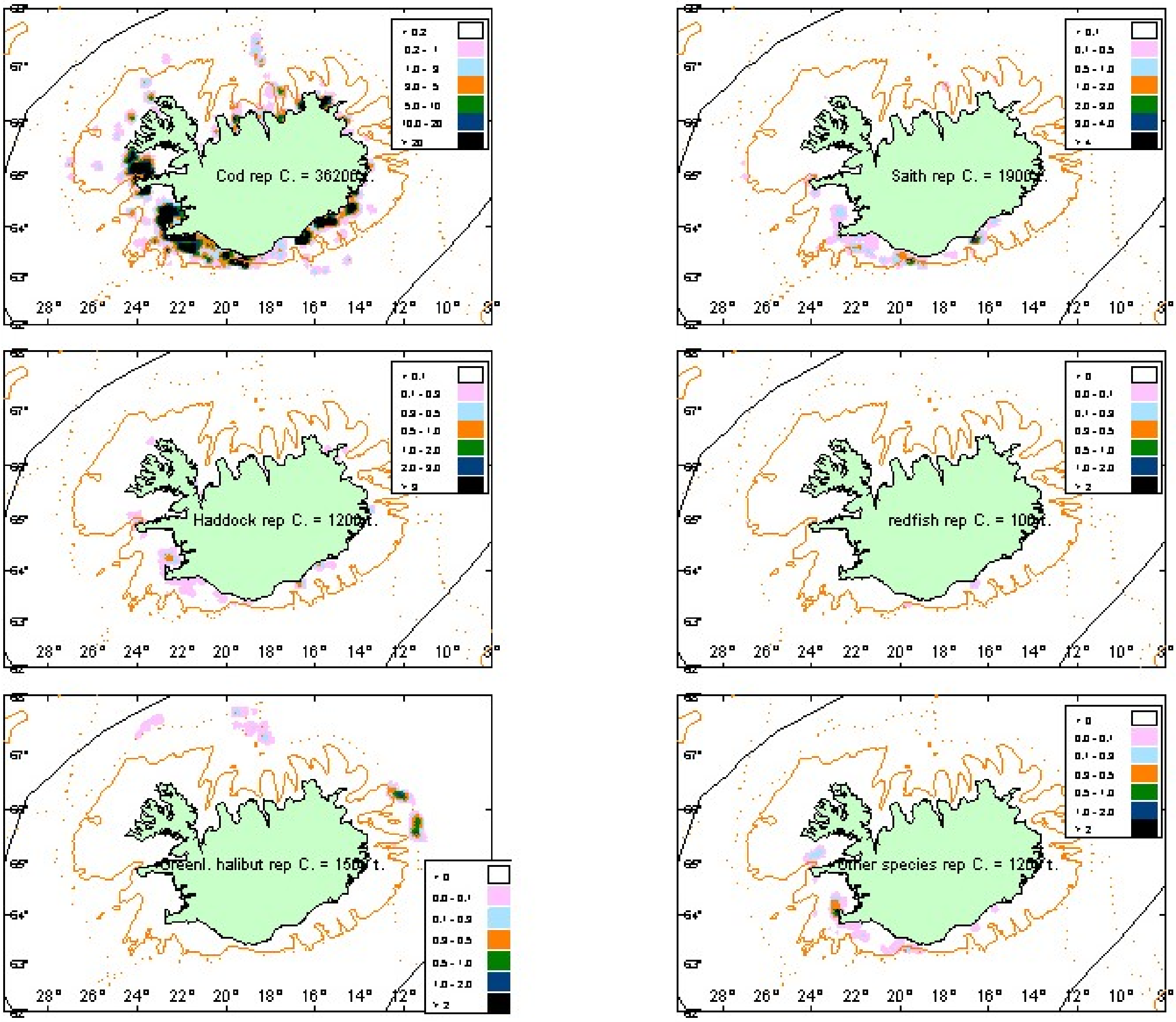

Figure 3.2.2.3 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with gillnets in 2003.

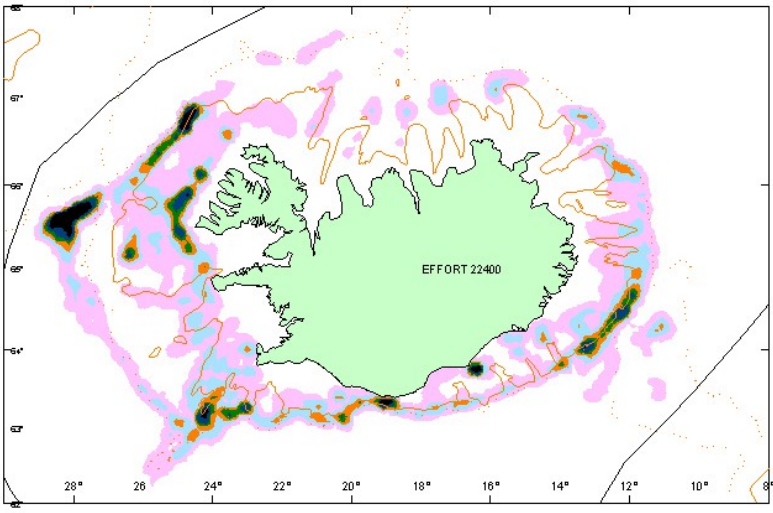

Figure 3.2.2.4 Effort of the trawler fleet in 2003. The dark colours show the areas of the greatest fishing effort to be off the southeast to the west coast and off Northwest Iceland.

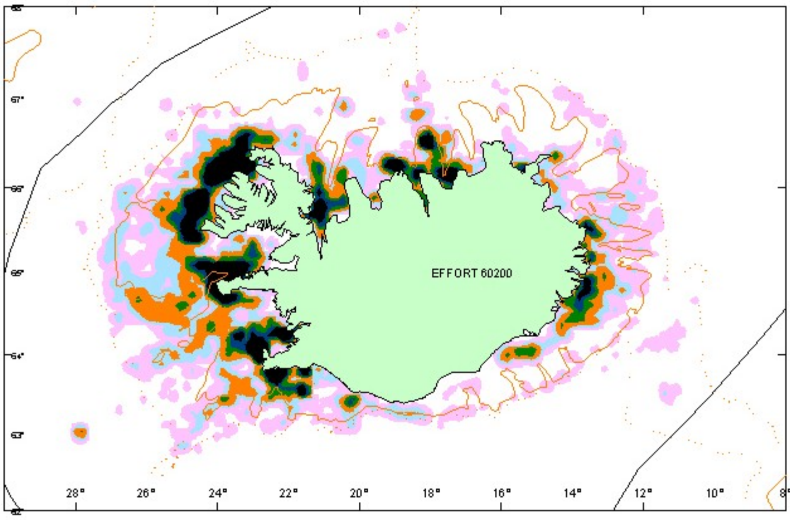

Figure 3.2.2.5 Effort in the longline fleet in 2003. The dark colours show the areas of the greatest fishing effort to be off the northwest and west coast, but fishing is also concentrated along the entire southwest and south coast. The main targeted species for longline fishing are cod, haddock, catfish and tusk.

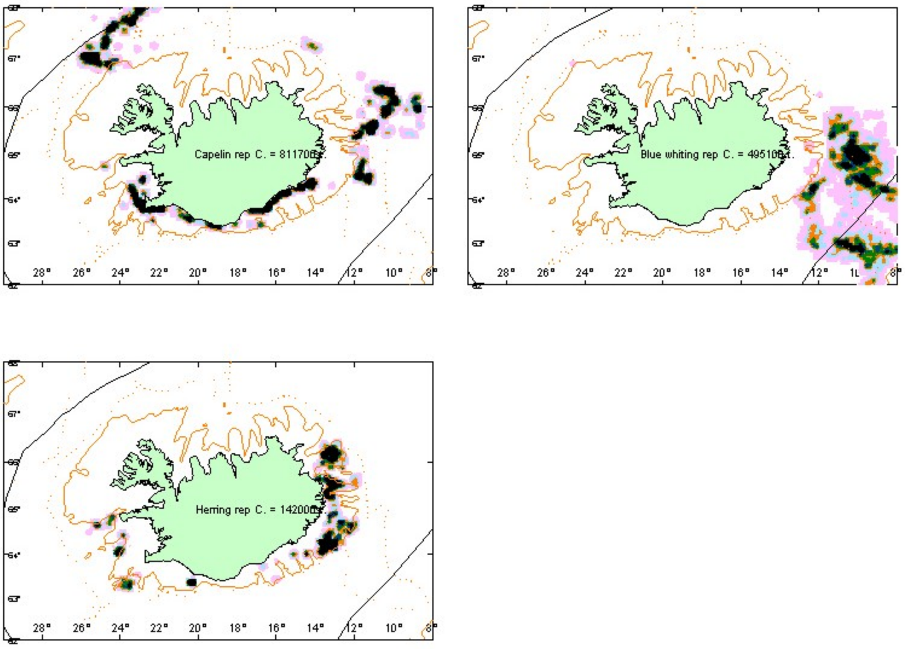

Figure 3.2.2.6 Location of catches of capelin, Icelandic spring-spawning herring, and blue whiting with purse seine and pelagic trawls in 2003.

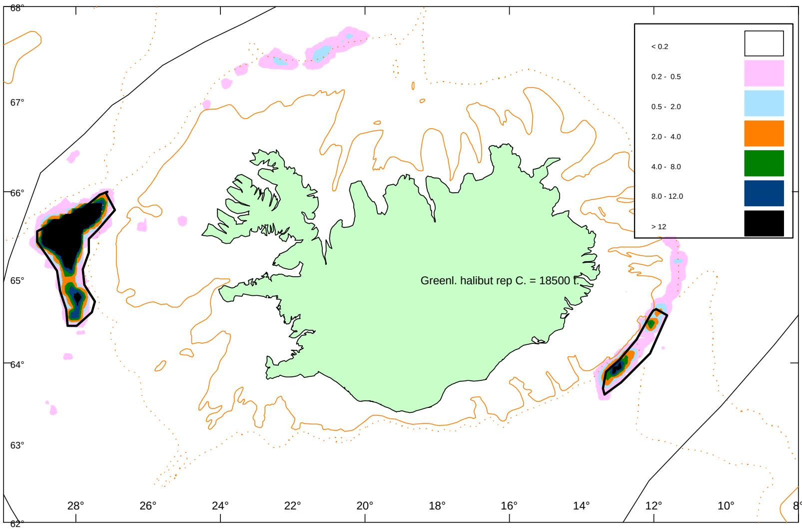

Figure 3.2.2.7 Greenland halibut catches in 2003. The boxed-in areas are the ones referred to in Table 3.2.2.2.

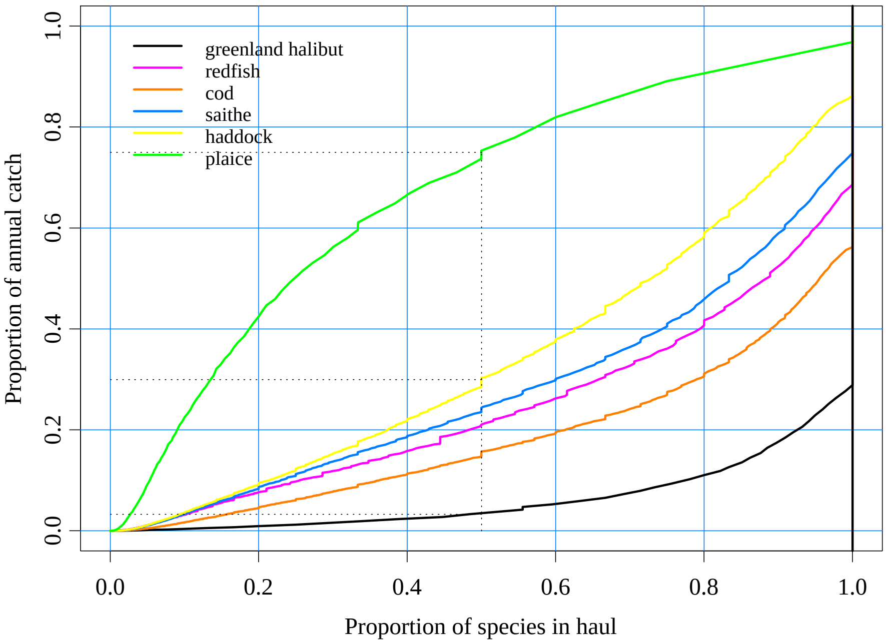

Figure 3.2.3.1.1 Cumulative plot for bottom trawl in 2003. This is probably best described by an example. Looking at the figure above it can be seen from the dashed lines that 30% of the catch of haddock comes from hauls where haddock is less than 50% of the total catch, while only 4% of the catch of Greenland halibut comes from hauls where it is less than 50% of the total catch. 75% of the plaice is on the other hand caught in hauls where plaice is a minority of the catches. The figure also shows that 70% of the catch of Greenland halibut comes from hauls where nothing else is caught, while the similar percentage for haddock is 15%. Of the species shown in the figure plaice is the one shown as the largest bycatch proportion, while Greenland halibut is the largest bycatch proportion caught in mixed fisheries

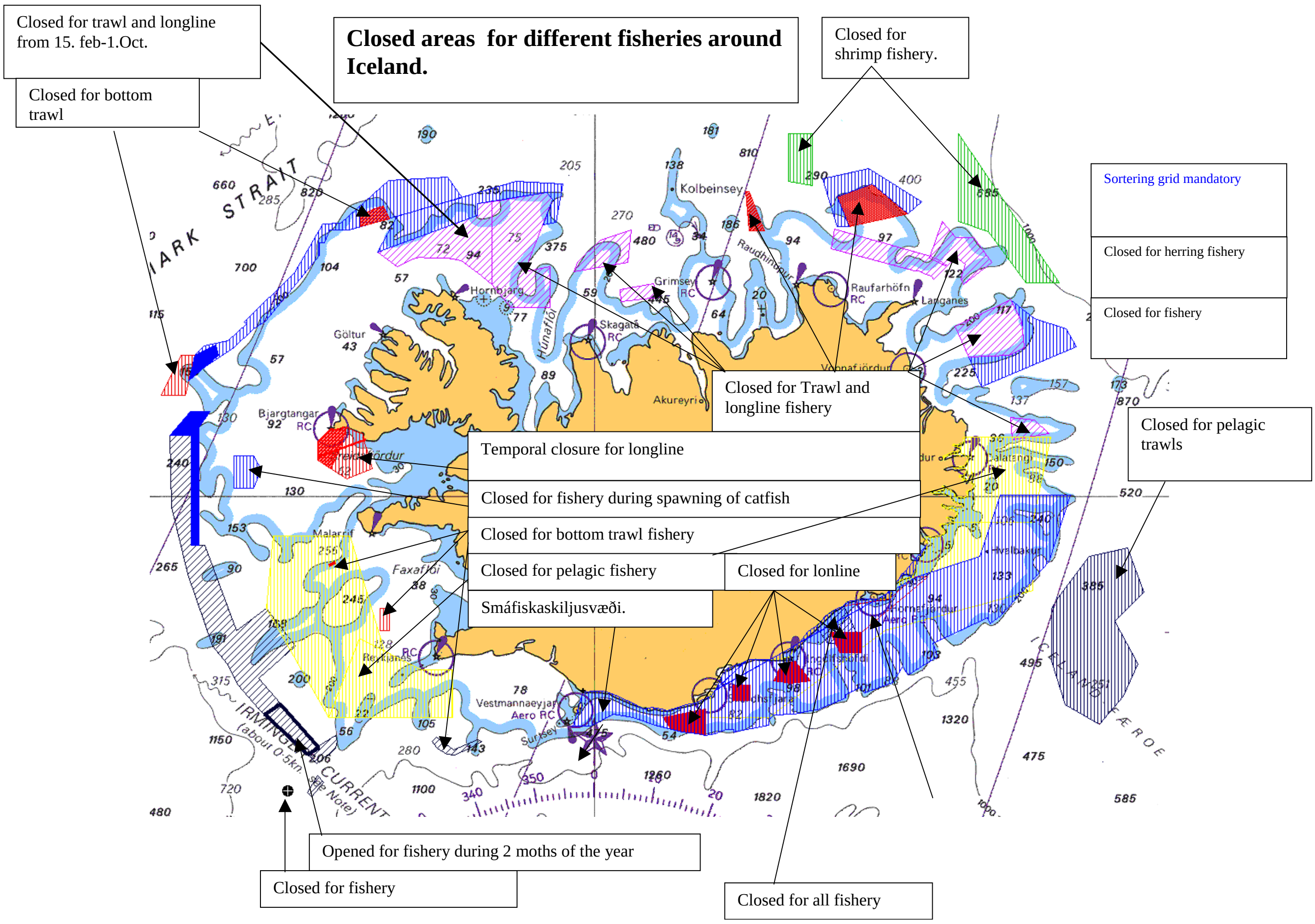

Figure 3.2.3.1.2 Overview of closed areas around Iceland in 2003. The boxes are of a different nature and can be closed for different time periods and gear type.

3.3 Faroe Islands (Division Vb)

3.3.1 The ecosystem

The waters around the Faroe Islands are in the upper 500 m dominated by the North Atlantic current, which to the north of the islands meets the East Icelandic current. Clockwise current systems create retention areas on the Faroe Plateau (Faroe shelf) and on the Faroe Bank. In deeper waters to the north and east is deep Norwegian Sea water, and to the south and west is Atlantic water. From the late 1980s the intensity of the North Atlantic current passing the Faroe area decreased, but it has increased again in the most recent years. The productivity of the Faroese waters was very low in the late 1980s and early 1990s. This applies also to the recruitment of many fish stocks, and the growth of the fish was poor as well. From 1992 onwards the conditions have returned to more normal values, which is also reflected in the fish landings. There has been observed a very clear relationship, from primary production to the higher trophic levels (including fish and seabirds), in the Faroe shelf ecosystem, and all trophic levels seem to respond quickly to variability in primary production in the ecosystem (Gaard, E. et al. 2001).

The primary production of the Faroe Shelf ecosystem may vary by as much as a factor of five. Steingrund & Gaard (submitted) has demonstrated a relationship between primary production and recruitment and growth (production) of cod; this could have pronounced effects on catchability and stock assessment as a whole. For cod there seems to be an inverse relationship between primary production and fishing mortality in recent years. The growth of cod seems to be negatively correlated with the catchability of longlines, suggesting that cod prefer longline baits when natural food abundance is low. Since longliners usually take a large proportion of the cod catch, the total fishing mortality fluctuates in the same way as the longline catchability and thus there is a negative relationship between cod growth and fishing mortality.

For haddock there may be a similar mechanism as for cod since there are indications that growth and fishing mortality is inversely related, at least in recent years.

For saithe no clear relationship was observed between the catchability for Cuba trawlers (pair trawlers take the majority of the catch) and other variables such as primary production, growth, and stock size.

3.3.2 The human use of the ecosystem Fisheries

The fisheries and their impact

The total demersal catches decreased from 120 000 t in 1985 to 65 000 t in 1993, but have since increased again to about 100 000 t in 1997–1999; the 2003 demersal catch was above 120 000 t. The decrease was mainly due to lower catches of cod, haddock, and saithe.

Part of the catches of mackerel, Norwegian spring-spawning herring and blue whiting are taken around the Faroe Islands. The catches of these species are reported together with the catches from other areas in the section on widely migrating stocks, see Section 3.9.

The main fisheries in Faroese waters are mixed-species, demersal fisheries and single-species, pelagic fisheries. The demersal fisheries are mainly conducted by Faroese fishermen, whereas the major part of the pelagic fisheries is conducted by foreign fishermen licensed through bilateral and multilateral fisheries agreements.

The longliners fish mainly cod and haddock; in addition, some longliners fish in deep water for ling and tusk. Most of the trawlers fish cod, haddock, and saithe, while some large trawlers fish in deeper waters for redfish, blue ling, Greenland halibut, and occasionally grenadier and black scabbardfish. The jiggers fish mainly saithe and cod. Recently, gillnet fisheries for Greenland halibut and anglerfish and a directed pair trawler fishery for argentines have been introduced.

Pelagic fisheries. Three main species of pelagic fish are fished in Faroese waters: blue whiting, Norwegian spring-spawning herring, and mackerel; several nations participate. The assessment and status of these stocks are discussed as “widely migrating stocks”, see Section 3.9, as these fish occur in major parts of the Northeast Atlantic. The Faroese pelagic fisheries are almost exclusively conducted by purse seiners and larger purse seiners also equipped for pelagic trawling. The pelagic fishery by Russian vessels is conducted by large factory trawlers. Other countries fishing for these fish in the Faroese ecosystem use purse seiners and factory trawlers. These fleets fish the pelagic stocks in other areas as well.

Demersal fisheries. Although they are conducted by a variety of different vessels, the demersal fisheries can be grouped into fleets of vessels operating in a similar manner. Some vessels change between longlining, jigging and trawling, and they can therefore appear in different fleets.

The small boats fishing in these waters are Faroese. The fleets of other countries are longliners > 110 GRT and otter board trawlers with more than 1000 HP.

Open boats. These vessels are below 5 GRT. They use longline and to some extent automatic, jigging engines and operate mainly on a day-to-day basis, targeting cod, haddock, and to a lesser degree saithe. The large number of open boats participating in the fisheries (above 1400 licenses) are often operated by non-professional fishermen.

Smaller vessels using hook and line. This category includes all the smaller vessels, between 5 and 110 GRT operating mainly on a day-to-day basis, although the larger vessels behave almost like the larger longliners above 110 GRT with automatic baiting systems and longer trips. The area fished is mainly nearshore, using longline and to some extent automatic, jigging engines. The target species are cod and haddock. The number of licenses is about 90.

Longliners > 110 GRT. This group refers to vessels with automatic baiting systems. The main species fished are cod, haddock, ling, and tusk. The target species at any one time is dependent on season, availability, and market price. In general, they fish mainly for cod and haddock from autumn to spring and for ling and tusk during the summer. During summer they also make a few trips to Icelandic waters. There are 19 Faroese vessels in this fleet. Vessels of the same type as the Faroese longliners larger than 110 GRT from other countries (mainly Norway) also fish in these waters. They target mainly ling and tusk with bycatches of cod, haddock and blue ling. Norway has in the bilateral fishery agreement with the Faroe Islands obtained a total quota of these species; numbers of vessels can vary from year to year.

Otter board trawlers < 500 HP. This refers to smaller fishing vessels with engine powers up to 500 Hp. The main areas fished are on the banks outside the areas closed for trawling. They mainly target cod and haddock. Some of the vessels are licensed during the summer to fish within the twelve nautical mile territorial fishing limit, targeting lemon sole and plaice.

Otter board trawlers 500-1000 HP. These vessels fish mainly for cod and haddock. They fish primarily in the deeper parts of the Faroe Plateau and the banks to the southwest of the islands.

Otter board trawlers >1000 HP. These vessels, also called the deepwater trawlers, consist of 13 vessels. They target several deepwater fish species, especially redfish, blue ling, Greenland halibut, grenadier, and black scabbard fish. Saithe is also a target species and in recent years they have been allocated individual quotas for cod and haddock on the Faroe Plateau. Vessels flying the flags of France, Germany, Greenland, United Kingdom, mainly otter board trawlers of the same type as the Faroese otter board trawlers also fish around the Faroe Islands. The smaller of these vessels, mainly from the United Kingdom and Greenland, target cod, haddock, and saithe, whereas the larger vessels, mainly French and German trawlers, target saithe and deep-sea species like redfish, blue ling, grenadier, and black scabbardfish. As for the longliners, these vessels fish under a bilateral fishery agreement with the Faroes, obtaining a total quota of these species; the numbers of vessels can vary from year to year.

Pair trawlers <1000 HP. These vessels fish mainly for saithe, however, they also have a significant bycatch of cod and haddock. The main areas fished are the deeper parts of the Faroe Plateau and the banks to the southwest of the islands.

Pair trawlers >1000 HP. This category targets mainly saithe, but their bycatch of cod and haddock is important to their profit margin. In addition, some of these vessels during the summers have special licenses to fish in deep water for greater silver smelt. The areas fished by these vessels are the deeper parts of the Faroe Plateau and the banks to the southwest of the islands. The number of vessels in the two pair trawlers fleets is 31.

Gillnetting vessels. This category refers to vessels fishing mainly Greenland halibut and monkfish. They operate in deep waters off the Faroe Plateau, Faroe Bank, Bill Bailey's Bank, Lousy Bank, and the Faroe-Iceland Ridge. This fishery is regulated by the number of licensed vessels (8) and technical measures like depth and gear specifications.

Jiggers. Consist of a mixed group of smaller and larger vessels using automatic jigging equipment. The target species are saithe and cod. Depending on availability, weather, and season, these vessels operate throughout the entire Faroese region. Most of them can change to longlines and in recent years jigging effort has decreased as compared to longlines.

Poor recruitment in the late 1980s combined with high fishing effort reduced the SSBs of Faroe Plateau cod and Faroe haddock to low levels, and in the period 1993–1995 ICES considered these stocks to be well below minimum biologically acceptable levels and consequently advised no fishing. Both stocks have since increased due to improved recruitment and growth. The SSBs are now above the precautionary SSB levels ($\mathbf{B}_{pa}$). The fishing mortality on both Faroe Plateau cod and Faroe haddock was reduced during the crisis in first half of the 1990s and has since then increased and is now above the precautionary level ($\mathbf{F}_{pa}$). The Faroe Bank cod stock seems to be at or slightly above average. The SSB of Faroe saithe has been increasing from the record low in 1992 to above the $\mathbf{B}_{pa}$ in 1998–2003. The fishing mortality is above the precautionary level ($\mathbf{F}_{pa}$).

The 2004 assessment confirms the high fishing mortalities on cod estimated in the 2003 assessment. In addition, cod biomass is estimated to have decreased markedly as opposed to the increasing trend in the 2003 assessment. Since the 1999 year class now is estimated considerable smaller than last year, the cod biomass is expected to decrease further, possibly close to levels seen in the early 1990s. The haddock and saithe biomasses are high and recent recruitments seem good.

3.3.3 Assessments and advice

3.3.3.1 Advice regarding biota and habitats

3.3.3.2 Fisheries advice

Mixed fisheries and fisheries interactions

The pelagic fisheries exploit stocks that occur widely in the Northeast Atlantic. Since these fisheries are single-species fisheries, management of these stocks should be done based on single-species upper boundary considerations and should consider exploitation in all areas where these stocks are fished, see Section 3.9.

Most demersal fisheries are mixed species fisheries; exceptions are gillnet fisheries for Greenland halibut and gillnet fisheries for anglerfish where bycatches are small.

Some of the demersal stocks are local, whereas others like Greenland halibut, anglerfish, redfish, and most deep-sea stocks occur over a wider area than the Faroese waters and management of them should consider exploitation in all areas where these stocks are fished.

At present, only a few stocks are assessed among those currently exploited in Faroese waters. Proper mixed fisheries considerations should include several other species that are not currently assessed. If proper fishery-based advice taking mixed fisheries issues into account should be given for the fishery in Vb, ICES would need to evaluate the status of these stocks.

In the present management regime, the stocks of cod, haddock, and saithe are regulated by gear and fleet specifications, area closures, and number of fishing days. Consequently, the status of each of the stocks must be taken into account in the regulation. Several of the fisheries could be described as mixed cod-haddock fisheries (i.e. the longline fisheries), whereas others (i.e. pairtrawlers and occasionally single trawlers) are saithe fisheries with bycatches of cod and haddock.

Single-stock exploitation boundaries and critical stocks

The state of stocks and single stock exploitation boundaries are summarised in the table below.

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
Faroe Plateau cod	Increased risk	Harvested unsustainably	Overfished	Reduce effort by at least 50%	Reduce effort by at least 65%		Rebuilding plan that should at least reduce the fishing mortality to the $\mathbf{F_{pa}}$ level. This would amount to an effort reduction in the neighbourhood of 2/3 compared to the recent level.
Faroe Bank cod	-	-		-	-		Effort not to exceed that of 1996-2002
Faroe Haddock	Acceptable	Increased risk		The management objectives are an exploitation rate equivalent to a fishing mortality of 0.45 on average. The current F estimate is uncertain but likely to be below the management target	Reduce effort by at least 17%		Fishing effort be reduced to correspond to a fishing mortality below $\mathbf{F_{pa}}$=0.25, corresponding to an effort reduction of about 17% ~ 19 000 t
Faroe Saithe	Acceptable	Increased risk	-	The management objectives are an exploitation rate equivalent to a fishing mortality of 0.45 on average. The current F is estimated around that management target. The present effort can be maintained.	Reduce effort by at least 30%		Fishing effort in 2004 should be reduced to a level corresponding to a fishing mortality below $\mathbf{F_{pa}}$ = 0.28, corresponding to an effort reduction of about 30% ~ 32 000 t. The present spawning closures should be maintained.

Advice for fisheries management

The Faroese effort management system links fishing mortality on the demersal stocks, i.e. that the effort level (number of fishing days) concurrently determines the fishing mortality on all three demersal stocks. The fishery for haddock and cod are closely linked. The fishery for saithe is a more directed fishery, albeit with bycatch of cod and haddock.

Fishing mortality for the Faroe Plateau cod in 2003 is more than twice the level that is recommended based on precautionary principles. For haddock and saithe the present fishing mortality is also above the precautionary level.

Therefore, ICES recommends a reduction of the fishing effort directed at cod and haddock in the neighbourhood of 2/3. For the saithe fisheries ICES recommends that effort be reduced by around 30%. This effort is predicated on the present low bycatch of cod and haddock in the saithe fisheries. If the bycatch of cod or haddock is observed to increase in the saithe fishery, then effort will have to be reduced proportional to the increase in bycatch rate. For Faroe Bank cod effort should be reduced to the 1996-2002 level.

Regulations in force and their effects

The catch quota management system introduced in the Faroese fisheries in 1994 was met with considerable criticism and resulted in discarding and in substantial misreporting of the catches. Reorganisation of enforcement and control did not solve the problems. As a result of the dissatisfaction with the catch quota management system, the Faroese Parliament discontinued the system as from 31 May 1996. In close cooperation with the fishing industry, the Faroese government has developed a new system based on individual transferable effort quotas in days within fleet categories. The new system entered into force on 1 June 1996. The fishing year from 1 September to 31 August, as introduced under the catch quota system, has been maintained.

The key elements in the Faroese fisheries management of the demersal stocks are:

1. A separation of the fishing vessels into fleet segments that are based on physical vessel attributes, mainly size (GRT and HP) and vessel types (trawlers, longliners etc.). The fleet segmentation is a central element in controlling capacity, effort and the fishing pattern.

2. A capacity policy aiming at maintaining the fleet capacity at the 1997 level. The capacity is in principle maintained within each fleet segment, but there are rules for allowing vessel transfers between groups (e.g. in conjunction with vessel replacement). The capacity policy is based on vessel licenses.

3. An effort system that allots a total number of fishing days for the coming fishing year to each of the fleet segments. The total fleet segment effort is subsequently divided between the individual vessels. Except for the small scale coastal fishery the general rule is that all vessels within the fleet segment gets an equal share. The small scale coastal fishery (fleet segment 5B) fishes on a common effort quota. The fishing days may be traded within fleet segments and with some restrictions between segments. The effort regulation is maintained through a fishing license system.

4. A complex system of area closures that regulates access to the fishing grounds for the various fleet segments. The main restrictions are: The trawlers are generally not allowed to fish within the 12 nautical mile limit and within other areas closed to trawlers, implying that large areas shallower than 200 m are closed to trawling. There are exceptions for small trawlers that are allowed a summer fishery for flatfish on the plateau. The near-shore area (inside the 6 nm line) is closed to the larger longliners. Gillnetters are only allowed to fish at depths deeper than 350 m.

5. A number of supplementary technical regulations such as: Spawning area closures, minimum mesh sizes, sorting grids, real-time closures to protect small fish, and minimum landing sizes. The Faroe Bank shallower than 200 m is closed to trawling.

The fleet segmentation used to regulate the demersal fisheries in the Faroe Islands and the regulations applied are summarised in Table 3.3.3.1.

The single trawlers that target deepwater resources (redfish, saithe, blue ling, Greenland halibut, and others) are not covered by the effort regulation, and catches of cod and haddock are limited by maximum bycatch allocation. Similarly, the gillnetters that target monkfish and Greenland halibut are not included in the effort system – their catch of cod, haddock, and saithe is almost nil due to the depth of fishing and the large mesh sizes. One fishing day by longliners is considered equivalent to two fishing days for jiggers in the same size category. Longliners could therefore double their allocation by converting to jigging. Holders of individual transferable effort quotas who fish outside this line can fish for 3 days outside for each day allocated inside the line. The effort history and allocation of effort is summarised in Tables 3.3.3.2 and 3.3.3.3.

The allocations of number of fishing days by fleet categories was made such that together with other regulations of the fishery they should result in average fishing mortalities on each of the 3 stocks of 0.45, corresponding to average annual catches of 33% of the exploitable stocks in numbers. Built into the system is also an assumption that the day system is self-regulatory, because the fishery will move between stocks according to the relative availability of each of them and no stock will be overexploited.

The management system with individual transferable days introduced in 1996 had as an objective to maintain the fishing mortality at an average of 0.45 for both plateau cod, haddock, and saithe. The current assessment shows that saithe and haddock have on average been harvested within this objective, whereas for cod the fishing mortality has exceeded the objective and in the most recent years has been around double of the target.

The fishing law also prescribes the percentage of total catches of cod, haddock, saithe, and redfish, which each fleet category on average is allowed to fish. However, these percentages are of little practical importance since they have not been used directly in the regulations since the abolishment of the quota system after the fishing year 1995-96. These percentages are as follows:

Fleet category	Cod	Haddock	Saithe	Redfish
Longliners < 110GRT, jiggers, single trawl. < 400HP	51%	58%	17.5%	1%
Longliners > 110GRT	23%	28%		
Pairtrawlers	21%	10.25%	69%	8.5%
Single trawlers > 400 HP	4%	1.75%	13%	90.5%
Others	1%	2%	0.5%	0.5%

An overview of the average catchability of the principal fleets for the three major stocks in Division Vb does not indicate any long-term positive or negative trends in catchability for the period 1985 to 2003. Natural factors may have a larger influence than technological, at least for Faroe cod and haddock, where the longline fishing constitutes a large part of the catch. Hence the short-term trends in the catchability of both cod and the haddock may be a result of variability in the productivity in the ecosystem as explained above.

Under effort management there are incentives for vessels to optimise their catch and its value per effort unit through an increase of efficiency (catchability). This introduces “Technological creeping” which has been demonstrated for many fishing fleets. Such “creeping” needs therefore to be monitored closely and accounted for in the regulations.

The relative prices for the three commercial fish species (cod, haddock, and saithe) are important. In 2003, the price for cod has been substantially higher than for haddock and saithe which may have contributed to an increased targeting and high fishing mortality for this species in 2003. The relative prices will shift fishing focus from one stock to the other.

Quality of assessments and uncertainties

The resources in the area have in general been managed on the basis of long time-series of commercial catch-at-age information. There are two annual ground fish surveys available from the mid-1990's. Several commercial CPUE series are available. The commercial CPUE series include larger vessels (fleet segments 1-3) only and are based on logbooks from a few selected vessels that are considered representative for the fleets. Detailed CPUE statistics that cover the majority of all fishing operations exist but are not at present available for assessment. This impedes a comprehensive analysis of the development in catchabilities that is necessary to evaluate the implementation of the effort system used in the Faroes.

Except for some selected fisheries, no estimates of discards are available. However, since almost no quotas are used in the management of the demersal fisheries, the incentives to discard in order to highgrade the catches should be low. Moreover, according to Faroese legislation, all discarding is banned. The landings statistics are therefore regarded as being adequate for assessment purposes.

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Table 3.3.3.1 Main regulatory measures by fleet in the Faroese fisheries.

Fleet segment		Sub groups		Main regulation tools
1	Single trawlers > 400 HP	*none*		Bycatch quotas, area closures
2	Pair trawlers	*none*		Fishing days, area closures
3	Long-liners > 110 GRT	*none*		Fishing days, area closures
4	Coastal vessels>15 GRT	4B	Trawlers > 40 tonnes	Fishing days
		4B	Longliners>40 tonnes	Fishing days
		4A	Trawlers< 40 tonnes	Fishing days
		4A	Longliners<40 tonnes	Fishing days
5	Coastal vessels <15 GRT	5A	Full-time fishers	Fishing days
		5B	Part-time fishers	Fishing days
6	Others		Gillnetters	Bycatch limitations, fishing depth, no. of nets
			Others	Bycatch limitations

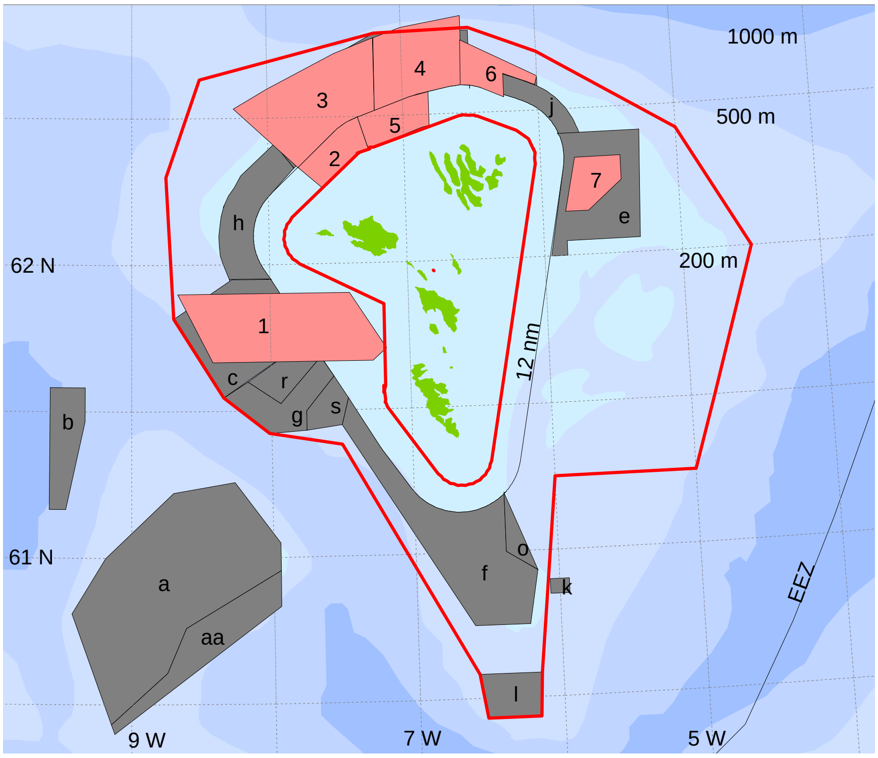
Table 3.3.3.2 Number of fishing days used by various fleet groups in Vb1 1985-1995 and 1998-2003. For other fleets there are no effort limitations. Catches of cod, haddock, saithe, and redfish are also regulated by bycatch percentages given in the text. In addition there are special fisheries regulated by licenses. (This is the real number of days fishing not affected by doubling or tripling of days by changing areas/gears).

(This is the real number of days fishing not affected by doubling or tripling of days by changing areas/gears)			
Year	Longliner 0-110 GRT, jiggers, trawlers < 400 HP	Longliners > 110 GRT	Pairtrawlers > 400 HP
1985	13449	2973	8582
1986	11399	2176	11006
1987	11554	2915	11860
1988	20736	3203	12060
1989	28750	3369	10302
1990	28373	3521	12935
1991	29420	3573	13703
1992	23762	2892	11228
1993	19170	2046	9186
1994	25291	2925	8347
1995	33760	3659	9346
Average(85-95)	22333	3023	10778
1998	23971	2519	6209
1999	21040	2428	7135
2000	24820	2414	7167
2001	29560	2512	6771
2002	30333	2680	6749
2003*	27642	2196	6624
Average(98-01)	25945	2458	6776

* Preliminary, not all days included

Table 3.3.3.3 Number of allocated days inside the outer thick line in Figure 3.3.3.1 for each fleet group since the new management scheme was adopted, and the number of licenses per fleet.

	Fleets	1996/1997	1997/1998	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	No. of licenses
Group 1	Single trawlers > 400 HP	Regulated by area and by-catch limitations								13
Group 2	Pair trawlers > 400 HP	8225	7199	6839	6839	6839	6839	6771	6636	28
Group 3	Longliners > 110 GRT	3040	2660	2527	2527	2527	2527	2502	2452	19
Group 4	Longliners and jiggers 15-110 GRT, single trawlers < 400 HP	9320	9328	8861	8861	8861	8861	8772	8597	106
Group 5	Longliners and jiggers < 15 GRT	22000	23625	22444	22444	22444	22444	22220	21776	>1400



Closed areas to trawlings

Areas inside the 12 nm zone closed year round

Area	Period
a	1 jan- 31 des
aa	1 jun – 31 aug
b	20 jan- 1 mar
c	1 jan- 31 des
d	1 jan- 31 des
e	1 apr- 31 jan
f	1 jan- 31 des
g	1 jan- 31 des
h	1 jan- 31 des
i	1 jan- 31 des
j	1 jan- 31 des
k	1 jan- 31 des
l	1 jan- 31 des
m	1 feb- 1 jun
n	31 jan- 1 apr
o	1 jan- 31 des
p	1 jan- 31 des
r	1 jan- 31 des
s	1 jan- 31 des

Spawning area closures

Area	Period
1	15 feb-31 mar
2	15 feb- 15 apr
3	1 feb- 1 apr
4	15 jan- 15 mai
5	15 feb- 15 apr
6	15 feb- 15 apr
7	15 jan- 1 apr

Figure 3.3.3.1 Fishing area regulations in Division Vb. Allocation of fishing days applies to the area inside the outer thick line on the Faroe Plateau. Holders of effort quotas who fish outside this line can triple their numbers of days. Longliners larger than 110 GRT are not allowed to fish inside the inner thick line on the Faroe Plateau. If longliners change from longline to jigging, they can double their number of days. The Faroe Bank shallower than 200 m depths (a, aa) is

3.4 The North Sea (Subarea IV)

3.4.1 The human use of the ecosystem

The fisheries and their impact

The fisheries in the North Sea can be grouped into demersal and pelagic human consumption fisheries and into industrial fisheries, which land their catch for industrial purposes. Demersal human consumption fisheries usually target a mixture of roundfish species (cod, haddock, whiting), or a mixture of flatfish species (plaice and sole) with a bycatch of roundfish. A fishery directed at saithe exists along the shelf edge. The catch of these fisheries is landed for human consumption. The pelagic fisheries mainly target herring, mackerel, and horse mackerel. Although most of the landings of these species may be landed for human consumption purposes, part of the landings are used for fishmeal and fishoil. The catch of the industrial fisheries mainly consists of sandeel, Norway pout, and sprat. The industrial catches also contain bycatches of other species, including herring, haddock, and whiting (Table 3.4.1.1). In addition to the finfish fisheries, smaller fleets exist which fish for crustaceans, including *Nephrops*, *Pandalus,* and brown shrimp (*Crangon crangon*).

Each fishery uses a variety of gears. Demersal fisheries: otter trawls, pair trawls, twin trawls, seines, gillnets, and beam trawls. Pelagic fisheries: pelagic trawls and purse seines. Industrial fisheries: small-meshed otter trawls, pelagic trawls, and purse seines.

Some major technological developments changed the fisheries in the North Sea during and after the 1960s such as the development of the beam trawl fishery for flatfish, purse seines in the pelagic fishery, and large pelagic trawls to replace driftnets. In recent years twin trawls have been introduced in the fishery for flatfish and roundfish. The introduction of power blocks in the 1960s has enormously increased the possibilities for the purse seiners. Right up to the present time further development of electronic equipment such as satellite navigation, fish finders, and sonar has increased the fishing efficiency of the fleets.

The trends in landings of the most important species landed by these fleets since 1970, together with the total international landings, are shown in Table 3.4.1.2 and in Figure 3.4.1.1. The demersal landings have steadily declined over the period. The pelagic landings, dominated by herring, decreased to a minimum in the late 1970s, when the fishery for herring was closed, but increased again up to over 1 million t in the period 1987–1995. In 1996 they were reduced by about half and have remained stable since then. The landings in the industrial fisheries increased to approximately 1.5 million t in the mid-1970s, and have fluctuated around 1 million t from 1980 onwards. These landings show the largest annual variations, due to the short life span of the species. The industrial landings have suddenly dropped to below 400 thousand tonnes in 2003. Total landings from the North Sea reached 3 million t in the early 1970s and the late 1980s. Landings have been just above 2 million t in the second half of the 1990s.

Landings by fleet segment in the North Sea demersal fisheries in 2003 are shown in Table 3.4.1.3 (a,b). This table allows a comparison to be made between different fleet segments. Discard estimates are included in the table, but in many cases the estimates of discards are based on extrapolations from other gears or fleets.

Landings by fleet segment in the plaice fisheries in IIIa and VIId in 2003 are shown in Tables 3.4.1.4 and 3.4.1.5.

Most commercial species are managed by TAC/quota regulations that apply to Subarea IV or a combination of Subarea IV with an adjacent area. The national management measures with regard to the implementation of the quota in the fisheries differ between species and countries. The industrial fisheries are subject to regulations for the bycatches of protected species.

Stock status

In the past 10 years the state of the stock for most roundfish and flatfish species in the North has further deteriorated. Some of these stocks have reached a historical low within this period. One of the major causes of this deterioration is the continuous very high level of exploitation. This exploitation has lead to a reduction in the number of age groups in the stocks and fishing opportunities have consequently become more dependent on the success of recruitment. Recruitment for most stocks is very variable. For a number of species (cod, plaice) recruitment in the recent decade has been lower than in previous decades. At the same time it is observed that a number of species (cod, haddock, whiting, sole, plaice) simultaneously show a reduction of growth. Southern species like sea bass and red mullet have increased in the North Sea and have sometimes attracted a new fishery. There is considerable speculation on the reasons for the observed changes. The reduction in recruitment can be explained by a reduction in the production of eggs by the reduced spawning stocks, but it cannot be excluded that changes in the environment play a role. In the past 10 years the climate has changed not only on land but also in the sea, and mean temperatures in the sea have increased. Changes in the sea currents have also been observed. The changes in environmental conditions may also be responsible for changes in the distribution and abundance of the different species.

All roundfish and flatfish stocks in the North Sea have been exposed to high levels of exploitation. The present assessments indicate that the average fishing mortality in the last three years has been reduced for cod, haddock, saithe, sole, and plaice (human consumption fishing mortality only).

Multispecies assessments have shown that there are indications of changes in natural mortality for a number of North Sea stocks. For haddock and cod these changes entail a reduction in natural mortality on the youngest ages due to a reduction in fish-predator abundances, and an increase in natural mortality on older ages due to increased abundance of grey seals. The single-species assessment models are only moderately affected by incorporating time-varying estimates in natural mortality and the assessments put forward by ICES do not include time-varying natural mortality.

Several technical measures have been implemented in the mixed demersal fisheries in the North Sea in 2001 and onwards. If implemented effectively, these measures are likely to impact the exploitation patterns on roundfish and to a lesser extend flatfish. The effects of the new technical measures have so far been observed only to a limited extent in changes in selection patterns or in weights-at-age in the landings.

The herring stock in the North Sea collapsed in the mid-1970s due to heavy exploitation, but has recovered after a closure of the fisheries between 1977 and 1981. In the mid-1990s it declined again. In 1996, effective management measures have been implemented to reduce the catches in both human consumption and industrial fisheries. These measures resulted in a considerable reduction in the fishing mortality in 1996–2001. Additionally, the North Sea autumn-spawning herring showed a very high recruitment over a number of years. The stock has been below B_{pa} **until 2002, but has now recovered and is expected to increase further until the recent weak year classes enter the fishery. The herring stock is exploited in the North Sea and the Channel (Downs herring) by human consumption fisheries. Bycatches of juvenile North Sea herring are taken in the industrial fishery for sprat in the North Sea and Division IIIa (Skagerrak/Kattegat). The sprat stock fluctuates considerably between years. The actual state of the sprat stock is not precisely known, but the biomass is thought to be high at present. The North Sea component of the Northeast Atlantic mackerel stock collapsed in the early 1970s and shows no signs of recovery. Most of the mackerel catches taken in the northern North Sea in recent years originate from the western component.**

Reported landings of **cod** in 2003 were 31 000 t. A substantial underreporting of cod is suspected. The assessment this year has included a procedure to estimate unaccounted catches based on the trends in the surveys. The spawning stock in 2004 has been estimated at 46 000 t. This is at the same level as the previous year. Recruitment has been below average since 1985 in all years, with the exception of the 1996 year class. The indications of the most recent year classes are that they are all low. The present assessment indicates that there has been a high fishing mortality in recent years which is decreasing rapidly if unaccounted removals are not included in the assessment but which is only slighly decreasing when unaccounted removals are included, which is considered the more likely case. A recovery plan has recently been agreed for this stock.

The spawning biomass of **saithe** (assessed for the North Sea and West of Scotland combined) has increased substantially in recent years. However, the perceived level of increase is now lower than assumed last year. The 1998 year class is well above average. Fishing mortality has almost continuously declined from the 1980s. Landings in 2003 have decreased to 107 000 t.

Human consumption landings of **haddock** in 2003 were around 70 000 t. Historically, the stock size has shown large variations due to the occasional occurrence of a very strong year class. The 1999 year class is estimated to be very strong and has led to the current large increase in SSB. Other recent year classes are all weak. The present assessment indicates that there has been a strong reduction in fishing mortality in recent years.

The status of the **whiting** stock is unknown. Different sources gave conflicting information on the development of this stock. Total landings have been gradually decreasing since 1976 and the landings in 2003, at 17 500 t, are again the lowest observed in the time-series. All assessments based on catch data indicate a declining stock, whereas the surveys on their own indicate that the stock may have increased over a longer time-scale.

The spawning stock of **plaice** is estimated to be near the lowest observed level historically. Landings have decreased since 1990 and were 66 500 t in 2003. Discards have been included in the assessment. The percentage of discards appears to have increased in recent years. The overall fishing mortality remains too high, but the estimated fishing mortality on landings appears to have decreased since the late 1990s. At its present exploitation rate there is a high probability that the stock will remain below the levels observed in the 1970s and 1980s. The abundant 1996 year class was expected to increase the spawning stock, but a slower growth of this year class and increased discarding has reduced its contribution to the spawning stock. The 2001 year class is also estimated to be strong.

Landings of **sole** were 18 000 t in 2003. The spawning stock reached an historic low in 1998. The stock appears to have recovered due to two strong year classes (1996, 2001). Fishing mortality has reduced in recent years and is now just above $\mathbf{F}_{pa}$.

Landings of **Norway pout** have been very low in recent years. Landings in 2003 were 25 000 t, whereas in 2002 they were still 77 000 t. The spawning stock in 2003 was the lowest in the time-series. Recruitment in recent years has been very low. Fishing mortality has generally decreased between 1974 and 1995 and has since then fluctuated around a low level. The stock dynamics are assumed to be primarily driven by natural forces.

Landings of **sandeel** in 2003 were 310 000 t, which is well below the average landings of this stock. Over the years, the spawning stock has been fluctuating without a trend, but the recent stock is rapidly decreasing and in 2004 came below $\mathbf{B}_{lim}$. There is a need for a harvest-rule for sandeel in combination with in-year monitoring.

The **herring** spawning stock biomass has recovered from a low and is currently considered to be around 2 million tonnes. The stock is expected to remain at this level in the short term. Recruitment of the 2001 and 2002 year classes is well above average. However, the 2003 and 2004 year classes appear to be weak. Catches in the human consumption and industrial fisheries in the North Sea have increased to 450 000 t in 2003 (IV and VIId) following an increase of the TAC.

Landings of **sprat** in 2003 were 177 000 t. The sprat stock is in good condition and biomass seems to have increased in recent years.

The spawning stock of **mackerel** in the North Sea remains small. Recruitment to this stock component has been very low for many years. An egg survey in 2002 estimated a slightly increasing spawning stock size. The fisheries for mackerel in the North Sea rely on a much larger stock component, the western mackerel, which spawns outside the North Sea and which is present in the northern North Sea in the second half of the year. Total landings of mackerel taken from the North Sea were 332 000 t in 2003.

The present state of the North Sea **horse mackerel** stock is not known. The last estimate from egg surveys in 1989–1991 indicated an SSB of about 240 000 t. Catches have increased to 32 000 t in 2003. The age composition and distribution of the catches suggests that the exploitation rate of juvenile fish has increased in recent years.

The *Nephrops* stocks in this area are: *Nephrops* in Division IIIa, *Nephrops* in Division IVa, rectangles 44-48 E6-E7+44 E8 (Management Area F), *Nephrops* in Division IVa, West of 2°E, excluding Management Area F (Management Area G), *Nephrops* in Division IVa, East of 2°E + rectangles 43 F5-F7 (Management Area S), *Nephrops* in Divisions IVb,c, West of 1°E (Management Area I), and *Nephrops* in Divisions IVb,c, East of 1°E, excluding rectangles 43 F5-F7 (Management Area H). Advice and stock status was given in 2003 (ICES CRR 261). They are all harvested sustainably.

The state of individual stocks is presented in more detail in the stock sections (Section 4.4).

3.4.2 Assessments and advice

Effect of fishing on the ecosystem

Sandeel and Norway pout

The apparent strong decline in the stocks of sandeel and Norway pout in the most recent years will have effects on the performance of the North Sea ecosystem. Sandeel and Norway pout are important food species in the North Sea ecosystem. The importance of these species in the food-web and the potential indirect effects of fishing have been discussed earlier by ICES (ICES, 1997a, p.119; and ICES, 2003b, pp. 152–175).

North Sea skates and rays

Skates and rays are taken as accidental bycatch in some demersal fisheries.

Elasmobranchs have been shown generally to have life history traits which make it possible for these species to sustain lower mortality rates than many species of demersal fish (Musick *et al*., 2000), and some species of skates and rays are widely thought to have relatively high catchabilities in fishing gears. This vulnerability to capture and the low rates of sustainable mortality taken together have been proposed as major factors in the severe decline in the common skate from the Irish Sea (Brander, 1981) and trends in a variety of other skates and rays (ICES, 1998; Heessen and Daan, 1996; Walker and Heessen, 1996). In 1998 ICES (ICES, 1998) reported life history-based estimates of the maximum total mortality rates that were sustainable for five species of rays (common skate *Dipturus batis* – 0.38, thornback ray *Raja clavata* – 0.5, spotted ray *Raja montagui* – 0.54, cuckoo ray *Raja naevus* – 0.58, and starry ray *Raja radiata* – 0.87). ICES (WGECO, 1998) also reported that recent estimates of total mortality from survey catch data were greater than the theoretical sustainable mortality rates for three of the five species, and could not be estimated for a fourth because it was reduced to such a low abundance that current mortality rates could not be estimated. However, the link between the long-term declines in abundance of some of these species and the catch and bycatch in fisheries remained circumstantial (although strong), and there was an insufficient basis for including the status of skates and rays directly in ICES catch advice. Instead, ICES (ICES, 1997b) advised that some specified areas of the North Sea should be closed to gears with a high bycatch of these species.

Recently ICES has developed and implemented analytical methods for estimating at least relative catchability of different fish species to different fishing gears (ICES, 2004b). ICES is also in the process of changing the form of advice to advise on fleet-based effort levels consistent with the single-species catch boundaries of the suite of species taken by the fishery. When the methods of estimating catchability have been applied to skates and rays, the combination of fleet-based effort advice and gear-specific catchabilities will allow estimates of the maximum fleet-specific effort levels that can be exerted without exceeding the sustainable mortality rates for skates and rays. Then it will be possible to integrate the fishery and fleet-based catch advice with the need to ensure that impacts on non-target species are also sustainable.

Mixed fisheries and fisheries interactions

Demersal fisheries in the area are mixed fisheries, with many stocks exploited together in various combinations in different fisheries. In these cases management advice must consider both the state of individual stocks and their simultaneous exploitation in demersal fisheries. Stocks in the poorest condition, particularly those outside safe biological limits, become the overriding concern for the management of mixed fisheries where these stocks are exploited either as a targeted species or as a bycatch.

The exploitation of sole and plaice are closely connected as they are caught together in fisheries mainly targeting sole, which are more valuable. This means that the minimum mesh size is decided on basis of the more valuable species, resulting in substantive discards of undersized plaice. The mixed fisheries for flatfish is dominated by a mixed beam trawl fishery using 80-mm mesh in the southern North Sea where up to 80% in number of all plaice caught are being discarded. Measures to reduce discarding in the mixed beam trawl fishery would greatly benefit the plaice stock and future yields.

Roundfish are caught in otter trawl and seine fisheries, with a 120-mm minimum mesh size. This is a mixed demersal fisheries with more specific targeting of individual species in some areas and/or seasons. Cod, haddock, and whiting form the predominant roundfish catch in the mixed fisheries, although there can be important bycatches of other species, notably saithe and anglerfish in the northern and eastern North Sea and of *Nephrops* in the more offshore

Nephrops grounds. Cod and whiting also comprise a bycatch in the beam trawl fisheries. Static gear fisheries with mesh sizes generally in excess of 140 mm are also used to target cod. Saithe in the North Sea are mainly taken in a directed trawl fishery in deeper water near the northern shelf edge and the Norwegian Deeps. There is little bycatch of other demersal species associated with the directed fishery.

For mixed demersal fisheries improvements to gear selectivity, such as increased mesh size or the inclusion of square mesh panels, would contribute to a reduction in discards and better exploitation patterns. Commission regulation (EC) No. 2056/2001 and several UK unilateral measures were evaluated by an EU expert meeting in April 2003 (Anon. 2003). The actual uptake of these measures is still unknown. However, in the case of full uptake it was shown that discards are substantially reduced over both the short and medium term. While for cod and haddock there would be medium-term gains in yield, for whiting, the effects of the gear regulations alone result in immediate and short-term (ca 2–3 years) losses in consumption landings that do not revert to gains in the medium term (ca. 10 years).

Nephrops fisheries take place in discrete areas that comprise an appropriate muddy seabed sediment. Targeted *Nephrops* fisheries on these grounds are taken predominantly in trawls with mesh sizes of around 70 mm using single or multiple-rig trawls. *Nephrops* fishing grounds vary from small, localised inshore grounds to more offshore large areas such as the Fladen Ground in the northern North Sea, and while there is bycatch and discarding of other demersal species associated with *Nephrops*, the general nature of these fisheries and their bycatch can vary widely.

Small-mesh industrial fisheries for sandeel and Norway pout occur separately in the North Sea. Sandeel fisheries take place throughout the North Sea in areas defined by the appropriate sandy seabed sediment. These have a low bycatch rate of important demersal species (Table 3.4.1.1 and 3.4.1.2). Fishing for Norway pout takes place in the northern and northeastern North Sea and has higher bycatch rates of other species such as haddock and whiting (Tables 3.4.1.1 and 3.4.1.2).

The available national logbook data suggest that landed bycatch of fish for human consumption from the *Pandalus* fisheries in Skagerrak and the Norwegian deep amounts to 10–15% of landed shrimp. In the Fladen Ground fishery for *Pandalus* (Danish logbook records) this bycatch varies from 8% to 20% relative to shrimp landings.

In 2002 for the first time, substantial discards of herring in the mackerel fishery have been observed in the 3rd and 4th quarter in the northwestern North Sea. At this time, the quotas for herring were already taken and herring occurred in mixed schools with mackerel. For the following year, the herring TAC has been increased significantly and the mackerel TAC reduced. Sampling of the same fisheries suggested that discarding of herring has reduced to less than 5% in that year.

Single-stock exploitation boundaries and critical stocks

The state and the limits to exploitation of the individual stocks are presented in the stock sections (Section 4.4). The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005 and % reduction in F.
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to high long-term yield	In relation to agreed management plan	In relation to high long-term yield	In relation to precautionary limits	
Cod in the North Sea, Eastern Channel and Skagerrak	Reduced reproductive capacity.	Harvested unsustainably.	Overfished.	According to the agreed MP the TAC should not be more than 15% above the 2004 level, corresponding to 35 880 t (for IIIa and IV). This implies a 55% reduction in F relative to 2003. Indications are that this would allow a 30% increase in SSB from 2005 to 2006 and rebuilding to above $\mathbf{B}_{lim}$.	Target reference points have not been agreed for this stock, but long-term yield would be maximized by fishing at approximately 20% of the recent levels of fishing mortality.	Given the low stock size, recent poor recruitment, continued substantial catch [78 000 t in 2003], the uncertainty in the assessment, and the inability to reliably forecast catch, ICES recommends zero catch until the estimate of SSB is above $\mathbf{B}_{lim}$ or other strong evidence of rebuilding is observed.	Zero TAC
Cod in Kattegat	Reduced reproductive capacity.	Harvested unsustainably.	Overfished.	Even if there are no landings in 2005, the SSB in 2006 will be below the minimum level of 6 400 t. According to the management plan (Article 7), the Council shall decide on a TAC that is lower than 1000 tonnes in 2005, which is the quota with F=0.6.	Target reference points have not been agreed for this stock. The present F (1.21) is above the candidate reference points $\mathbf{F}_{0.1}$ and $\mathbf{F}_{max}$.	The state of the stock has not improved since 1997 and the fishing mortality has remained at a high level. Therefore, there should be no fishing on this stock in 2005.	Zero TAC
Haddock in the North Sea and Division IIIa	Full reproductive capacity.	Harvested sustainably.	Below F_{max}.	Following the agreed management plan would imply human consumption landings of 92 000 t in 2005, which is expected to lead to an SSB of 297 000 t in 2006	The present F of 0.2 is close to $\mathbf{F}_{0.1}$, which is a candidate for a target reference point.	Fishing mortality in 2005 should be less than $\mathbf{F}_{pa}$, which is equivalent to the agreed management plan.	TAC 92 000 t. (=2.8 * $\mathbf{F}_{sq}$)
Whiting in the North Sea and Eastern Channel	Unknown.	Unknown.	Unknown.	Unknown.	Unknown.	In the light of the inconsistencies in the assessment the catches in 2005 should not be allowed to increase above the recent average of 52 000 t (1997–2003). Human consumption landings of 25 000 t.	TAC 25 000 t. (recent average)

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005 and % reduction in F.
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**In relation to high long-term yield**	**In relation to precautionary limits**	
Saithe in the North Sea, Division IIIa and Subarea VI	Full reproductive capacity.	Harvested sustainably.	Overfished.	Following the agreed management plan, landings in 2005 should be 150 000 t, which is expected to allow an increase in SSB to 241 000 t in 2006.	The current fishing mortality ($\mathbf{F}_{sq}$) is estimated as 0.29, which is above rates that would lead to high long-term yields ($\mathbf{F}_{0.1}$=13 and $\mathbf{F}_{max}$=0.25).	Same as management plan.	TAC 150 000 t. (= 1.4*$\mathbf{F}_{sq}$)
Anglerfish in Division IIIa, Subareas IV and VI	Unknown.	Unknown.	Unknown.	Unknown.	Unknown.	The effort in this fishery should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycatch fish.	No effort increase. Mandatory data collection.
Plaice in the North Sea	At risk of reduced reproductive capacity.	At risk of being harvested unsustainably.	Overfished.	Following the ICES interpretation of the management plan, human consumption catches in 2005 should be 35 000 t, which is expected to allow an increase in SSB to 230 000 t in 2006.	The current fishing mortality ($\mathbf{F}_{sq}$) is estimated as 0.71, which is above rates that would lead to high long-term yields ($\mathbf{F}_{max}$=0.17).	The exploitation boundaries in relation precautionary limits imply human consumption landings of 35 000 t in 2005, which is expected to lead to an SSB of 230 000 t in 2006.	TAC 35 000 t. (=0.5*$\mathbf{F}_{sq}$)
Plaice in the Eastern Channel	At risk of reduced reproductive capacity.	At risk of being harvested unsustainably.	Overfished.	No management plan.	The current fishing mortality ($\mathbf{F}_{sq}$) is estimated as 0.60, which is above rates that would lead to high long term yields ($\mathbf{F}_{max}$=0.19).	Fishing mortality in 2005 should be reduced to less than $\mathbf{F}_{pa}$, corresponding to landings of less than 4 000 t.	TAC 4 000 t. (=$\mathbf{F}_{sq}$*0.75)
Plaice in Division IIIa	Full reproductive capacity.	At risk of being harvested unsustainably.	Overfished.	No management plan.	The current fishing mortality ($\mathbf{F}_{sq}$) is estimated as 0.79, which is above rates that would lead to high long-term yields ($\mathbf{F}_{max}$=0.18).	There is no basis for an analytical forecast. Fishing mortality in 2005 should not be allowed to increase which may be achieved by allowing landings of less than 9 500 t in 2005, which is the average of landings of the last four years.	TAC 9 500 t. (recent average)
Sole in Division IIIa	Full reproductive capacity.	Harvested sustainably.	Overfished.		The present F (0.29) is above candidate reference points $\mathbf{F}_{0.1}$ and $\mathbf{F}_{med}$.	F below $\mathbf{F}_{pa}$ = 0.30 corresponds to landings of less than 370 t in 2005.	TAC 370 t. (=$\mathbf{F}_{sq}$*0.86)

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005 and % reduction in F.
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**In relation to high long-term yield**	**In relation to precautionary limits**	
Sole in the North Sea	Full reproductive capacity.	At risk of being harvested unsustainably.	Overfished.	No management plan.	The current fishing mortality ($\mathbf{F}_{sq}$) is estimated as 0.44, which is above rates that would lead to high long-term yields ($\mathbf{F}_{0.1}$=13).	The exploitation boundaries in relation to precautionary limits imply human consumption landings of 17 300 t in 2005, which is expected to lead to an SSB of 37 400 t in 2006.	TAC 17 300 t. (=$\mathbf{F}_{sq}$*0.91)
Sole Eastern Channel	Full reproductive capacity.	Harvested sustainably.	Overfished.	No management plan.	The current fishing mortality ($\mathbf{F}_{sq}$) is estimated as 0.37, which is above rates that would lead to high long-term yields ($\mathbf{F}_{0.1}$=0.15 and $\mathbf{F}_{max}$=0.32).	The exploitation within precautionary limits would imply landings of less than 5 700 t in 2005, which is expected to lead to a SSB of 11 200 t in 2006.	TAC 5 700 t. (=$\mathbf{F}_{sq}$*1.1)
Sandeel North Sea	Reduced reproductive capacity.	Unknown.	Unknown.	No management plan.	Management of fisheries should try to prevent local depletion of sandeel aggregations, particularly in areas where predators congregate.	The management of the sandeel fishery in 2005 should attempt to rebuild SSB to $\mathbf{B}_{pa}$ by 2006. A real-time monitoring approach should be set up to estimate the size of the incoming 2004 year class and to set the effort level for the rest of 2005 based on that monitoring. In the absence of a real-time monitoring system the effort in 2005 should be less than 40% of the effort in 2004, which is based on an indicative forecast with a conservative recruitment value.	In-year monitoring or effort reduction to 40% of effort in 2005.
Norway pout the North Sea	At risk of reduced reproductive capacity.	Unknown.	Unknown.	No management plan.	Precautionary F reference points are not defined for this stock.	There is no basis for fishing on this stock in 2005 due to the present low state of the stock and the low recruitments in most recent years.	No fishery.

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005 and % reduction in F.
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**In relation to high long-term yield**	**In relation to precautionary limits**	
Autumn-spawning herring in the North Sea, VIId and IIIa	Full reproductive capacity.	Harvested sustainably.	Appropriate.	The present management plan is consistent with the PA and high long-term yields. The plan implies TACs and corresponding allocations among fleets as indicated in the catch options tables.		Catch forecasts are presented for different options of sharing the catch amongst fleets. Since the management plan only stipulates overall fishing mortalities for juveniles and adults, making fleet-wise predictions for 4 fleets provides an extensive range of options for 2005.	TAC between 594 000 and 617 000 tonnes (~$\mathbf{F}_{sq}$).
Spring-spawning herring in Subdivisions 22-24 and IIIa	Reference points not defined.	Reference points not defined.	Unknown.			Current fishing mortality has led to stable or increased SSB and the fishing mortality should not be allowed to increase. This corresponds to landings of less than 92 000 t in 2005.	TAC 92 000 t. ($\mathbf{F}_{sq}$).
Sprat in the North Sea	Unknown.	Unknown.	Unknown.			No advice. The present assessment and TAC-setting regime requires a two-year forecast. This means that the estimated TAC for 2005 has to be calculated in 2004 based on data collected in 2003. This may not be a realistic approach for a stock consisting of only a few year classes, with a predominance of 1-year-old fish in the catches.	No advice.
Mackerel in the North Sea	Unknown.	Unknown.	Unknown.			ICES advises that the existing measures to protect the North Sea spawning component remain in place. These are: - There should be no fishing for mackerel in Divisions IIIa and IVb,c at any time of the year. - There should be no fishing for mackerel in Division IVa during the period 15 February–31 July. - The 30-cm minimum landing size at present in force in Subarea IV should be maintained.	No fishing for mackerel in IIIa and IVb,c.

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005 and % reduction in F.
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**In relation to high long-term yield**	**In relation to precautionary limits**	
Horse Mackerel in the North Sea	Unknown.	Unknown.	Unknown.			ICES reiterates the recommendation made in 2004 to limit the catches to be below the 1982-1997 average of 18 000 t, in order to constrain the fishery until there is more information about the structure of horse mackerel stocks, and sufficient information to show that higher exploitation rates are sustainable.	TAC 18 000 t. (average catch 1982-1997).

Nephrops in Division IIIa	All stocks are exploited at sustainable levels. Advice given in 2003 (ICES, 2003a)
Nephrops in Division IVa, rectangles 44-48 E6-E7+44 E8 (Management Area F)	
Nephrops in Division IVa, West of 2° E, excluding Management Area F (Management Area G)	
Nephrops in Division IVa, East of 2° E + rectangles 43 F5-F7 (Management Area S)	
Nephrops in Divisions IVb,c, West of 1° E (Management Area I)	
Nephrops in Divisions IVb,c, East of 1° E, excluding rectangles 43 F5-F7 (Management Area H)	
Pandalus in Division IIIa and Division IVa East (Skagerrak and Norwegian Deeps)	**November 2004**
Pandalus in Division IVa (Fladen Ground)	

Identification of critical stocks

The above table identifies the stocks where spawning stock biomass is at reduced reproductive capacity (Cod in the North Sea, Eastern Channel and Skagerrak, Cod in Kattegat, Sandeel in the North Sea) and/or where fishing mortality indicates unsustainable harvesting of the stock (Cod in the North Sea, Eastern Channel and Skagerrak, Cod in Kattegat). Norway pout is also being considered as a critical stock because the spawning stock is around $\mathbf{B}_{lim}$ and recent recruitments of this short-living species have been very low. The North Sea mackerel component is still considered to be severely depleted and should be protected. These stocks are the overriding concerns in the management of all demersal fisheries:

- for cod in Division IIIa, North Sea and Eastern Channel and cod in Kattegat, ICES recommends a zero catch;
- for Norway pout in the North Sea ICES recommends that no fishing takes place;
- for sandeel in the North Sea ICES recommends an in-year monitoring system or, in the absence of that a reduction in fishing effort to 40% of the 2004 level.

Stocks for which reduction in fishing pressure is advised

Several other stocks are at risk of being harvested unsustainably (North Sea plaice, Eastern Channel plaice, Division IIIa plaice, North Sea sole), sometimes in combination with risk of reproductive capacity (plaice in the North Sea and plaice in Eastern Channel). For these stocks, reductions in fishing mortality are recommended as follows:

- North Sea plaice: F = $\mathbf{F}_{sq}$*0.5 (in order to rebuild to above $\mathbf{B}_{pa}$)
- Eastern Channel plaice: F = $\mathbf{F}_{sq}$ *0.75 (in order to rebuild to above $\mathbf{B}_{pa}$)
- Skagerak-Kattegat (Division IIIa) plaice: recent average landings
- North Sea sole: F = $\mathbf{F}_{sq}$ * 0.91.

Fishing mortality is related to fishing effort; as a first proxy it is assumed that these are proportional. Fishing at $\mathbf{F}_{sq}$ therefore represents current fishing pressure and a reduction in fishing mortality over $\mathbf{F}_{sq}$ implies a similar reduction in fishing effort, e.g. for North Sea plaice fishing effort should be halved.

Advice for fisheries management

Fisheries in Division IIIa (Skagerrak-Kattegat), in Subarea IV (North Sea), and in Division VIId (Eastern Channel) should in 2004 be managed according to the following rules, which should be applied simultaneously:

Demersal fisheries

- **with minimal bycatch or discards of cod;**
- **Implement TACs or other restrictions that will curtail fishing mortality for those stocks mentioned above for which reduction in fishing pressure is advised;**
- **within the precautionary exploitation limits for all other stocks (see text table above);**
- **Where stocks extent beyond this area, e.g. into Division VI (saithe and anglerfish) or are widely migratory (Northern hake), taking into account the exploitation of the stocks in these areas so that the overall exploitation remains within precautionary limits.**

Pelagic fisheries exploiting herring (western Baltic spring-spawning and North Sea autumn-spawning stocks) and mackerel

- **with minimal bycatch or discards of cod;**
- **with minimal catch of North Sea mackerel, respecting the closed season;**
- **within the precautionary exploitation limits for the herring stocks taking into account the exploitation of herring in the western Baltic (Subdivisions 22-24);**
- **Where stocks extend beyond this area, e.g. widely migratory species (NEA mackerel and blue whiting), taking into account the exploitation of the stocks in these areas so that the overall exploitation remains within precautionary limits.**

Fisheries for industrial purposes (Norway pout, sandeel, and sprat)

- **with minimal bycatch of cod and other fish used for human consumption;**
- **without fishing for Norway pout;**
- **apply an in-year real-time monitoring of the sandeel stock status to ensure that the stock is harvested inside precautionary limits, or reduce effort by 40%;**
- **within the precautionary exploitation limits for all other stocks (see text table above).**

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species that are identified as critical stocks. Industry-initiated programmes to pursue such incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of critical stocks are fully and credibly reported. Such programmes could be considered in the management of these fisheries.

Reductions in fishing mortalities have been advised for several demersal stocks in the North Sea. Fishing mortality is generally high, but for some stocks there are now indications that fishing mortality has been decreasing in recent years. This is consistent with the observed decrease in fishing effort due to days-at-sea regulations and decommissioning in the major fleets. ICES reiterates that required reductions in fishing mortality can only be achieved if significant reductions in effort are included in management, and effective deterrents to discarding are implemented. Extensive discarding occurs in most fisheries on roundfish, flatfish, and *Nephrops* in the North Sea. These discards are largely small and juvenile fish. They always result in foregone potential yield, and for depleted stocks they are a serious impediment to rebuilding.

A recovery plan for cod has been implemented in 2004. Previous versions of proposed recovery plans for cod stocks have been evaluated by ICES in 2003 (ICES, 2003a). ICES concluded that the proposed rebuilding plan is not likely to lead to safe and rapid rebuilding of these four cod stocks. ICES found that the plan must be expanded with an adaptive element, implying that the fisheries for cod remains closed until an initial recovery of the cod SSB has been proven. Such a sign could be an average or a strong year class that has passed through its immature phase without being reduced by fishing, and that the following year classes are not very weak.

Short-term implications

The catch options that would apply if single stocks could be exploited independently of others are summarized in the table above. However, many stocks are exploited in mixed fisheries. Mixed fisheries management options should be based on the expected catch in specific combinations of effort in the various fisheries, taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, which is also the basis for the scientific advice presented above.

The extent to which the stocks are taken in the same fisheries has not been quantified on the basis of available data. The existing information suggest that the stocks are caught together to a high (H), medium (M), or low (L) extent, or not at all (0), as indicated in the table below. The information in the table relates to catches and the linkage is thus indicated as high also in cases where the catches of most of one stock taken in a fishery with another stock are discarded.

The table presented below summarises the technical interactions that exist between fisheries. These indicate when management measures applied to a stock would have implications for the fisheries on another stock.

Main gears	Interactions															
	Cod 347d	**Cod katt.**	**Had 34**	**Whg 47d**	**Sai 346**	**Ang 346**	**Ple 4**	**Ple 7d**	**Ple 3a**	**Sol 3a**	**Sol 4**	**Sol 7d**	**San 4**	**Nop 4**	**Nep stocks**	**Pan stocks**
Cod 347d		0	H	H	M*	H	M-H	L-M	M	M	M	M	L	L	H	L
Cod kattegat	BT, OT		L	0	0	0	0	0	M	M	0	0	0	0	H	0
Had 34	OT			H	M*	H	L-H	0	L	L	L	0	L	L	H	L
Whg 47d	OT		OT		M	H	M-H	L-M	0	0	M	M	L	L	H	L
Sai 346	OT		OT	OT		H	L-M	0	L	L	L	0	L	L	L	L-M
Ang 346	OT		OT	OT	OT		L-M	0	0	0	L	0	0	L	L-M	L
Ple 4	BT		OT	BT	OT	BT, OT		0	0	0	H	0	0-L	0-L	L	0
Ple 7d	BT, OT			BT, OT					0	0	0	H	L	L	0-L	0
Ple 3a	BT, OT	BT, OT	OT							H	0	0	0	0	L	0
Sol 3a	BT,OT,GN	BT,OT,GN	OT	BT, OT					BT		0	0	0	0	L	0
Sol 4	BT		OT	BT	OT	OT	BT					0	0	0	L	0
Sol 7d	BT			BT				BT					0	0	0-L	0
San 4	Ind		Ind	Ind	Ind	none	none				none	none		M	0	0
Nop 4	Ind		Ind	Ind	Ind	none	none				none		Ind		0	M
Nep. stocks																L
Pan. stocks																

H; the stocks are taken together in most fisheries where they are taken and their fisheries linkage is therefore high; M: the stocks are taken together in some, but not all important fisheries and their fisheries linkage is therefore medium; L: the stocks are taken together in some fisheries, but are mainly caught independently of each other and their fisheries linkage is therefore low; 0: the stocks are never or only rarely caught together and they are thus not linked in the fisheries; na: information not available. *) denotes: only in northern areas.

Gears: BT = beam trawl, OT = otter trawl, GN = gillnet, Ind = industrial trawl.

Regulations in force and their effects

An emergency measure (Council Regulation (EC) 259/2001) involving the closure of a large area of the North Sea was implemented from 14 February to 30 April 2001 to all fishing vessels using gears likely to catch cod. Analysis of the effectiveness of the emergency measures indicated that the closure had an insignificant effect upon the spawning potential for cod in 2001. The redistribution of the fishery, especially along the edges of the box coupled to the increases in proportional landings from January and February appeared to have been able to negate the potential benefits of the box. The conclusion from the study was that the box would have to be extended in both space and time to be more effective (see: ICES, 2004a). The emergency measure has not been adopted after 2001.

EU technical regulations in force in 2003 and 2004 are contained in Council Regulation (EC) 850/98 and its amendments. The regulation prescribes the minimum target species' composition for different mesh size ranges. In 2001, haddock in the whole of NEAFC region 2 were a legitimate target species for towed gears with a minimum codend mesh size of 100 mm. As part of the cod recovery measures, the EU and Norway introduced additional technical measures from 1 January 2002 (EC 2056/2001). The basic minimum mesh size for towed gears for cod from 2002 was 120 mm, although through a transitional arrangement until 31 December 2002, vessels were allowed to exploit cod with 110-mm codends provided that the trawl was fitted with a 90-mm square mesh panel and the catch composition of cod retained on board was not greater than 30% by weight of the total catch. From 1 January 2003, the basic minimum mesh size for towed gears for cod was 120 mm. The minimum mesh size for vessels targeting haddock in Norwegian waters is also 120 mm. There is some indication of the effect of mesh size regulations in the sudden increase in weight-at-age in the human consumption component for age 2 haddock. However, a shift in exploitation pattern at the early ages has not been observed.

Effort restrictions in the EC were introduced in 2003 (EC 2341/2002, Annex XVII, amended in EC 671/2003). Effort restriction measures were revised for 2004 (EC 2287/2003, Annex V). Preliminary analysis of fishing effort trends in the major fleets exploiting demersal stocks indicates that fishing effort in those fleets has been decreasing since the mid-1990s, due to a combination of decommissioning and days-at-sea regulations. The decrease in effort is most pronounced in the years 2002 and beyond.

A cod protection area has been implemented in 2004 (EC 2287/2003, amended in EC 867/2004) which defined the conditions under which certain stocks, including haddock, could be caught in Community waters. A maximum of 35% of the haddock TAC in 2004 could be taken from within the cod protection area. For UK a special permit was introduced that was needed to fish for haddock in the cod protection area. Although this management scheme was proposed to permit additional haddock to be caught in 2004, the uptake of the special permit has been relatively low.

In 2004 agreement was reached within the EU on a formal cod recovery plan that will not be operational during the TAC and management decision processes of 2004, effectively rendering the plan operational in 2005 (EC 423/2004). Previous versions of proposed recovery plans for cod stocks have been evaluated by ICES in 2003 (ICES, 2003a). The conclusion was that: *"In conformity with the advice given in 2002 ICES concludes that the proposed rebuilding plan cannot be accepted as likely to lead to safe and rapid rebuilding of these four cod stocks. ICES finds that the plan – in order to meet its stated goals of rebuilding the cod stocks – must be expanded with an adaptive element, implying that the fisheries for cod remains closed until an initial recovery of the cod SSB has been proven. Such a sign could be an average or a strong year class that has passed through its immature phase without being reduced by fishing, and that the following year classes are not very weak."*

Technical measures applicable to the flatfish fishery in the North Sea included mesh size regulations, minimum landing size, gear restrictions, and a closed area (the plaice box). Mesh size regulations for towed gears require that vessels fishing North of 55°N (or 56°N east of 5°E, since January 2000) should have a minimum mesh size of 100 mm, while to the south of this limit, where the majority of the plaice fishery takes place, an 80-mm mesh is allowed. In the fishery with fixed gears a minimum mesh size of 100 mm is required. In addition to this, since 2002 a small part of the North Sea plaice fishery is affected by the additional cod recovery plan (EU regulation 2056/2001) that prohibits trawl fisheries with a mesh size <120 mm in the area to the north of 56°N. The aggregated beam length of beam trawls is limited to 24 m in the 12 nautical mile zone, and the maximum aggregated beam length is 9 m in the plaice box. The plaice box has been enforced since 1989, and the area has been closed in all quarters since 1995. The closed area applies to vessels using towed gears, but vessels smaller than 300 HP are exempted from the regulation. The effectiveness of the plaice box has been evaluated by an expert group in 2004, but the report of that group was not yet available to ICES.

A management plan has been implemented from 2002 for the North Sea herring fishery. The management plan consists of restraining fishing mortality and keeping the stock above threshold levels. Simulations indicate that the current management strategy maintains this stock within precautionary limits. The likelihood of exceeding or encountering precautionary limits depends on the accuracy of the assessment and the compliance of the fishery to the regulations. Thus, overfishing the TAC by 20% combined with an overestimation of the stock in assessment by 10% on average would lead to a near-50% risk that SSB drops below $\mathbf{B}_{pa}$, and a 4% risk that it falls below $\mathbf{B}_{lim}$.

Information from the fishing industry

ICES held consultations with the North Sea Commission Fisheries Partnership in Copenhagen, October 4–5 2004, during which meeting the participants and two invited experts reviewed four stocks: cod, whiting, plaice, and sole. Plaice and cod were also reviewed in 2002 and 2003 and various recommendations made as part of those reviews have been implemented by the relevant assessment working group. The independent reviews gave the following general comments on the assessments:

"*The review process was fairly limited and there are a number of options for improving the level and extent of the review. This report represents a short consultation, with one of the reviewers (J. Ianelli) having had very little exposure to North Sea fisheries issues. The presentation and documents provided to the Panel were particularly useful to bring them up to speed. Note that this report reflects a very brief effort in evaluating the assessment and should not be misconstrued as being comprehensive.*

The presentation of uncertainty could be substantially improved. In particular, it would be useful to point out assessment outputs that are considered robust (e.g., relative stock decline) and those that are less certain (e.g., absolute stock level). The level of uncertainty due to sampling, process, and model error could be more usefully portrayed. The Panel acknowledges that alternative approaches and a fuller portrayal of uncertainty would require time that is not readily available within the constraints of WG meetings, and may not even be required or welcomed by clients who desire simple advice. Nevertheless, in order confidently to provide simple advice that does not itself expose undue uncertainties, it would be useful if the working group was given time and resources to explore the assessments more fully and for ACFM to be aware of relevant issues. We note that for the assessments considered, the use of diagnostics (e.g., retrospective patterns, Laurec-Shepherd residuals by individual fleet, trends in catchability residuals) were useful.

There appear to be considerable irregularities in data availability by fleet and there is a fundamental need for certain types of data (e.g., observed catch/by-catch and discard information). The WG is to be commended for doing a good job given these deficiencies. We note that these added data requirements should not be at the expense of existing data collection programs which are often used for other things (e.g., species interactions considerations, technical measures evaluations etc.). The need to involve fishers in the process of acquiring data was noted and should be followed through. The meeting recognized that involving fishers in the process of building sustainable fisheries will improve the potential for useful governance systems.

Several developments were made this year on estimating discards. In general, the data are poor, even though in some fisheries discards are a major component of mortality. It may be possible to explore alternative estimation methods. E.g., using beam trawl charters/surveys for alternative by-catch estimates. The possibility of having an "observer effect" for vessels sampled for discards should be evaluated.

The use of ADAPT this year was considered an improvement and the use again of SURBA was useful. The ADAPT method is less ad hoc but still requires assumptions that may be inappropriate for providing advice on stock conditions. Presenting an integrated statistical approach was encouraged and is something that could be done inter-sessionally. Inter-sessional work should be encouraged so that the work done during the WG meeting can be more effective.

Due to the magnitude of the work required of the WG, the quality of the reports suffered, making them more difficult to evaluate. For these assessments to be available in a useful form to wider audiences more care and time needs to be allocated to report preparation and editing.

The commercial CPUE data are not used for calibration because of targeting and distribution contractions. However, the Panel felt that this information was useful for qualitative evaluations.

The industry survey information was seen as a useful resource. However, these data need to be presented in a more meaningful way. In general, industry involvement should be encouraged and further developed, preferably towards the production of quantitative information that can formally be included in the assessment process.

Biological reference points, if they are to be presented, should be updated when management changes (e.g., mesh size requirements) and model changes (e.g., use of different age ranges) are implemented. The Panel encourages the ACFM to deal with this in their upcoming meeting.

The Panel thought that forecasts might be evaluated by comparing past performances (e.g., ACFM landings data versus agreed TACs). However, it is recognized that this may be problematic when dealing with uncertainty in unreported catches."

Quality of assessments and uncertainties

The biological data available from scientific sources for the assessment of roundfish, flatfish, herring, and mackerel are relatively good. The level of biological sampling of most of the commercial landings has been maintained. However, a major drawback in the available data is that they mostly refer to the landed component of the catch for most species. Discard data have traditionally only been used directly in assessments for haddock and whiting, but based on a historical series only for one country. Several countries now collect discard data on a recurrent basis. This year, discard data has been included in the assessments of North Sea cod and plaice. It is noted that the inclusion of discards appears to reduce potential biases but may increase the uncertainties in the assessment (noise), because discard sampling is often rather scanty. In order to be able to include discards into an assessment, when discards have only been sampled in recent years, assumptions have to be made about the historical part of the time-series. These assumptions could compromise the reliability of the assessment that is based on them.

Data on landings, fishing effort, and species composition are available from several fisheries. There are catch and effort data available for many fisheries, but it is uncertain how reliably these data reflect trends in effective effort, i.e. nominal effort after corrections for technological improvements or changes in efficiency generally. Restrictive management measures (TACs) have also resulted in changes in the fishing practice of some fleets and redirected their effort to other species. In a number of cases this has lead to abandoning the use of time-series of commercial CPUE data in the assessments (cod, haddock, whiting, plaice), although the time-series of CPUE are still presented in the working group reports. In some recent years there has been misreporting of roundfish landings associated with restrictive quotas. Substantial underreporting of cod landings is estimated to have occurred between 1993 and 2003.

Several series of research vessel survey indices are available for most species. Quarterly data were available from the International Bottom Trawl Survey for a period of 6 years (1991–1996) and these were used in the assessments of some stocks. This survey has since then covered quarters 1 and 3. For herring and mackerel the spawning stock sizes are estimated by annual larvae- and acoustic surveys (herring) or intermittent egg surveys (mackerel).

Analytical assessments were performed on cod, haddock, whiting, saithe, herring, mackerel, plaice, sole, sandeel, and Norway pout.

Multispecies considerations are incorporated in the assessments and in the forecasts for the North Sea stocks of cod, haddock, whiting, herring, sprat, sandeel, and Norway pout. In those cases average natural mortalities estimated by multispecies assessments were incorporated in the assessments. Incorporation of time variable natural mortalities from a multispecies assessment model into the single-species assessments has been carried out as a sensitivity analysis of the assessments.

Sources of information

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Table 3.4.1.1 Species composition in the Danish and Norwegian small-meshed fisheries in the North Sea ('000 t). Data provided by working group members.

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1974	525	314	-	736	62	48	130	42		1857
1975	428	641	-	560	42	41	86	38		1836
1976	488	622	12	435	36	48	150	67		1858
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1674
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1039	63	146	162	28	2	36	1	59	1536
1990	591	71	115	140	22	3	50	8	40	1040
1991	843	110	131	155	28	5	38	1	38	1349
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1994	769	281	40	172	11	5	10	-	19	1307
1995	911	278	66	181	64	8	27	1	15	1551
1996	761	81	39	122	93	5	5	0	13	1119
1997	1091	99	15	126	46	7	7	3	21	1416
1998	956	131	16	72	72	5	3	3	24	1283
1999	678	166	23	97	89	4	5	2	40	1103
2000	655	191	24	176	98	8	8	6	21	1187
2001	810	156	21	59	76	6	7	3	14	1152
2002	804	142	26	73	107	4	8	8	15	1186
2003	303	175	16	18	139	1	3	8	18	681
Avg 74-03	718	200	61	238	63	13	38	9	33	1359

Year quarter	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1998 q1	37	7	7	13	11	1	0	0	5	80
1998 q2	754	1	2	8	12	2	1	0	4	784
1998 q3	153	60	4	29	38	2	1	2	9	298
1998 q4	12	63	4	23	12	0	0	0	6	121
1999 q1	14	14	4	8	23	1	1	1	8	74
1999 q2	507	2	4	22	30	1	2	1	8	577
1999 q3	139	129	10	41	18	1	2	0	7	347
1999 q4	17	21	6	25	17	1	1	0	18	106
2000 q1	10	42	1	9	13	1	0	0	5	82
2000 q2	581	2	4	17	32	3	2	0	4	646
2000 q3	63	133	10	30	39	2	3	6	5	291
2000 q4	0	15	8	119	14	2	3	0	8	169
2001 q1	12	40	2	20	15	1	1	0	3	94
2001 q2	462	1	2	10	32	3	1	2	4	517
2001 q3	314	44	4	4	12	1	2	0	5	386
2001 q4	22	72	13	24	16	1	2	0	2	152
2002 q1	11	5	6	8	18	0	0	0	2	50
2002q2	772	0	3	5	19	1	2	0	4	806
2002q3	21	71	8	31	46	1	3	5	4	189
2002q4	0	66	10	28	24	1	2	3	6	141
2003 q1	3	18	1	2	14	0	0	1	5	45
2003 q2	239	1	2	4	42	0	1	1	3	292
2003 q3	57	56	4	5	56	0	1	4	4	188
2003 q4	4	100	9	7	28	0	1	2	6	157

0 denotes < 500 tonnes

Table 3.4.1.2 Landings of demersal, pelagic, and industrial species from the North Sea. For some species Divisions IIIa and/or VIId have been included.

Species	Cod	Cod	Haddock	Haddock	Whiting	Whiting	Saithe	Saithe	Sole	Plaice	Norway pout	Sandeel	Sprat	Herring autumn spawners	Mackerel	Horse mackerel	Demersal	Pelagic	Industrial	Total
Type	dem	ib	dem	ib	dem	ib	dem	ib	dem	dem	i	i	i	p	p	p				
landings/catch	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	catch	catch	catch				
Area	3a,4,7d	3a,4,7d	4	4	4,7d	4,7d	3a,4	3a,4	4	4	3a,4	4	4	3a,4,7d	3a,4	4				
1970	226	n/a	525	180	83	115	163	59	20	130	238	191	51	563	322	12	1147	897.451	834	2878
1971	328	n/a	235	32	61	72	218	35	24	114	305	382	95	520	244	32	980	795.673	921	2697
1972	354	n/a	193	30	64	61	248	28	21	123	445	359	92	498	189	8	1003	694.599	1015	2713
1973	239	n/a	179	11	71	90	229	31	19	130	346	297	228	484	327	42	867	852.519	1003	2723
1974	214	n/a	150	48	81	130	267	42	18	113	736	524	314	275	298	31	843	604.391	1794	3241
1975	205	n/a	147	41	84	86	271	38	21	108	560	428	641	313	263	10	836	586.062	1794	3216
1976	234	n/a	166	48	83	150	295	67	17	114	437	488	622	175	306	9	909	489.709	1812	3211
1977	209	n/a	137	35	78	106	217	6	18	119	390	786	304	46	260	1	778	306.531	1627	2712
1978	297	n/a	86	11	97	55	163	3	20	114	270	787	398	11	149	5	777	164.817	1524	2466
1979	270	n/a	83	16	107	59	134	2	23	145	329	578	380	25	153	1	762	178.823	1364	2305
1980	294	n/a	99	22	101	46	142		16	140	483	729	323	71	88	2	792	160.931	1603	2556
1981	335	n/a	130	17	90	67	145	1	15	140	239	569	209	175	67	7	855	249.388	1102	2206
1982	303	n/a	166	19	81	33	185	5	22	155	395	611	153	275	35	3	912	313.271	1216	2441
1983	259	n/a	159	13	88	24	197	1	25	144	451	537	88	387	41	4	872	432.405	1114	2418
1984	228	n/a	128	10	86	19	214	6	27	156	393	669	77	429	44	26	839	498.885	1174	2512
1985	215	n/a	159	6	62	15	222	8	24	160	205	622	50	614	50	23	842	687.546	906	2436
1986	204	n/a	166	3	64	18	202	1	18	165	178	848	16	671	244	20	819	935.012	1064	2818
1987	216	n/a	108	4	68	16	177	4	17	154	149	825	32	792	302	21	740	1114.28	1030	2884
1988	184	n/a	105	4	56	49	140	1	22	154	110	893	87	888	338	60	661	1286.78	1144	3092
1989	140	n/a	76	2	45	36	117	1	22	170	168	1039	63	787	282	111	570	1179.734	1309	3059
1990	125	n/a	51	3	47	50	100	8	35	156	152	591	73	646	305	130	514	1081.29	877	2472
1991	102	n/a	45	5	53	38	115	1	34	148	193	843	112	657	366	75	497	1098.169	1192	2787
1992	114	n/a	70	11	52	27	104		29	125	300	855	124	716	367	116	494	1199.271	1317	3010
1993	122	0.66	80	11	53	20	118	1	31	117	184	579	200	671	391	140	521	1201.291	995.66	2718
1994	111	0.78	80	5	49	10	115		33	110	182	786	320	571	472	110	498	1153.434	1303.78	2955
1995	136	0.96	75	8	46	27	124	1	30	98	241	918	357	579	322	99	509	999.709	1552.96	3062
1996	126	0.34	76	5	41	5	120	0	23	82	166	777	137	275	213	26	468	513.964	1090.34	2072
1997	124	0.79	79	7	36	7	110	3	15	83	170	1137	103	264	229	79	447	572.648	1427.79	2447
1998	146	0.4	77	5	28	3	107	3	21	71	80	1004	164	392	270	28	450	689.306	1259.4	2399
1999	96	0.1	66	4	30	5	114	3	25	81	92	735	188	363	301	57	412	720.267	1027.1	2159
2000	71	0.06	47	9	28	8	88	6	23	81	184	699	196	388	273	30	338	691.812	1102.06	2132
2001	50	0.1	41	8	25	7	95	3	20	82	66	862	170	363	315	20	313	697.508	1116.1	2127
2002	55	0.03	58	3.7	21	7.3	117	7.8	16	70	77	811	144	372	372	50	337	793.404	1050.83	2181
2003	31	0.05	44	1.1	17.4	2.7	102	8	18	66	25	325	177	480	332	32	278.4	843.835	538.85	1661

dem= demersal, ib = industrial by catch, i = industrial, p = pelagic.

Table 3.4.1.3.a North Sea landings and discards by species and country as estimated by the working group.

	COD_NS		HAD_NS		PLE_NS		POK_NS		SOL_NS		WHG_NS		Total Land	Total Disc
Country	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**		
BEL	1501	72	368	166	4519	2044	44	3	1603	139	305	137	8340	2560
DEN	7962	382	5252	2364	13731	6211	10511	643	609	53	76	34	38141	9687
ENG	2214	106	1561	703	7224	3268			483	42	659	296	12141	4415
FRA	1971	95	1105	497	258	117	21550	1318	724	63	8813	3957	34421	6046
GER	2106	101	1679	756	3802	1720	9015	551	752	65	332	149	17686	3342
NED	2303	110	141	64	28224	12767			13462	1166	1492	670	45622	14777
NOR	4987	239	2304	1037	1967	890	61690	3772	125	11	38	17	71111	5966
SCO	7692	369	31105	14004	6768	3061	4711	288	250	22	5630	2528	56155	20271
SWE	510	24	147	66									657	91
Grand Total	31246	1498	43661	19657	66492	30077	107520	6575	18008	1560	17345	7788	284273	67155

Table 3.4.1.3.b North Sea landings and discards by species and country, gear, and mesh size range as estimated by the working group.

			COD_NS		HAD_NS		PLE_NS		POK_NS		SOL_NS		WHG_NS		Total Land	Total Disc
country	**Gear**	**Mesh size range**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**		
BEL	-1	-1	129	6	0	0	36	16			43	4	92	41	301	68
	LARGE_BEAM	-1	1130	54	347	156	3602	1629	23	1	1081	94	76	34	6260	1969
		80-99	34	2									40	18	74	20
	OTTER	-1	98	5	15	7	323	146	18	1	55	5	21	10	531	173
	SMALL_BEAM	-1	95	5	5	2	558	253	2	0	424	37	51	23	1135	319
		80-99	15	1									24	11	39	12
DEN	-1	-1	1478	71	1045	470	1421	643	3401	208	168	15	7	3	7520	1410
	BEAM	>=120	56	3	41	18			9	1					106	22
		100-119	4	0	0	0									5	0
	DEM_SEINE	>=120	456	22	837	377	1261	571	219	13	1	0	2	1	2777	984
		-1	6	0	2	1	28	13	0	0	0	0			36	14
		100-119	42	2	44	20	228	103	12	1	0	0			327	126
		80-99	226	11	243	109	191	86	63	4	0	0	8	4	731	214
	GILL	>=220	15	1	0	0	11	5	0	0	1	0			26	6
		-1	10	0	0	0	0	0	0	0	2	0			12	1
		100-119	42	2	14	6	63	28	4	0	216	19			339	56
		120-219	2622	126	187	84	4261	1927	134	8	122	11			7326	2156
		90-99	3	0	0	0	6	3	0	0	88	8			97	11
	LARGE_BEAM	>=120	42	2	23	10	1440	651	1	0	0	0			1507	664
		-1	4	0	0	0	163	74	0	0	0	0			167	74
	OTTER	<16	12	1	25	11	0	0	120	7					158	19
		>=120	1402	67	1712	771	2061	932	3774	231	2	0	42	19	8993	2020
		-1	4	0	5	2	22	10	4	0	0	0			35	13
		100-119	113	5	74	33	775	351	85	5	1	0	2	1	1049	395
		16-31	5	0	27	12			53	3					86	16
		32-54	174	8	128	58	1	0	378	23	1	0	3	1	685	91
		70-79	69	3	18	8			34	2					121	14
		80-99	1176	56	825	371	1791	810	2219	136	7	1	13	6	6031	1380
	SMALL_BEAM	>=120	0	0			5	2			0	0			5	2
		-1	0	0	0	0	3	1			0	0			3	1

Table 3.4.1.3b (cont.)

ENG	DEM_SEINE	>=120	11	1	31	14	341	154			0	0	3	1	385	170
	DREDGE	-1	1	0			0	0			0	0			2	0
	GILL	>=220	0	0							3	0			3	0
		100-119	24	1			9	4			53	5	3	1	90	11
		120-219	482	23	26	12	16	7			26	2	13	6	562	50
		90-99	14	1			0	0			28	2	1	0	43	4
	LARGE_BEAM	100-119	7	0	1	1	148	67			28	2	5	2	189	72
		80-99	127	6	48	22	5893	2666			216	19	12	6	6297	2718
	LONGLINE	-1	300	14	0	0	0	0			2	0	2	1	304	16
	OTTER	>=120	1081	52	1180	531	746	338			113	10	414	186	3535	1116
		70-79	138	7	273	123	70	32			4	0	206	93	692	254
	POTS	-1	29	1	1	1	0	0			10	1	0	0	40	3
FRA	DREDGE	-1	0	0									0	0	0	0
		80-99	0	0									1	0	1	0
	GILL	-1	94	5			12	6			115	10	7	3	228	23
		100-119	25	1							0	0	1	0	26	2
		10-30									1	0			1	0
		120-219	278	13	0	0	5	2	15	1	6	0	9	4	314	21
		50-70	10	0									0	0	10	1
		90-99	253	12			62	28			537	47	16	7	868	94
	LONGLINE	-1	8	0									0	0	8	0
	OTTER	<16	1	0									0	0	1	0
		>=120	11	1	30	14	0	0	432	26			2	1	475	41
		-1	34	2	1	0	0	0	89	5	0	0	65	29	190	37
		100-119	86	4	1055	475	0	0	20993	1284			318	143	22452	1906
		16-31	0	0									2	1	2	1
		32-54	6	0									23	10	29	11
		55-69	0	0									0	0	0	0
		70-79	0	0									2	1	3	1
		80-99	1132	54	18	8	92	42	0	0	14	1	8276	3716	9533	3821
	PEL_TRAWL	100-119											0	0	0	0
		32-54	2	0									8	4	11	4
		80-99	7	0									32	15	39	15
	POTS	-1	0	0									0	0	0	0

Table 3.4.1.3b (cont.)

		-1	23	1			86	39	19	1	51	4	50	23	230	68
GER	DEM_SEINE	>=120	616	30	480	216	6	3	257	16			1	0	1360	265
	GILL	100-119	3	0			8	4			54	5			65	8
		120-219	124	6	2	1	13	6			4	0			143	13
		90-99	1	0			1	0			17	1			19	2
	LARGE_BEAM	>=120	3	0	1	0	31	14			10	1	1	0	46	16
		100-119	1	0			14	6							15	6
		16-31					17	8			10	1	1	0	28	9
		80-99	57	3	2	1	1121	507			493	43	71	32	1744	585
	OTTER	>=120	1067	51	1015	457	41	19	6525	399			45	20	8693	946
		100-119	59	3	82	37	580	262	2185	134	2	0	8	4	2916	439
		32-54			2	1			7	0					9	1
		55-69											2	1	2	1
		80-99	168	8	95	43	1777	804	6	0	69	6	202	91	2317	952
	PEL_TRAWL	32-54							35	2					35	2
	SMALL_BEAM	>=120					4	2							4	2
		100-119					6	3							6	3
		16-31									3	0			3	0
		80-99	7	0			183	83			90	8	1	0	281	91
NED	LARGE_BEAM	100-119	2303	110	141	64							1492	670	3936	844
		80-99					28224	12767			13462	1166			41686	13933
NOR	DEM_SEINE	>=120	208	10	206	93	37	17	47	3			2	1	500	123
		80-99	10	0	10	5			3	0					23	5
	GILL	120-219	1910	92	368	165	51	23	7160	438	10	1	3	1	9501	720
	LARGE_BEAM	100-119	42	2	29	13	1115	504	1	0	99	9	1	1	1288	529
	LONGLINE	-1	1272	61	458	206	0	0	558	34			1	0	2289	302
	OTTER	>=120	1138	55	1045	470	754	341	49831	3047	15	1	20	9	52803	3923
		32-54	309	15	161	73	1	0	223	14			11	5	704	106
		70-79	48	2	18	8	3	1	66	4			0	0	135	16
	PEL_SEINE	32-54	3	0	7	3			3749	229					3759	232
	PEL_TRAWL	32-54			0	0			39	2					40	3
	POTS	-1	47	2	1	1	6	3	14	1	0	0			69	6
SCO	DEM_SEINE	>=120	995	48	6441	2900	195	88	373	23	0	0	888	399	8892	3457
		100-119	6	0	423	191	5	2	2	0	0	0	41	18	477	211
		32-54	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3.4.1.3b (cont.)

		55-69	0	0	69	31	0	0	4	0	0	0	5	2	77	33
		-79	1	0	11	5	0	0	1	0	0	0	3	1	16	6
		80-99	5	0	49	22	1	0	1	0	0	0	12	5	69	28
	GILL	>=220	1	0	0	0	0	0	0	0	0	0	0	0	1	0
		-1	4	0	0	0	0	0	0	0	0	0	0	0	4	0
		120-219	27	1	0	0	0	0	0	0	0	0	0	0	28	1
	LARGE_BEAM	>=120	36	2	23	11	871	394	2	0	11	1	10	4	953	412
		100-119	22	1	8	4	2191	991	0	0	30	3	1	0	2253	999
		32-54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		80-99	142	7	19	9	2194	992	0	0	206	18	40	18	2601	1044
	LONGLINE	-1	19	1	14	6	0	0	18	1	0	0	0	0	52	9
	OTHER	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		32-54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	OTTER	<16	0	0	9	4	0	0	0	0	0	0	0	0	10	4
		>=120	5300	254	19064	8583	481	218	3633	222	0	0	3041	1365	31519	10642
		-1	0	0	2	1	0	0	2	0	0	0	0	0	3	1
		100-119	177	8	976	439	374	169	99	6	1	0	214	96	1841	719
		16-31	0	0	6	3	0	0	0	0	0	0	0	0	7	3
		32-54	3	0	193	87	3	1	1	0	0	0	9	4	208	92
		55-69	0	0	1	0	0	0	0	0	0	0	0	0	1	0
		70-79	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		80-99	949	45	3796	1709	365	165	575	35	1	0	1366	613	7053	2569
	SMALL_BEAM	>=120	0	0	0	0	37	17	0	0	0	0	0	0	37	17
		80-99	1	0	0	0	50	23	0	0	1	0	0	0	51	23
SWE	GILL	120-219	34	2	0	0									34	2
	OTTER	>120	35	2	46	21									81	22
		100-119	21	1	5	2									26	3
		32-54	36	2	21	9									57	11
		70-79	24	1	1	0									25	2
		80-99	360	17	74	33									434	51
Grand Total			31246	1498	43661	19657	66492	30077	107520	6575	18008	1560	17345	7788	284273	67155

Table 3.4.1.4.a Skagerrak and Kattegat landings and discards by species and country as estimated by the working group.

	PLE_KS	
country	Land	Disc
BEL	38	2
DEN	5455	307
GER	7	0
NED	1539	87
NOR	74	4
SWE	392	22
Grand Total	7506	423

Table 3.4.1.4.b Skagerrak and Kattegat landings and discards by species and country, gear, and mesh size range as estimated by the working group.

			PLE_KS	
country	Gear	Mesh_size_range	Land	Disc
BEL	LARGE_BEAM	-1	38	2
DEN	-1	-1	444	25
	BEAM	>=120	1378	78
		100-119	52	3
	DEM_SEINE	>=120	83	5
		-1	6	0
		100-119	171	10
		80-99	1623	91
	GILL	-1	13	1
		100-119	3	0
		120-219	537	30
		90-99	13	1
	OTTER	<16	1	0
		>=120	114	6
		-1	0	0
		100-119	132	7
		16-31	3	0
		32-54	3	0
		70-79	32	2
		80-99	849	48
GER	DEM_SEINE	>=120	1	0
	OTTER	>=120	1	0
		80-99	5	0
NED	LARGE_BEAM	80-99	1539	87
NOR	DEM_SEINE	80-99	1	0
	GILL	120-219	55	3
	OTTER	>=120	5	0
		32-54	10	1
		70-79	3	0
SWE	GILL	120-219	69	4
	OTTER	>120	2	0
		100-119	8	0
		32-54	0	0
		70-79	8	0
		80-99	305	17
Grand Total			7506	423

Table 3.4.1.5.a Eastern Channel landings and discards by species and country as estimated by the working group.

	PLE_EC	
country	Land	Disc
BEL	985	
FRA	2401	
Grand Total	3386	

Table 3.4.1.5.b Eastern Channel landings and discards by species and country, gear, and mesh size range as estimated by the working group.

			PLE_EC	
country	Gear	Mesh_size_range	Land	Disc
BEL	-1	-1	1	
	LARGE_BEAM	80-99	653	
	OTTER	-1	4	
	SMALL_BEAM	80-99	327	
FRA	DREDGE	>=120	0	
		-1	30	
		100-119	0	
		32-54	0	
		70-79	0	
		80-99	24	
	GILL	>=220	0	
		-1	106	
		100-119	37	
		120-219	104	
		50-70	14	
		90-99	197	
	LONGLINE	-1	0	
	OTTER	<16	1	
		>=120	0	
		-1	126	
		100-119	6	
		16-31	1	
		32-54	29	
		55-69	0	
		70-79	2	
		80-99	1083	
	POTS	-1	1	
	ZZZ	-1	639	
Grand Total			3386	

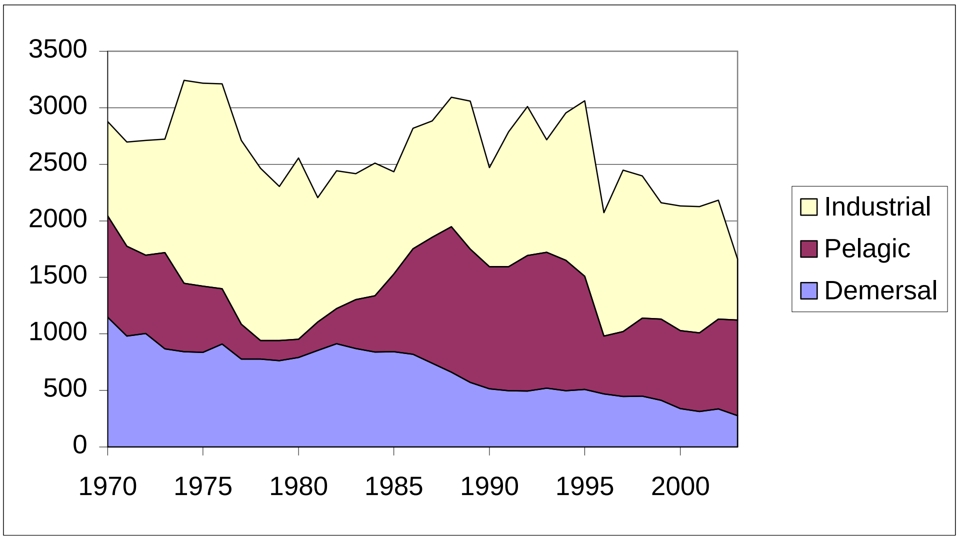

Figure 3.4.1.1 Estimated landings in the North Sea.

3.5 West of Scotland and Rockall (Subarea VI)

3.5.1 The human use of the ecosystem

The fisheries and their impact

The main fleets operating in Division VIa include the mixed roundfish otter trawl fleet, the *Nephrops* otter trawl fleet, the otter trawl fleet targeting anglerfish, megrim, and hake, and the fleet targeting saithe and/or deep-sea species. To a large extent, the roundfish fishery in Division VIa is an extension of the similar fishery in the North Sea. The demersal fisheries in Division VIa are predominantly conducted by otter trawlers fishing for cod, haddock, anglerfish, and whiting, with bycatches of saithe, megrim, and lemon sole.

The majority of the vessels in the demersal fishery are locally-based Scottish trawlers using 'light-trawls', but trawlers from Ireland, Northern Ireland, England, France, and Germany also participate in this fishery. The importance of Scottish seiners essentially targeted at haddock has been declining in recent years as many of these vessels have been converted to trawlers. Part of the fleet of light trawlers has diversified into a fishery for anglerfish that has been expanding into deeper water off the northern coast of Scotland. Bycatches in this fishery include megrim, ling, and tusk.

About 200 Scottish trawlers also take part in the fisheries for *Nephrops* on inshore grounds. In recent years Irish vessels have also been targeting *Nephrops* in Division Via, mainly on offshore grounds. These *Nephrops* vessels also land smaller quantities of haddock, cod, whiting, and small saithe, but discard large amounts of whiting and haddock.

The new effort regulations have provided an incentive for some vessels previously using >100-mm mesh in otter trawls to switch to smaller mesh gears, thus claiming a higher number of days-at-sea. After the implementation of EC Regulation No. 850/98 these vessels will also be required to target either *Nephrops* or anglerfish, megrim, and whiting, with various catch and bycatch composition limits. No detailed information is available to quantify how many vessels have switched to using smaller meshes as a result of effort regulation as this information is not reliably recorded in the logbook information for some countries.

The development of a directed fishery for anglerfish has led to considerable changes in the way the Scottish fleet operates. Part of this is a change in the distribution of fishing effort; the development of a directed fishery has led to effort in the roundfish fisheries shifting away from the traditional inshore areas to more offshore areas and deeper waters. The expansion in area and depth range fished has been accompanied by the development of specific trawls and vessels to exploit the stock. These vessels mainly use large twin-rig otter trawls with >100-mm mesh. A smaller Irish fleet also targets anglerfish, megrim, and hake on the Stanton bank with 90- to 100-mm mesh. This fleet has declined in numbers in recent years.

The fishery for anglerfish has expanded into deeper waters with an associated increase in catches. The expansion of this fishery has been further accelerated by the diversion of fishing effort from other stocks subject to more restrictive quotas in recent years and by market opportunities. The fishery has expanded into areas believed to have been a refuge for adult anglerfish, increasing the vulnerability of the stock to over-exploitation. Immature fish are subjected to exploitation for a number of years prior to first maturity.

The larger Scottish and Irish trawlers fish for haddock at Rockall when opportunities arise for good catches from the Division VIb stock. Vessels from the Russian Federation have fished for haddock and other demersal species at Rockall since 1999 when part of the Bank was designated as being in international waters. Although young saithe are caught by coastal trawlers in Subarea VI, the fishery for saithe essentially takes place on the shelf edge to the west and northwest of Scotland. Traditionally, this fishery has largely been operated by the larger deep-sea French trawlers. However, the number of these vessels has declined in recent years. Since the late 1980s, some of these vessels diverted their activity toward deep-sea species, notably orange roughy, and some medium-sized trawlers also participate in the fishery for deep-sea species during summer in some years.

The pelagic fishery for herring is mainly operated by UK, Dutch, and German vessels in the north, and by Irish vessels in the south. Substantial misreporting of catches from the North Sea and between the northern and southern stocks occurred in the past, but UK licensing regulations are thought to have reduced misreporting since 1997. In recent years TACs for the northern stock have not been restrictive, presumably because of low effort and a weak market. The Clyde herring fishery has declined sharply in recent years as the stock has suffered from a series of low recruitments. Recent TACs have not been taken and the catches have been less than 1 000 t since 1991.

There is a directed trawl fishery for mackerel and horse mackerel in the area. The mackerel fishery mainly takes place in the fourth and first quarter of the year, when the mackerel is returning from the feeding area to the spawning area. The horse mackerel is mainly fished in the second half of the year. In addition, there are fisheries for blue whiting in the area.

The industrial fisheries in Division VIa are much smaller than in the North Sea. The Scottish sandeel fishery started in the early 1980s, peaking in 1986 and 1988. It is irregular, depending on the availability of the resource and of processing facilities at Shetland, Denmark, and the Faroes. Bycatches in this fishery are very small. The Norway pout fishery is conducted mainly by Danish vessels.

ICES has advised on the occurrence of cold-water corals in the North East Atlantic for the past two years. It has also advised that should managers wish to protect these habitats from the effects of fishing, the only effective way to do this is by closing them to all damaging fishing gear. In Subarea VI, one such area has been closed by fishery managers: the Darwin Mounds. This area lies to the south of the Wyville Thomson ridge (to the northeast in Figure 3.5.1.1). The Darwin Mounds have been impacted by towed bottom-fishing gear (ICES, 2002).

Figure 3.5.1.1 Distribution of cold-water coral records within ICES Subarea VI (from ICES, 2003).

Not all of the records of cold-water coral in Figure 3.5.1.1 are of reefs: some records are of individual fragments trawled or dredged up from the seabed. Accurate determination of the existence and location of reefs requires either remote sonar surveys or visual inspection, either using cameras or manned submersibles, coupled with accurate geo-referencing of the seafloor.

In Subarea VI, reefs have been found in UK internal waters to the east of Mingualay in the Outer Hebrides of Scotland (ICES, 2004), on the Rockall Bank (Figure 3.5.1.2), particularly on the northwestern and southeastern parts of the Bank (ICES, 2002; 2003). On the southeast Rockall Bank, the coral reefs are associated with large carbonate mounds (the Logachev Mound province) and are particularly well developed. Tangle nets and trawl scar marks have been observed in these reefs (ICES, 2003).

Both the UK and Irish governments have initiated processes that may, in due course, lead to some of these reefs (and other areas if found suitable) being designated as protected areas under European legislation. It seems very likely that if such sites are designated, fisheries legislation will be needed to help protect them. In the absence of designation, fisheries measures can also be taken to prevent such damage under the Common Fisheries Policy. Outside the European fishing zone (in the high seas to the west of Rockall), no formal protection measures seem possible yet.

Further development towards integrating this issue into combined ICES advice needs further information to be gathered on the location of cold-water coral habitats (and other sensitive benthic habitats) and on the effort being applied by fisheries in these areas, disaggregated on a fine scale.

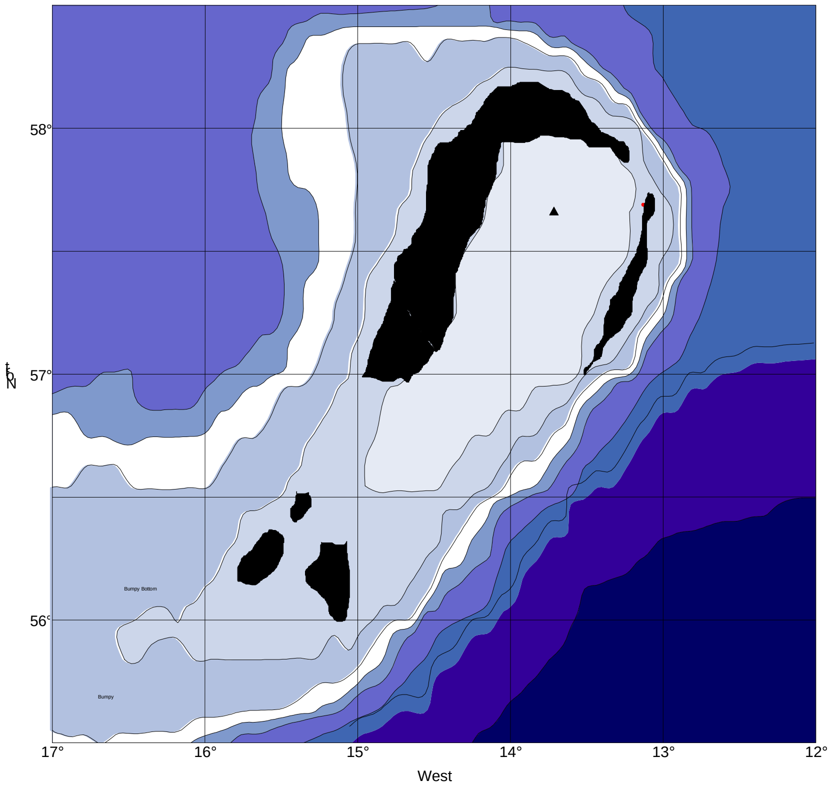

Figure 3.5.1.2 The distribution of coral reefs on Rockall Bank from fishermen's records (J. Hall-Spencer, pers comm.). The cross-hatched areas indicate the presence of *Lophelia* reefs (From ICES, 2003).

Stock status

It is likely that the stocks of haddock, saithe, anglerfish, and megrim in Division VIa are closely related to those of the same species in the North Sea. The saithe stock is assessed as part of the North Sea stock, and the pattern of haddock recruitment in the two areas is very similar. Data compilation for anglerfish now treats the catches from Division VIa and the North Sea as coming from a single stock.

Information on stock status of individual stocks is found in Section 4.5 and is summarised below in the text table providing single-stock boundaries.

3.5.2 Assessments and advice

Nominal catches

Table 3.5.2.1 represents total landings (in tonnes) by stock.

	Cod	Haddock	Whiting	Saithe	Anglerfish	Megrim	Sandeel	Norway pout	Herring(North)	Herring (South)
1985	18607	-	-	-	-	-	18586	-	39142	-
1986	11820	19574	-	-	-	-	24469	-	70764	-
1987	18971	27004	-	-	-	-	14479	-	44360	-
1988	20413	21137	-	-	-	3526	24465	6742	35591	29100
1989	17169	16693	7531	-	-	2267	18785	28196	34026	28200
1990	12176	10136	5643	-	5799	2210	16515	3316	44693	41439
1991	10927	10560	6660	-	5357	2432	8532	4348	28529	34300
1992	9763	11353	6004	-	8117	2549	4935	5158	28985	31750
1993	11778	19067	6872	-	9369	2721	6236	7338	31778	36550
1994	10806	14243	5901	-	8039	2693	10627	14148	24430	33200
1995	9600	12372	6076	-	11466	3498	7111	24439	29575	27792
1996	9427	13452	7156	-	17556	4054	13257	6322	26105	32500
1997	7034	12866	6285	9418	12836	3272	12679	9562	35233	27100
1998	5714	14401	4631	8436	9654	2705	5320	7186	33353	38900
1999	4201	10426	4613	7342	7413	2648	2627	4625	29736	26109
2000	2977	6949	3010	5890	6425	2247	5771	2005	23163	15005
2001	2347	6731	2438	6818	4728	2473	295	3214	24974	14060
2002	2442	7093	1709	5186	4155	1828	706	4815	31787	13587
2003	1241	5330	1356	5250	3439	1598	-	6397	28835	12921

Mixed fisheries and fisheries interactions

Demersal fisheries in the area are mixed fisheries, with many stocks exploited together in various combinations in different fisheries. In these cases management advice must consider both the state of the individual stocks and their simultaneous exploitation in demersal fisheries. Stocks in the poorest condition necessarily become the overriding concern for the management of mixed fisheries where these stocks are exploited either as a targeted species or as a bycatch.

Roundfish are caught in otter trawl and seine fisheries, with a 120-mm minimum mesh size that comprises mixed demersal fisheries with more specific targeting of individual species in some areas and/or seasons. Cod, haddock, and whiting form the predominant roundfish catch in the mixed fisheries, although there can be important bycatches of other species, notably saithe and anglerfish in the deeper water and of *Nephrops* on the more inshore *Nephrops* grounds. Static gear fisheries with mesh sizes generally in excess of 140 mm are also used to target cod. Saithe are mainly taken in a directed trawl fishery in deeper water along the shelf in Subarea VI. There is thought to be little bycatch of other demersal species associated with the directed fishery.

Large *Nephrops* fisheries take place in discrete areas that comprise appropriate muddy seabed sediment. Targeted *Nephrops* fisheries on these grounds are taken predominantly in trawls with mesh sizes of less than 100 mm using single- or multiple-rig trawls. *Nephrops* fishing grounds are mainly inshore grounds although there are smaller offshore fisheries at Stanton Bank and west of the Hebrides. The bycatch and discarding of other demersal species associated with *Nephrops*, the general nature of these fisheries and their bycatch can vary widely.

There are trawl and gillnet fisheries targeting hake and anglerfish and otter trawl fisheries targeting hake, megrim, and anglerfish in Subarea VI. The catch of other demersal species associated in these fisheries is uncertain. Management of these fisheries needs to include provisions to substantially reduce catches of hake so that the total catch of hake is less than 13 800 t over the distributional area of the stock.

There is an international fishery targeting haddock, grey gurnards, and other species at Rockall using small mesh. Successful application of TACs for this stock would require that there is a simple relationship between recorded landings and effort exerted. This assumption is unlikely to be true for Rockall haddock especially when coupled with ways of evading TACs including mis-reporting, high grading, and discarding. In the case of Rockall haddock these may occur to a large extent due to the remote nature of the fishery and the processing of catches at sea by some fleets. Direct effort regulation is therefore suggested as a means of controlling fishing mortality on Rockall haddock.

Single-stock exploitation boundaries and critical stocks

The state and the limits to exploitation of the individual stocks are presented in the stock sections (Sections 4.5.1–4.5.9). The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
Cod West of Scotland	Reduced reproductive capacity.	Increased risk of being harvested unsustainably.	Overfished.		ICES cannot provide quantitative forecasts.		Zero catch of cod in 2005. No recovery has been observed in this stock.
Hake – Northern stock (Division IIIa, Subareas IV, VI, and VII, and Divisions VIIIa, b, d)	Increased risk.	Increased risk.	Overfished.			The fishing mortality should be below $\mathbf{F}_{pa}$ and SSB should be above $\mathbf{B}_{pa}$. Reaching 140 000 tonnes SSB in 2006, requires F= 0.19.	Landings of less than 33 000 t.
Cod in Division VIb (Rockall)							No assessment.
Haddock West of Scotland	Full reproductive capacity.	Harvested sustainably.	Overfished. The current estimated fishing mortality is 0.56.		No gain in the long-term yield to have fishing mortalities above $\mathbf{F}_{max}$ (0.21).	Maintain SSB above $\mathbf{B}_{pa}$ in 2006, requires a reduction in fishing mortality to less than 0.39.	Landings less than 7 600 t in 2005. (SSB(2006) > $\mathbf{B}_{pa}$).
Haddock in Division VIb (Rockall)	Uncertain.	Uncertain.	Uncertain.				Catches reduced to the lowest possible level.
Whiting West of Scotland	Uncertain. Stock is low.						Not more than TAC for 2004 = 1,600 t
Whiting in Division VIb (Rockall)							No assessment.

Megrim in Subarea VI (West of Scotland and Rockall)	Uncertain.	Uncertain.	Uncertain.				About 2 200 t.
Anglerfish in Division IIIa, Subarea IV, and Subarea VI	Unknown.	Unknown.	Unknown.				Effort not allowed to increase. Fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycatch fish.
Norway pout West of Scotland							No assessment.
Sandeel in Division VIa							No assessment.
Nephrops in Division VIa (Management Area C)		Three functional units, all three harvested at sustainable levels.					11 300 t for 2004 and 2005.
Herring West of Scotland (Division VIa)	Spawning stock biomass acceptable. above $\mathbf{B}_{pa}$.	Reference points are not defined.					30 100 t. The present level of fishing mortality appears to be sustainable and has lead to a rise in SSB. Fishing at $\mathbf{F}_{sq}$ is sustainable.

Identification of critical stocks

The above table identifies the stocks that are below $\mathbf{B}_{lim}$, i.e. cod in Division VIa, northern hake, and haddock in Division VIb. These stocks are the overriding concerns in the management advice of all demersal fisheries:

- for the cod stock in Division VIa ICES recommends a zero catch;
- for hake the fishing should be restricted within a recovery plan. Such a plan should cover all areas and fisheries in which northern hake is fished;
- for haddock in Division VIb the catches should be reduced to the lowest possible level.

	Anglerfish IV+VI	Megrim	Cod VIa	Haddock VIa	Whiting VIa	Nephrops VIa	Saithe IV+VIa	Herring VIa	NEA Mackerel	Deepwater fish
Anglerfish IV+VI										
Megrim	Strong									
Cod VIa	Medium	Medium								
Haddock VIa	Medium	Medium	Strong							
Whiting VIa	Medium	Medium	Strong	Strong						
Nephrops VIa	Medium	Medium	Medium	Strong	Strong					
Saithe IIIa+IV+VIa	Weak	Weak	Weak	Weak	Weak	Weak				
Herring VIa	Weak	Weak	Weak	Weak	Weak	Weak	Weak			
NEA Mackerel	Weak	Weak	Weak	Weak	Weak	Weak	Weak	Weak		
Deepwater fish	Medium	Weak	Weak	Weak	Weak	Weak	Weak	Weak	Weak	

	Interaction
Weak	Weak
Medium	medium
Strong	strong

Stock interactions

Advice on fisheries management

Demersal fisheries in Subarea VI should in 2005 be managed according to the following rules, which should be applied simultaneously:

They should fish:

- **without catch and discards of cod in Subarea VI;**
- **in accordance with a recovery plan for northern hake or within an effectively implemented TAC of less than 33 000 t covering all areas where northern hake is caught;**
- **no directed fishery for haddock in Division VIb;**
- **Concerning deepwater stocks fished in Subarea VI, see Section 3.10;**
- **within the biological exploitation limits for all other stocks (see table above).**

Furthermore, unless ways can be found to harvest species caught in mixed fisheries within precautionary limits for <u>all</u> those species individually, then fishing should not be permitted.

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species that are at risk. Industry-initiated programmes to pursue such incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of species for which ICES expresses concern are fully and credibly reported. Such programmes could be considered in the management of these fisheries.

On a single-species basis, reductions in fishing mortalities have been advised for several stocks. Fishing mortality is generally high and has reached, for most stocks, their highest recorded values in recent years. The observed declines in SBB below precautionary levels are a clear indication of excessive effort. This, and the poor performance of TACs, as implemented in reducing fishing mortality, leads ICES to reiterate that the required reductions in fishing mortality can only be achieved if significant reductions in effort are included in management, and effective deterrents to discarding are implemented. Extensive discarding occurs in most fisheries on roundfish, anglerfish, and *Nephrops* to the west of Scotland. These discards are largely small and juvenile fish. They always result in foregone potential yield, and for depleted stocks they are a serious impediment to rebuilding.

Short-term implications

The catch options that would apply if single stocks could be exploited independently of others are summarized in the table above.

However, for the mixed fisheries management options must be based on the expected catch in specific combinations of effort in the various fisheries, taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, but must also result in catches that comply with the scientific advice presented above.

The information on the mix of species observed caught in fisheries in this area is not complete. An evaluation of the effects of any combination of fleet effort on depleted stocks would require that the catch data on which such estimates were based included discard information for all relevant fleets. Such data are not available to ICES. ICES is therefore not in a position to present scenarios of the effects of various combinations of fleet effort. If data including discards were available it would be possible to present a forecast based on major groupings of fleet/fisheries.

Regulations in force and their effect

The cod stock has been declining for some time and various stringent measures have been introduced to reduce fishing pressure on the cod stock:

- Commission Regulation (EC) No. 456/2001, of 6 March 2001, establishing measures for the recovery of the stock of cod to the west of Scotland (ICES Division VIa) and associated conditions for the control of activities of fishing vessels.

- Commission Regulation (EC) No. 715/2001, of 10 April 2001, amending Regulation (EC) No. 456/2001 establishing measures for the recovery of the stock of cod to the west of Scotland (ICES Division VIa) and associated conditions for the control of activities of fishing vessels.

- Commission Regulation (EC) No. 2056/2001, of 19 October 2001, establishing additional technical measures for the recovery of the stocks of cod in the North Sea and to the west of Scotland.

- Council Regulation (EC) No. 423/2004, of 26 February 2004, establishes multi-annual recovery plans that will constrain effort to specified harvest control rules.

- Council Regulation (EC) No. (EC Reg. 2287/2003) Annex IV established a new closed area for cod west of Scotland in 2004 and for haddock at Rockall.

These measures include technical regulations of minimum mesh sizes, closed areas, and decommissioning schemes for UK demersal vessels in 2001 and 2003. The 2001 scheme removed approximately 11% of the UK gross tonnage as recorded over 1998–2000 and 10% of the UK KW days fished. Figures corresponding to the 2003 scheme are not yet available.

Emergency EU measures were established in the first half of 2001 and led to short-term area closures from 6 March–30 April 2001 in the north of the Division and on a smaller scale in the Clyde Sea area. The regulations sought to minimise cod catches, but also to minimise the effect of the measures on certain pelagic and shellfish fisheries. Consequently, derogations existed for: purse seine and pelagic trawls targeting pelagic fish species; dredges, pots, and creels; and for the inner Clyde area, *Nephrops* trawls. The aim of the controlled areas was to allow as many cod as possible to spawn before the end of April when the spawning season finishes (Commission Regulation (EC) No. 456/2001). Consequently, the regulation targeted areas where high catch rates of cod are usually experienced during March and April. The controlled areas were not defined for the purposes of regulating fishing effort on the cod stock in this area. No measures were applied to regulate effort displaced during the period of the control. Since 2001, these trawlers have adopted mesh sizes of 100–120 mm and other gear modifications, depending on the requirements of recent EU technical conservation regulations and national legislation. The otter trawl vessels were required to use gear with minimum mesh size of 120 mm in 2002 and 2003. These measures were aimed at reducing the considerable rates of discarding of young fish, particularly cod as observed on vessels using 100-mm mesh trawls. The minimum mesh size for vessels fishing in the mixed demersal fishery in EC Zones 1 and 2 (West of Scotland, and the North Sea excluding Skagerrak) changed from 100 mm to 120 mm from the start of 2002. This came under EU regulations regarding the cod recovery plan (Commission Regulation EC 2056/2001), with a one-year derogation of 110 mm for vessels targeting species other than cod. This derogation was not extended beyond the end of 2002.

Gadoids are also a bycatch in the *Nephrops* and anglerfish fisheries in Division VIa. These fisheries use a smaller mesh size of 80 mm, but landings of cod are restricted through bycatch regulations. The minimum landing size of cod in the human consumption fishery in this area is 35 cm. Since mid-2000, UK vessels in this fishery have been required to include a 90-mm square mesh panel (SSI 227/2000), predominantly to reduce discarding of the large 1999 year class of haddock. Further unilateral legislation in 2001 (SSI 250/2001) banned the use of lifting bags in the Scottish fleet. Emergency measures were enacted in 2001, consisting of area closures from 6 March–30 April, in an attempt to maximise cod egg production. These measures have been retained into 2003 and 2004. Vessel decommissioning has been underway since 2002. Effort reductions for much of the international fleet to 16 days at sea per month have been imposed since February 2003 (EU 2003/0090).

Square mesh panels were introduced in UK fisheries in 2000 in an attempt to improve selectivity. The minimum mesh size for vessels fishing for cod in the mixed demersal fishery in EC Zones 1 and 2 (West of Scotland, and the North Sea excluding Skagerrak) was changed from 100 mm to 120 mm from the start of 2002 under EU regulations regarding the cod recovery measures (Commission Regulation EC 2056/2001), with a one-year derogation of 110 mm for vessels targeting other species, including whiting. If implemented effectively, these measures should help to improve gear selectivity and reduce discarding.

Effort regulations

Annex XVII to Council Regulation (EC) No. 2341/2002 regulated the maximum number of days in any calendar month of 2003 for which a fishing vessel may be absent from port to the West of Scotland. The maximum number of days of absence from port in any calendar month in 2003 and 2004 varies for particular gears:

West of Scotland	Maximum number of days of absence from port allowed:	
Gear:	2003:	2004:
Demersal trawls, seines, or similar towed gears of mesh size ≥ 100 mm, except beam trawls	9	10
Demersal trawls, seines, or similar towed gears of mesh size between 70 mm and 99 mm, except beam trawls[1]	25	22
Demersal trawls, seines, or similar towed gears of mesh size between 16 mm and 31 mm, except beam trawls	23	20

[1] With mesh size between 80 mm and 99 mm in 2004.

In 2003 and 2004 additional days may be allocated to Member States by the European Commission on the basis of the achieved results of decommissioning programmes.

A Commission Decision (C(2003) 762) in March 2003 allocated additional days absent from port to particular vessels and Member States. United Kingdom vessels were granted 4 additional days per month (based on evidence of decommissioning programmes). An additional two days was granted to demersal trawls, seines, or similar towed gears (mesh ≥ 100 mm, except beam trawls) to compensate for steaming time between home ports and fishing grounds and for the adjustment to the newly installed effort management scheme.

Information from the fishing industry

The fishing industry has provided information which has been included as part of the assessment process. Such information has contributed to the understanding of the fisheries, and is increasingly provided in a form which enables direct inclusion in quantitative assessments. Furthermore, for the third year in a row there has been information available from a fishermen’s survey on stock trends.

Quality of assessments and uncertainties

The assessments of demersal and herring stocks in Subarea VI continued to be hampered by the poor quality of catch data due to mis- and non-reporting. Survey information shows that estimates of the total removal of gadoids in Division VIa may have been underestimated in the past decade relative to earlier periods. This is particularly pronounced for cod and whiting. Although the discrepancy between the survey information and the catch information has been apparent for some time, new analysis of the data has revealed the extent of this discrepancy. The discrepancy is considered to be higher than can be explained by potential effects due to change in survey design.

There are thus indications that management control is not effective on limiting the absolute amount of removal. If the removal rate is not known, the productivity of the stock cannot be assessed reliably. The effect of the fishery on the stock can thus not be evaluated properly, and advice on future catches may therefore not be possible.

Estimates of area misreporting since 1987 were made for anglerfish and megrim. The distribution of reported catch data was also examined to estimate the likely extent of misreporting of herring between the North Sea and Division VIa North.

The biological data available from scientific sources for the assessment of roundfish, flatfish, herring, mackerel, and *Nephrops* in Division VIa are relatively good. The level of biological sampling of most of the commercial landings has been maintained or improved with the recent introduction of the Data Collection Regulation (EC 1543/2001). Discard data are used directly in assessments for *Nephrops*, cod, haddock, and whiting.

Several series of research vessel survey indices are available for most species. Otter-trawl surveys are presently undertaken in Division VIa by UK (Scotland) and Ireland. The UK (Scotland) also conduct a number of underwater television surveys for *Nephrops* in VIa. A survey is also conducted at Rockall by UK (Scotland) every two years.

Analytical assessments were performed on cod, haddock, whiting, *Nephrops*, and herring. Multispecies considerations are not incorporated in the assessments or the forecasts for the stocks in Subarea VI.

Trends in fishing mortality on megrim are poorly defined, and high rates of discarding have been observed in some fisheries. Recent studies have shown that male megrims attain a much smaller maximum size than females; thus female megrim make up the bulk of the landed megrim catch. Megrim has been taken as a bycatch in the anglerfish fishery. Previous management of the megrim stock was therefore linked to that for anglerfish on the assumption that landings were correlated in the fishery. It was assumed that the anglerfish management would also constrain fishing mortality on megrim. This may no longer be true due to recent changes in the fishing pattern in the Scottish and Irish fleets, and the dynamics of the two species are probably not linked.

The assessment of the stock of herring in Division VIa North is less uncertain than in previous years, reflecting the stability of the input data over the last two or three years. The fishing mortality is at present considered to be low. SSB is believed to have risen recently due to a good year class that entered the fishery in 2001 and an increase in the proportion of mature fish. However, reference points have not been set so far. The state of the herring stock in Division VIa South is uncertain and the fishery appears to be dependent on occasional strong year classes. There are indications that this stock may have declined considerably in recent years, and that levels of fishing mortality may be comparatively high. There is evidence that the Clyde herring stock remains low.

When last assessed (in 1996) the level of exploitation on sandeel was moderate and the SSB of this stock appears to be high. The stock is, however, subject to large variations depending on recruitment. Precautionary management has been put in place on a three-year basis, including a TAC and fishery closures after 31 July each year, in order to reduce the interaction with breeding seabirds.

Sources of information

ICES. 2002. Report of the ICES Advisory Committee on Ecosystems. ICES Cooperative Research Report, No. 254.

ICES. 2003. Report of the ICES Advisory Committee on Ecosystems. ICES Cooperative Research Report, No. 262.

ICES 2004. Report of the Working Group on *Nephrops* Stocks, 28 April–1 May 2003. ICES C.M. 2004/ACFM:19.

ICES. 2005. Report of the Working Group on Northern Shelf Demersal Stocks, 4–13 May 2004. ICES C.M. 2005/ACFM:01.

3.6 The Irish Sea, the Celtic Sea and Southwest of Ireland (Divisions VIIb,c,f,g,h,j,k), Western Channel (Division VIIe), and northern parts of the Bay of Biscay (Divisions VIIIa,b,d,e)

3.6.a The Celtic Sea and Southwest of Ireland (Divisions VIIb,c,f,g,h,j,k), Western Channel (Division VIIe), and northern parts of the Bay of Biscay (Divisions VIIIa,b,d,e)

3.6.a.1 The ecosystem

To date, stocks for which ecological dependence is considered in management advice have not been identified on a systematic basis. Rather, management strategies that take account of ecological dependence have been adopted when research has shown clearly that ecological dependence has a significant effect on the dynamics of the target stock, whether prey or predators. Predation is a much smaller contributor to mortality for large fish than for ‘forage’ species where predation mortality may commonly take 2/3 or more of the biomass annually. The effect of fishing therefore usually dominates mortality of “adult” fish of commercially exploited species, but less so for traditional ‘forage’ species or juveniles. Predation mortality on pre-recruit fish is high and can be variable over time within species. The “typical” effect of fishing on pre-recruit fish is much weaker. The possibility that fishing a depleting spawning stock biomass (SSB) would lead to a lasting reduction in recruitment is a particularly important aspect of this relationship.

Stocks for which ecological dependence has already been considered in management advice are: Barents Sea capelin, sandeel in the Shetland area, and sandeel in Subarea IV. There are also a number of stocks for which ecological dependence may need to be considered in management advice and for which quantitative assessments may or may not be available. These include: capelin in the Iceland-East Greenland-Jan Meyen area, sandeel in Division IIIa, Norway pout in Subarea IV and Division IIIa, sandeel in Subarea IV, Norway pout in Division VIa, and sandeel in Division VIa. These stocks are primarily from Northern regions; there are no stocks from the Southern Shelf area in this list. It would be naïve to assume that predator-prey dependencies do not exist in this area. A large number of pelagic stocks occur in this region (e.g. anchovy, sardine, herring, blue whiting, argentine, mackerel) that could be candidates as important prey species.

State of the art

Over the past four years preliminary multi-species models have been developed for parts of the Southern Shelf area. The EU Framework V project DST^2 (Development of Structurally Detailed Statistically Testable Models of Marine Populations; EU, QLRT-1999-01609), aimed to construct multispecies Gadget models [Globally applicable Area Dis-aggregated General Ecosystem Toolbox], for the Celtic Sea). The GADGET framework evolved from two earlier age-length-based modelling approaches, Bormicon (Stefánsson and Pálsson, 1997) and Fleksibest (Frøysa *et al.*, 2002).

Originally, it was planned that a model might be developed for the Celtic Sea which would include nine stocks: cod, hake, haddock, whiting, monkfish, megrim, sole, plaice, and *Nephrops*, chosen largely on the basis of their commercial importance. These species together represent around 49% of the total value of all Celtic Sea landings, yet they account for only 17% of the tonnage landed and less than 3% of fish biomass in the system. Preliminary analyses of published stomach content data (in particular the studies of Du Buit 1982, 1987, 1992, 1995, 1996), revealed that biological interactions between the proposed species were relatively weak and consequently that a multispecies formulation would prove of very limited value. 98% of predation by cod for example, focussed on species that would be outside of the proposed model. It was suggested (Anon., 2002) that the addition of pelagic fish species might introduce more interesting dynamics into the model. In particular, 58% of the total predation pressure on blue whiting *Micromesistius poutassou* was thought to be exerted by the nine 'selected species' and consequently the original short-list was broadened to include blue whiting, horse mackerel (54% of all landings), and mackerel (56% of fish biomass).

In the first instance, three single-species models were developed (cod, whiting, blue whiting), covering the period 1984–1998, and operating on a quarterly (seasonal) time-scale. Each model covered ICES areas VIIe-k, the geographical unit used in some demersal stock assessments for the region.

Cod, whiting, and blue whiting models were combined (in terms of predation, but not technical interactions), in autumn 2003. Data from France and the UK were entered into a DST^2 data warehouse with the aim of using automatic extraction processes to create new single-species Gadget models, e.g. for hake and/or megrim (*L. whiffiagonis*). For blue whiting (which is eaten by both cod and whiting), differences between the single-species

and multispecies Gadget formulation were examined. Biomass and abundance time-series from the two Gadget models were very similar (with a massive peak in 1998), although the estimated stock size in 1998 differed by 30 kt (706 kt in the multispecies model, compared to 41.4 kt in the single-species model). Hake *Merluccius merluccius* eat large quantities of blue whiting in the Celtic Sea (Du Buit, 1996), and hence this species would be a logical candidate for inclusion should the model be expanded further in the future.

The protection of sensitive ecosystems and the evaluation of damage caused by fishing activity are other aspects of importance to an ecosystem approach. ICES (ICES, 2002) advised that the only proven method of preventing damage to deep-water biogenic reefs from fishing activities is through spatial closures to towed gear that potentially impacts the bottom. While this would undoubtedly be effective in preserving (mainly the *Lophelia*) habitat, the practicality of closing all such habitats to trawl fishing is open to question (ICES, 2003a). ICES (2003a) identified that an urgent requirement for furthering the management of sensitive areas is the need for broad regional-scale maps, as well as detailed habitat maps on a site-specific scale. Temporary spatial closures may result in negative effects outside the closure, resulting from increased fishing activity in areas not normally exploited and fishing intensity may be increased to offset the loss of fishing opportunity (Dinmore *et al.*, 2003).

More work is required to develop criteria for evaluating and ranking the sensitivity of habitats with respect to fishing activities and in this way to identify environments that require management action. Consideration needs to be given to how the application of the criteria would use information on the structural and physical aspects of the habitat and the individual species that occupy these habitats. In general, sufficient information exists in the scientific literature to predict the physical effects of the majority of existing fishing practices, particularly those involving the use of towed gears that directly contact the seabed, on a number of habitats that may be considered as proxies for sensitive habitats, and to suggest mitigating actions. Gaps mainly exist in relation to the effects of bottom long-lining and tangle netting, and the type of mitigation measures that may be appropriate.

Stock boundaries

Time-series of the spatial distribution of abundance indices from the UK-WCGFS carried out in the Celtic Sea in March are available for hake, anglerfish (*L. piscatorius* and *L. budegassa*), and megrim (*L. whiffiagonis*) in the Celtic Sea area (Tidd and Warnes, *in prep*.). This survey indicates that the abundance of 2+ hake is highest along the shelf edge to the west and southwest of southern Ireland and southwest of Brittany. In some years hake also occur in high abundance to the south of Ireland, and there are sometimes smaller concentrations to the southwest of Cornwall. The distribution of juvenile (age 1) hake tends to be less associated with the shelf edge, with highest abundance often to the southwest of Brittany and to the south of Ireland. The distribution of megrim (*L. whiffiagonis*) is similar to that of hake, with highest abundance along the shelf edge to the west and southwest of southern Ireland. The distribution of anglerfish (*L. piscatorius*) is widespread with fish sometimes occurring in high abundance from the shelf edge into the Celtic Sea and western Channel, while anglerfish (*L. budegassa*) are much more concentrated along the shelf edge.

Functionality and structure of the ecosystem

There is little published information on the general sediment structure of the Celtic Sea, particularly further offshore (Ellis *et al.*, 2002). The substrates of the Western Channel are primarily sands and gravel with cobbles and rock off Cornwall (Bouysse *et al.*, 1979). Offshore the shelf sediments are primarily muddy sand, sand with shell debris, and gravels (Hartley, 1979; OSPAR Commission, 2000). Areas of mud exist in the Celtic Deep and along the shelf edge, where there are also extensive moribund sand banks (Stride *et al.*, 1982; Heathershaw and Codd, 1985). Channels and canyons exist on the continental slope (Kenyon *et al.*, 1978).

Ellis *et al.* (2002) describes the data used from beam trawl surveys and multivariate community analyses to describe the marine fauna of the Celtic Sea. Prior to this there were no published quantitative studies of the benthic assemblages in the Celtic Sea (Marine Institute, 1999) although molluscs had been sampled and reported on (Hartley and Dicks, 1977; Hartley, 1979) and there is work relating to benthic communities in the Irish Sea and St. Georges Channel (Mackie *et al.*, 1995; Ellis *et al.*, 2000) and more extensively to the Porcupine Bank and Goban Spur (Lampitt *et al.*, 1986; Flach and Heip, 1996a,b; Flach *et al.*, 1998; Flach and Bruin, 1999).

Two distinct macro-epibenthic assemblages were identified by Ellis *et al.*, (2002); one dominated by the anenome *Actinauge richardi* found along the edge of the Celtic Shelf and another characterised primarily by the hermit crab *Pagurus prideaux* and its commensal anenome *Adamsia carciniopados*, but with 3 sub categories and dominated by a wider range of species, found in the Celtic Sea. The most frequently occurring fish species associated with the *A. richardi* assemblage were the spotted dragonet, *Callionymus maculatus* and megrim, *L. whiffiagonis*, while poor cod, *Trysopterus minutus* and common dragonet, *Callionymus lyra* were associated with the *P. prideaux* assemblage. It was concluded that the Celtic and North Seas were relatively similar in terms of the dominant macro-epibenthic fauna, but biogeograhical differences occurred in particular due to the influence of Lusitanian species in the Celtic Sea.

At the present time the ICES Study Group on Cold Water Corals (SGCOR) has not identified deepwater biogenic reefs requiring protection from damage due to trawling on the Celtic Sea shelf, although sites where *Lophelia* is present have been identified on the shelf edge (ICES, 2003c).

Trophic web

As part of the EU Framework V project DST[2] (EU, QLRT-1999-01609) a database of stomach content records collected in the Celtic Sea between 1977 and 1994, was assembled and analyzed (Pinnegar *et al.*, 2003; Trenkel *et al.*, submitted). Mackerel, horse mackerel, and blue whiting were identified as important prey species for commercial fish stocks including hake and megrim. Diets changed markedly as the animals grew larger, with larger predators selecting larger prey, but also continuing to select smaller low-value benthic prey that were easier to catch rather than the large energy-lucrative prey (e.g. mackerel), even though the latter were available in high abundance. In general hake exhibited a preference for all types of small pelagic prey (blue whiting, argentines, and clupeoids), but hake >50 cm particularly targeted horse mackerel and clupeoids (*Sardina pilchardus*), whilst those <50 cm exploited blue whiting, argentines, *Trisopterus* spp., and small clupeoids (*Sprattus sprattus*). Megrim consumed a wide diversity and size-range of prey, with a preference for dragonettes, particularly by megrim <40 cm, which also consumed gobies and small flatfish. *Trisopterus* spp. were important for megrim >40 cm, and blue whiting and argentines were eaten by megrim across the whole length range. Significant or near-significant correlations between prey abundance in the environment (on an annual basis) and stomach contents were obtained only for blue whiting as prey of both megrim and hake. Megrim appeared to consume more dragonettes and gobies in years when these prey were abundant. The average prey-predator length ratio was lowest for hake and whiting, indicating that these species take large prey relative to their own size (Pinnegar *et al.*, 2003). The conclusion that blue whiting are an important prey for megrim and hake in the Celtic Sea and Bay of Biscay was also noted by du Buit (1982).

In further analyses Trenkel *et al.* (submitted) revealed evidence of density-dependent feeding by hake on horse mackerel, but not for any predators on mackerel. Blue whiting and other small pelagic species (argentines and clupeoids) were identified as being particularly important and were consumed at rates higher than would be expected, given the estimated abundance of the prey species. Complimentary seasonal patterns of predation were detected, by commercial species including hake and megrim, on blue whiting in summer and mackerel and *Trisopterus* spp. in winter. There was also some evidence of matching spatial density distributions (spatial collocation) between predators and prey, but to a lesser degree and only during spring for megrim and hake, with blue whiting, horse mackerel, and mackerel as prey (Trenkel *et al.*, submitted).

3.6.a.2 The human use of the ecosystem

The fisheries and their impact

Most of the demersal fisheries in this area have a mixed catch. Although it is currently possible to associate specific target species with particular fleets, various quantities of cod, whiting, hake, anglerfish, megrim, sole, plaice, and *Nephrops* are taken together, depending on gear type. Some fleets have also a large part of valuable non-TAC species in their catch (squids, cuttlefish, red mullet, a.o.). This is particularly true of coastal fleets.

Some of the main commercial demersal fleets as used in stock assessments are listed in Table 3.6.1.1.

Since the 1930s, hake has been the main demersal species supporting trawl fleets on the Atlantic coasts of France and Spain. Spain took around 60% of the landings, France 30%, UK 5%, Denmark 3%, and Ireland 2%. Hake are caught throughout the year, the peak landings being made in spring-summer months. The three main gear types used by vessels fishing for hake as a target species are lines (England and Wales, Spain), fixed-nets and trawls (all countries), mostly bottom trawls, and recently also Very High Opening trawls (Spain).

In the Celtic Sea and Western Channel, fisheries for demersal species, mainly cod, whiting, sole, and plaice, are conducted by Belgium, France, Ireland, and the UK. The principal gears used are otter trawls and beam trawls.

The targeting of sole and plaice using beam trawls became prevalent during the mid-1970s, leading to an increase in the landings of these two species. More recently, cuttlefish have become an important component of beam trawl landings, particularly during the winter months. The gradual replacement of otter trawls by beam trawls has occurred in the

Belgian and UK fleets. In the Bay of Biscay, since the 1980s, there has been a substantial replacement of inshore trawling by gillnet fisheries targeting sole.

A trawl fishery for anglerfish by Spanish and French vessels developed in the Celtic Sea, on the shelf edge around the 200-m contour to the south and west of Ireland and in the Bay of Biscay in the 1970s which expanded until 1990. This fishery used single- and twin-rig otter trawls in medium and deep water in Divisions VIIb,c,e-k. Bycatch species include hake, megrim, and to a lesser extent *Nephrops*. Although effort in most fleets appears to have declined since the early 1990s the increasing use of twin trawls may have increased the overall efficiency. In addition, a gillnet fishery targeting anglerfish developed in the Celtic Sea on the shelf edge around the 200-m contour to the south and west of Ireland in the 1990s.

Megrim in the Celtic Sea, west of Ireland, and in the Bay of Biscay are caught predominantly by Spanish and French vessels, which together have reported more than 60% of the total landings, and by Irish and UK demersal trawlers. Most UK landings of megrim are made by beam trawlers fishing in Divisions VIIe,f,g,h. Otter trawlers account for the majority of Spanish landings from Subarea VII, prosecuting a mixed fishery for anglerfish, hake, and megrim on the shelf edge around the 200-m contour to the south and west of Ireland. Irish megrim landings are largely made by multi-purpose vessels fishing in Divisions VIIb,c,g for gadoids as well as for plaice, sole, and anglerfish. Megrim landings have remained fairly stable over the period 1986–2003.

Nephrops are an important component of the fisheries in this area. These fisheries developed in the 1970s and 1980s. Fishing effort has decreased continuously since the early 1990s. However, gear efficiency has increased in recent years and this may have helped in maintaining LPUE at relatively high levels. In the Bay of Biscay, since 1st January 2000, the mesh size used when fishing for *Nephrops* has increased and is now similar to the one used for other demersal fish (70 mm). Management of these fisheries needs to be sensitive to bycatches of other stocks.

There are separate pelagic trawl fisheries targeting herring in the Celtic Sea and mackerel and horse mackerel in the whole area. In the past the herring fishery in this area was principally a “roe” fishery. In recent years the number of vessels in this fishery has declined substantially and the fishery has change to targeting herring for human consumption. There is also a small directed fishery for sprat in the Channel.

Stock status

None of the fish stocks assessed in this area are suffering reduced reproductive capacity. However, many of them are considered to be at risk of reduced reproductive capacity, and two are considered to be harvested unsustainably.

Of particular concern are Western Channel (VIIe) sole and plaice, Celtic Sea (VIIf,g) plaice, Celtic Sea (VIIe-k) cod, Bay of Biscay (VIIIa,b,d) sole, and Northern hake. These stocks exhibit high F and low SSB.

The SSB for both stocks of anglerfish decreased from 1986 until 1993, then increased up to 1995–1996 and are at present stable above $\mathbf{B}_{pa}$. For both stocks, fishing mortality in most years has been above $\mathbf{F}_{pa}$. In 2003 fishing mortality is estimated to be below $\mathbf{F}_{pa}$ for *L. budegassa*, while F 2003 for *L. piscatorius* is slightly above $\mathbf{F}_{pa}$. Recent recruitments (1997–2002 year classes) for both species are above average. There are indications of strong year classes – around the year 2000 for *L. piscatorius* and the 1998 year class for *L. budegassa* – but recruitment is poorly estimated.

Fishing mortality of Celtic Sea cod has been above $\mathbf{F}_{pa}$ since 1986 but has decreased in the last 4 years and is estimated to be just below $\mathbf{F}_{pa}$ in 2003. Recruitment is highly variable. The 1999 and 2000 year classes are above average, whilst the 2001 and 2002 year classes are estimated to be very weak. SSB is currently above $\mathbf{B}_{pa}$ but is predicted to decrease.

The assessment of Celtic Sea haddock was considered indicative of trends in the stock (due to the short time-series). The Celtic Sea haddock stock in 2003 is at a relatively high level in response to high recruitment in recent years. Fishing mortality has been relatively stable since 1996, but the estimate for 2003 suggests a large reduction and is the lowest in the (short) time-series. Recruitment seems to be highly variable. The 2001 year class is estimated to be very strong and there are indications that the 2002 year class may be even stronger.

The Northern hake stock is discussed fully in Section 3.9. It is important to note that this species is taken by most of the demersal fleets in this area. SSB of Northern hake has generally declined to the early 1990s to below $\mathbf{B}_{pa}$ and has remained stable since then. Preliminary indications from the 2004 survey indicate that the hake stock in 2004 is similar in size to 2003 and is somewhat higher than in 2001 and 2002. Fishing mortality has declined in recent years and this is estimated in 2003 to be just above $\mathbf{F}_{pa}$. The preliminary results of the Spanish Porcupine 2004 survey indicate that the year class 2002 is likely to be above average.

SSB of megrim (*L. whiffiagonis*) was high from 1984 to 1988, then declined until 1990. SSB increased from 1991 onwards and has been above $\mathbf{B}_{pa.}$ The fishing mortality has declined from the 1991 peak until 1997 and has increased since then to above $\mathbf{F}_{pa}$ in 1998, and decreased again in 2003. Recruitment at age 1 has been relatively stable. The 2001 year class is estimated to be strong.

There are no major concerns about the *Nephrops* stock in the Celtic Sea (FU 20-22), SW of Ireland (FU 19), and Aran grounds (FU 17). There are concerns about the status of the *Nephrops* stock on the Porcupine Bank (FU 16) as landings and LPUE have declined significantly in recent years.

The *Nephrops* stock in the Bay of Biscay has declined since the early 1990s but may have increased in the last few years. A reduction in the fishing mortality and an improvement of the selection pattern is required. The recent increase in mesh size (from 55 mm to 70 mm), which occurred in 2000 is unlikely to have improved selectivity significantly. SSB of Celtic Sea plaice peaked in 1988–1990, following a series of good year classes, then declined rapidly and has since 2000 remained close to, but above $\mathbf{B}_{lim}$. F has fluctuated around an average level (0.60) for the entire time-series. Most recent year classes have been below average.

SSB of Western Channel plaice peaked in 1988–1990, following a series of good year classes, then declined rapidly and has subsequently fluctuated between 1 600 t and 2 200 t, above $\mathbf{B}_{lim}$ but below $\mathbf{B}_{pa}$. F has fluctuated above $\mathbf{F}_{pa}$ for almost the entire time-series, and was in 2003 estimated at 0.76, a maximum for the series. There is evidence of a strong 2001 year class.

SSB of Celtic Sea sole has declined steadily since the early 1970s. SSB fell below $\mathbf{B}_{pa}$ in 1989, remained around that level until 1995, then fell again to a series low in 1998. SSB remained low until 2001, when the outstanding 1998 year class began to contribute and SSB increased above $\mathbf{B}_{pa}$. Fishing mortality has increased since the late 1970s, exceeding $\mathbf{F}_{pa}$ since the early 1980s, and in 2003 was above $\mathbf{F}_{lim}$. Recruitment has fluctuated with some peaks. The 1998 year class is the strongest in the series.

SSB of sole in the western Channel has declined since 1980 and is in 2004 estimated to be at its lowest level. Fishing mortality has been above $\mathbf{F}_{pa}$ since 1978, and mostly above $\mathbf{F}_{lim}$ since 1982. Since 1990 most year classes are estimated to have been below average.

SSB of sole in the Bay of Biscay has declined from the high levels of 1992–94, and has been below $\mathbf{B}_{pa}$ since 1999. Fishing mortality has generally increased since 1984 and has been above $\mathbf{F}_{lim}$ since 1997, with the exception of 2003. Since 1992 recruitment has been at a lower but stable level.

SSB of Celtic Sea whiting reached high levels in 1995 and 1996, and has decreased until 1999 though remaining well above $\mathbf{B}_{pa}$. SSB increased in 2001 as the strong 1999 year class matured. The 2000–2002 year classes are estimated to have been very weak. Fishing mortality was very high during the 1980s, decreased in the early 1990s and is currently estimated to be around 0.5.

The abundance of anchovy varies considerably according to fluctuations in recruitment, which is likely to be strongly dependent on environmental factors. The stock is very low in relation to the levels observed throughout the 1990s and this is mostly due to poor 2001 and 2002 year classes. There are some indications that the 2003 year class is below average, but somewhat better than the 2001 and 2002 year classes.

The state of individual stocks is presented in more detail the stock sections (see Section 4.6).

3.6.a.3 Assessments and advice

Mixed fisheries and fisheries interactions

Demersal fisheries in the area are mixed fisheries, with many stocks exploited together in various combinations in different fisheries. In these cases management advice must consider both the state of individual stocks and their simultaneous exploitation in demersal fisheries. Stocks in the poorest condition, particularly those outside safe biological limits, necessarily become the overriding concern for the management of mixed fisheries where these stocks are exploited either as a targeted species or as a bycatch.

Many of the fleets in the area operate on a mixture of demersal species (Table 3.6.1.1). As trends in stocks of various species are generally not in synchrony, advice provided on the basis of the status of individual species may result in advised fishing mortalities for a group of co-harvested species that cannot be realized simultaneously within the context of mixed fisheries. Stocks in need of special conservation efforts, such as those affected by recovery plans, present particularly difficult challenges. The reduction of fishing mortality (and effort) required for stocks outside safe biological limits, makes it very unlikely that TACs which would be sustainable for healthier stocks in the mixed fisheries could be taken. The needs of the stock(s) under recovery plans could be met most directly by simply setting the TACs for all species in mixed fisheries to correspond to the fishing mortality intended for the species under recovery plans, which would result in large foregone yields in many healthier stocks. The foregone yield could be reduced somewhat if effort could be adjusted on a fleet-by-fleet basis to comply with the total fishing mortality in the proposed recovery plan, while allowing as much harvesting of other species as possible. However, such an approach requires reliable information on the catch-at-age for all species in all fisheries, and is still likely to leave substantial potential harvestable biomass of several species unavailable to any fishery. Formulating advice in relation to mixed fisheries is a two-step procedure. First, ICES establishes limits for the exploitation of each species on the basis of its status, consistent with the Precautionary Approach. The second step is to identify the major constraints within which mixed fisheries should operate and through this analysis identify the additional constraints that further limit the fishing possibilities.

The main interactions between stocks in the Celtic Sea – Bay of Biscay area are:

- between sole and plaice in the beam-trawl fishery in Divisions VIIfg and VIIe,
- between *Nephrops* and cod and whiting in the *Nephrops* fishery in the Celtic Sea, and between *Nephrops* and hake in the Bay of Biscay,
- between the gadoids (cod and haddock, and whiting and haddock) within the trawl fishery for roundfish, mainly in Divisions VIIfg.

Sole in the Bay of Biscay is mostly (75%) caught by a gillnet fishery having few interactions with other stocks.

In the Bay of Biscay, large experiments to improve selectivity in the trawl fishery have been started in recent years. A rigid grid is being tested to avoid the catch of *Nephrops* less than 8.5 cm (total length). Preliminary results show that the use of such a device should be encouraged. Furthermore, in the *Nephrops* fishery the use of square mesh panels in the trawl is reported to reduce the catch of small hake (less than 27cm) by one-third.

Single-stock exploitation boundaries

The state and the exploitation limits of the individual stocks are presented in the stock sections (Section 4.6). The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	In relation to target reference points	
Anglerfish in Divisions VIIb–k and VIIIa,b *(L. piscatorius* and *L. budegassa)*	Acceptable	Increased risk (*L. piscatorius*) Acceptable (*L. budegassa*)	Overfished	-	Fishing mortality be reduced or kept below $\mathbf{F}_{pa}$		34 000 t for both species combined (23 800 t *L. piscatorius*, and 10 200 t *L. budegassa*) F below $\mathbf{F}_{pa}$ for L.piscatorius.
Cod in Divisions VIIe-k	Acceptable	Acceptable	Overfished	-	Fishing mortality be reduced by 17% to bring SSB above $\mathbf{B}_{pa}$ in one year		5 200 t F reduced by 17%
Haddock in Divisions VIIb-k	Unknown	Unknown	Unknown		Effort not allowed to increase		effort not allowed to increase
Hake – Northern stock (Division IIIa, Subareas IV, VI and VII, and Divisions VIIIa, b, d)	Increased risk	Increased risk	Overfished		Fishing mortality be reduced by 25% to bring SSB above $\mathbf{B}_{pa}$ in one year		33 000 t F reduced by 25%
Megrim in Divisions VIIb,c,e-k and VIIIa,b,d (*L. whiffiagonis and L. boscii*)	Acceptable	Acceptable	Overfished		F below $\mathbf{F}_{pa}$		the TAC for the two species combined no more than 22 600 t. 12% reduction in F
Nephrops in Divisions VIIb,c,j,k (Management Area L)	Unknown	Unknown	Overfished		Catches in FU 16 should be less than 1 100 t. In other FUs catches =< 2 200 t.		3 300 t
Nephrops in Divisions	Unknown	Unknown	Overfished		landings from		4 600 t

VIIf,g,h, excluding Rectangles 31 E1 and 32 E1-E2 + VIIa, south of 53°N (Management Area M)					Management Area M should not exceed 4 600 t		
Nephrops in Divisions VIIIa,b (Management Area N)	Unknown	Unknown	Overfished		stabilisation of the stock biomass		3 100 t
Plaice in the Celtic Sea (Divisions VIIf and g)	Increased risk	Unknown	Overfished		F to be reduced by 70% to bring SSB above $\mathbf{B}_{pa}$ in one year. If such a reduction is not possible, a recovery plan which includes a sustained reduction of fishing mortality should be implemented.		250 t F reduced by 70%
Plaice in Division VIIe (Western Channel)	Increased risk	Increased risk	Overfished		F to be reduced by 64% to bring SSB above $\mathbf{B}_{pa}$ in one year.		580 t F reduced by 64%
Plaice Southwest of Ireland (Division VIIh-k)	Uncertain	Uncertain	Uncertain		Catches in 2005 be no more than the recent average (2001–2003).		271 t
Plaice West of Ireland (Division VIIb,c)	Uncertain	Uncertain	Uncertain		Catches in 2005 be no more than the recent average (2001–2003).		77 t
Sole in the Celtic Sea (Divisions VIIf and g)	Acceptable	Harvested unsustainably	Overfished		F to be reduced below $\mathbf{F}_{pa}$		840 t 29% reduction in F

Sole in Division VIIe (Western Channel)	Increased risk	Harvested unsustainably	Overfished		F to be reduced by 80% to bring SSB above **B**$_{pa}$ in one year. If not possible, a recovery plan should be implemented		230 t 80% reduction in F
Sole in Divisions VIIIa,b (Bay of Biscay)	Increased risk	Increased risk	Overfished		F to be reduced by 25% to bring SSB above **B**$_{pa}$ in one year.		4 100 t F reduced by 25%
Sole Southwest of Ireland (Division VIIh-k)	Uncertain	Uncertain	Uncertain		Catches in 2005 be no more than the recent average (2001–2003).		335 t
Sole West of Ireland (Division VIIb,c)	Uncertain	Uncertain	Uncertain		Catches in 2005 be no more than the recent average (2001–2003).		62 t
Whiting in Divisions VIIe–k	Acceptable	Unknown	Overfished		No increase in F		10 600 t
Celtic sea herring	Uncertain	Reference points not defined	Unknown	restriction as least as stringent as those currently in place should continue in 2005 and into the future until there is clear evidence of stock recovery	**The current level of SSB level is uncertain relative to** B$_{pa}$**.**		11 000 t F change not known
Herring in VIa south and VIIb,c	Unknown	Unknown	Unknown		The fishery should not be allowed to expand. Further restrictions may be necessary.		14 000 t F change not known

The extent to which the stocks are taken in the same fisheries cannot be quantified on the basis of available data. The existing information suggest that the stocks are caught together to a high (H), medium (M), low (L) extent, or not at all (0), as indicated in the table below. The information in the table relates to catches, and the linkage is thus indicated as high also in cases where the catches of most of one stock taken in a fishery with another stock is discarded.

Technical interaction matrix	Anchovy VIII	Anglerfish budegassa VIIb-k, VIIIabd	Anglerfish piscatorius VIIb-k, VIIIabd	Cod VIIe-k	Haddock VIIb-k	Hake Northern	Herring Celtic Sea and Division VIIj	Herring VIa(S) and VIIbc	Horse Mackerel Southern
Anchovy VIII		0	0	0	0	0	0	0	0
Anglerfish budegassa VIIb-k, VIIIabd	none		H	L	L	M	0	0	0
Anglerfish piscatorius VIIb-k, VIIIabd	none	Trawl		L	L	M	0	0	0
Cod VIIe-k	none	Trawl	Trawl		H	L	0	0	0
Haddock VIIb-k	none	Trawl	Trawl	Trawl			0	0	0
Hake Northern	none	Trawl	Trawl	Trawl			0	0	0
Herring Celtic Sea and Division VIIj	none	none	none	none	none	none		0	0
Herring VIa(S) and VIIbc	none	none	none	none	none	none	none		0
Horse Mackerel Southern	none	none	none	none	none	none	none	none	
Horse Mackerel Western	none	none	none	none	none	none	none	none	none
Mackerel North East Atlantic	none	none	none	none	none	none	none	none	
Megrim VII, VIIIabd	none	Trawl	Trawl	Trawl		Trawl	none	none	none
Nephrops Area L: VIIbcjk	none	Nephrops trawl	Nephrops trawl	Nephrops trawl	Nephrops trawl	Nephrops trawl	none	none	none
Nephrops Area M: VIIfgh+VIIa	none	Nephrops trawl	Nephrops trawl	Nephrops trawl	Nephrops trawl	Nephrops trawl	none	none	none
Nephrops VIIIa,b	none	Nephrops trawl	Nephrops trawl	none	none	Nephrops trawl	none	none	none
Nephrops VIIIc	none			none	none		none	none	none
Plaice VIIbc	none			none			none	none	none
Plaice VIIe	none	Otter trawl, Beam trawl	Otter trawl, Beam trawl	Otter trawl, Beam trawl	none		none	none	none
Plaice VIIfg	none	Otter trawl, Beam trawl	Otter trawl, Beam trawl	Otter trawl, Beam trawl	Otter trawl, Beam trawl	none	none	none	none
Plaice VIIhjk	none			Beam trawl, Otter trawl			none	none	none
Sardine VIIIc, IXa	none	none	none	none	none	none	none	none	none
Sole VIIbc	none			none			none	none	none
Sole VIIe	none	Beam trawl, Otter trawl	Beam trawl, Otter trawl	Beam trawl, Otter trawl	none		none	none	none
Sole VIIfg	none	Beam trawl, Otter trawl	Beam trawl, Otter trawl	Beam trawl, Otter trawl	Beam trawl, Otter trawl	none	none	none	none
Sole VIIhjk	none			Beam trawl, Otter trawl			none	none	none
Sole VIIIab	none	Beam trawl	Beam trawl	none	none	Beam trawl	none	none	none
Sprat VIIde	none	none	none	none	none				none
Whiting VIIe-k	none	Trawl	Trawl	Trawl	Trawl		none	none	none
Seabass	none						none	none	none
Rays	none	Beam trawl, Otter trawl	Beam trawl, Otter trawl	Beam trawl, Otter trawl			none	none	none

Horse Mackerel Western	Mackerel North East Atlantic	Megrim VII, VIIIabd	Nephrops Area L: VIIbcjk	Nephrops Area M: VIIfgh+VIIa	Nephrops VIIIa,b	Nephrops VIIIc	Plaice VIIbc	Plaice VIIe
0	0	0	0	0	0	0	0	0
0	0	M	M	M	M			L
0	0	M	M	M	M			L
0	0	L	L	M	0	0	0	L
0	0		M	L	0	0		0
0	0	M	M	L	M			
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	H	0	0	0	0	0	0	0
	H	0	0	0	0	0	0	0
		0	0	0	0	0	0	0
none	none		H	M	M			
none	none	Nephrops trawl		0	0	0	L	0
none	none	Nephrops trawl	none		0	0	0	0
none	none	Nephrops trawl	none	none		0	0	0
none	none		none	none	none			
none	none		Nephrops trawl	none	none			0
none	none		none	none	none		none	
none	none		none	none	none	none	none	none
none	none		Nephrops trawl	none	none		none	none
none	none	none	none	none	none	none	none	none
none	none		none	none	none			none
none	none		none	none	none	none	none	Beam trawl, otter trawl
none	none	none	none	Nephrops trawl	none	none	none	none
none	none		none	none	none		none	none
none	none	none	none	none	Nephrops trawl	none	none	none
none	none		none	none	none		none	none
none	none		Nephrops trawl	Nephrops trawl	none		none	none
none	none							
none	none							

Plaice VIIfg	Plaice VIIhjk	Sardine VIIIc, IXa	Sole VIIbc	Sole VIIe	Sole VIIfg	Sole VIIhjk	Sole VIIIab	Sprat VIIde	Whiting VIIe-k	Seabass	Rays
0	0	0	0	0	0	0	0	0	0	0	0
L		0		L	L		M		L		M
L		0		L	L		M		L		M
M	L	0	0	L	L	L	0	0	H/M		L
L		0		0	L		0	0	H		
0		0			0		L				
0	0	0	0	0	0	0	0		0	0	0
0	0	0	0	0	0	0	0		0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
		0			0		0				
0	L	0	0	0	0	0	0	0	M		
0	0	0	0	0	L	0	0	0	M		
0	0	0	0	0	0	0	M	0	0		
0		0		0	0		0				
0	0	0		0	0	0	0	0	0		
0	0	0	0	H	0	0	0	0	0		
	0	0	0	0	H	0	0	0	L		M
none		0	0	0	0	0	0	0			
none	none		0	0	0	0	0	0	0	0	0
none	none	none		0	0	0	0	0	0		
none	none	none	none		0	0	0	0	0		
Beam trawl, otter trawl	none	none	none	none		0	0	0	L		M
none	none	none	none	none	none		0	0			
none	none	none	none	none	none	none		0	0		M
none	none	none	none	none	none	none	none				
Beam trawl, otter trawl		none	none	none	Beam trawl, otter trawl		none				
		none									
		none			Beam trawl, otter trawl		Beam trawl				

H; the stocks are taken together in most fisheries where they are taken and their fisheries linkage is therefore high; M: the stocks are taken together in some but not all important fisheries and their fisheries linkage is therefore medium; L: the stocks are taken together in some fisheries but are mainly caught independently of each other and their fisheries linkage is therefore low; 0: the stocks are never or only rarely caught together and they are thus not linked in the fisheries; na: information not available.

Identification of critical stocks

The table above identifies the stocks that are outside precautionary reference points.

Stocks for which reduction in exploitation is required are cod, hake, megrim, plaice Celtic Sea, plaice Western Channel, sole celtic Sea, sole Western Channel, and sole in the Bay of Biscay.

These stocks are the overriding concerns in the management advice for all fisheries where the interactions between stocks taken in the same fisheries should be considered:

- For sole VIIe and plaice VIIf,g either catches in 2005 as indicated in the table above, or recovery plans to define the limits within which the fisheries can take place and which ensure a large reduction in F in 2005;

- Reduction in fishing mortality has been advised for sole in Divisions VIIIa,b (Bay of Biscay), cod in Divisions VIIe-k, hake – Northern stock, Western Channel plaice (Division VIIe), and megrim in the whole area.

Advice on fisheries management

Fisheries in the Celtic Sea, Western Channel, and the Bay of Biscay should in 2005 be managed according to the following rules, which should be applied simultaneously:

They should fish:

- **without jeopardizing the recommended reduction in fishing mortality of cod, hake, megrim, plaice Celtic Sea, plaice Western Channel, sole Celtic Sea, sole Western Channel, and sole in the Bay of Biscay;**
- **Concerning deepwater stocks fished in Subareas VII and VIII, see Section 3.10;**
- **within the biological exploitation limits for all other stocks (see text table above).**

Furthermore, unless ways can be found to harvest species caught in a mixed fisheries within precautionary limits for <u>all</u> those species individually, then fishing should not be permitted.

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species that are at risk. Industry-initiated programmes to pursue such incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of species for which ICES expresses concern are fully and credibly reported. Such programmes could be considered in the management of these fisheries.

On a single-species basis, reductions in fishing mortalities have been advised for several stocks. Fishing mortality is generally high and have reached, for most stocks, their highest recorded values in recent years. The observed declines in SBB below precautionary levels are a clear indication of excessive effort. This, and the poor performance of TACs, as implemented in reducing fishing mortality, leads ICES to reiterate that the required reductions in fishing mortality can only be achieved if significant reductions in effort are included in management, and effective deterrents to discarding are implemented. Extensive discarding occurs in most fisheries on roundfish, anglerfish, and *Nephrops* in this area. These discards are largely small and juvenile fish. Discarding always results in foregone potential yield, and for depleted stocks they are a serious impediment to rebuilding.

Short-term implications

The catch options that would apply if single stocks could be exploited independently of others are summarized in the table above.

However, in mixed fisheries management options must be based on the expected catch in specific combinations of effort in the various fisheries, taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, but must also result in catches that comply with the scientific advice presented above.

The information on the observed mix of species caught in fisheries in this area is not complete. An evaluation of the effects of any combination of fleet effort on depleted stocks would require that the catch data on which such estimates were based included discard information for all relevant fleets. Such data are not available to ICES. ICES is therefore not in a position to present scenarios of the effects of various combinations of fleet effort. If data including discards were available it would be possible to present a forecast based on major groupings of fleet/fisheries.

Regulations in force and their effects

The assessment units used for many of the demersal stocks in this area are small and catches deriving from them are generally in the region of 10 000 t or less. However, the TACs set for the stocks often cover many assessment units. In addition, for some units, there are still insufficient data for adequate assessments. This means that TACs comprise a summation across units of analytical forecasts and average catches which may offer no effective management control of the exploitation rate. Since a number of stocks affected by this problem are close to or outside safe biological limits, there is a need to reconsider the areas for which TACs are set if management is to improve.

A notable feature of the demersal fisheries in this area is their mixed nature. The effectiveness of single-species TACs is likely to be diminished unless this is taken into account. Use of measures to reduce fishing mortality directly, such as effort reductions in fleets, is likely to avoid a number of the disadvantages of catch controls in regulating the exploitation rate.

The fisheries in the Celtic Sea are very similar to the fisheries in the Bay of Biscay and some of the same fleets operate in both areas. However, the technical measures in the two areas differ. Despite the revision by the European Commission Technical Conservation Regulation of existing technical measures on 1st January 2000, the minimum mesh sizes in the Celtic Sea are still often different from those in the Bay of Biscay. These differences make enforcement more difficult.

The catch includes a large amount of juveniles of some late-maturing species (anglerfish, hake). While improving selectivity to prevent any catch of hake less than 55 cm (length of maturity for females) seems to be difficult, some selective devices such as rigid grids should be promoted to protect juveniles of the incoming strong year classes of white anglerfish.

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Table 3.6.1.1 Commercial Fleets West of Ireland (Divisions VIIb,c,j,k), in the Celtic Sea (Divisions VIIf-k), Western Channel (Division VIIe), and northern parts of the Bay of Biscay (Divisions VIIIa,b,d, and e) as used by Working Groups for tuning.

Fleet Name	**Code**	**Gear Type**	**Fishing Area**		**Target assemblage**	**Used in the assessment of:**
UK (E+W) Inshore fleet	UK-INSHORE	Beam trawlers	VIIe		Flatfish	
UK (E+W) Offshore fleet	UK-OFFSHORE	Beam trawlers	VIIe		Flatfish	
UK(E+W) <24 Beam trawlers	UK-WEC<24BT	Beam trawlers	VIIe		Flatfish	
UK(E+W) >24 Beam trawlers	UK-WEC>24BT	Beam trawlers	VIIe		Flatfish	
UK (E+W) VIIe Otter trawlers	UK-WECOT	Otter trawlers	VIIe		Demersal	Plaice VIIe Sole VIIe Cod VIIe-k
UK (E+W) VIIf Otter trawlers	UK-CSOT	Otter trawlers	VIIf		Demersal	Plaice VIIfg
UK (E+W) VIIe Beam trawlers	UK-WECBT	Beam trawlers	VIIe		Flatfish	Plaice VIIe Sole VIIe
UK (E+W) VIIf Beam trawl	UK-CSBT	Beam trawlers	VIIf		Flatfish	Sole VIIfg Plaice VIIfg
Belgium beam trawlers (different fishing power corrections)	BEL-BEAM	Beam trawlers	VIIfg		Flatfish	Sole VIIfg
Irish Otter Trawl	IR-OT	Otter trawlers	VIIb VIIj		Demersal	Sole VIIh-k
Irish VIIj Otter Trawl	IR-7J-OT	Otter trawlers	VIIj		Demersal	Cod VIIe-k
Irish Combined VIIb,j Otter Trawl	IR-7B&J-OT	Otter trawlers	VIIb,j		Demersal	Haddock VIIb-k
Irish Combined VIIg,j Otter Trawl	IR-7G&J-OT	Otter trawlers	VIIg,j		Demersal	Whiting VIIe-k Haddock VIIb-k
Irish VIIj Beam Trawl	IR-BT	Beam trawlers	VIIj		Demersal	
Irish Nephrops Trawlers	IR Neph	Otter trawlers	FU 17, 19, 20-22		*Nephrops*	*Nephrops*
French Lorient gadoids trawlers	FR-LORIENT	Otter trawlers	VIIfgh VIIfg		Gadoids	Cod VIIe-k Whiting VIIe-k
French *Nephrops* trawlers St Guénolé & Loctudy	FR-NEPHROPS	Otter trawlers	VIIfgh VIIfg		*Nephrops*	*Nephrops* Cod VIIe-k Whiting VIIe-k
French Les Sables offshore trawlers	FR- SABLES	Otter trawlers	VIIIab		Demersal	Sole VIIIab
French La Rochelle offshore trawlers	FR-ROCHEL	Otter trawlers	VIIIab		Demersal	Sole VIIIab

Table 3.6.1.1 (Cont'd)

Fleet Name	**Code**	**Gear Type**	**Fishing Area**		**Target assemblage**	**Used in the assessment of**:
UK (E+W) Beam trawlers	EW-FU06	Beam trawlers			Flatfish	N. *L. pisc* N. *L. bude* (Not used)
Irish Combined VIIb,g,j Otter Trawl	IR-7-OT	Otter	VIIb,g,j		Demersal	N. megrim
French *Nephrops* trawlers in VIII	**FR-FU09**	Otter	VIII		**Nephrops**	**Nephrops**
French Lesconil *Nephrops* trawlers in VIII	FR-LESCONIL	Otter	VIII		**Nephrops**	N. Hake
French Les Sables offshore trawlers in VIII	FR- SABLES	Otter	VIII		Demersal	N. Hake (20/24 h)
French benthic trawlers in VII	FR-FU04	Otter	VII		benthic	N. *L. pisc* (en h) N. *L. bude* (en h) N. Megrim (* kW)
French benthic trawlers in VIII	FR-FU14	Otter	VIII		benthic	N. *L. pisc* N. *L. bude* (Not used)
Spanish Vigo trawlers in VII	SP-VIGOTR7	Otter	VIIj-h		Megrim Hake Anglerfish	N. Hake N. *L. pisc* N. *L. bude* N. Megrim (days / 100 HP)
Spanish A Coruña trawlers in VII	SP-CORUTR7	Otter	VIIb-c,j-k		Hake Nephrops Megrim	N. Hake (days) N. *L. pisc* (days / 100 HP) N. *L. bude* ('') N. Megrim (N)
Spanish Pasajes "Bou" trawlers in VIII	SP-BOU_PA8	Otter	VIII		Hake	N. Hake (N)
Spanish Cantábrico trawlers in VII	SP-CANTAB7	Otter	VII		Mixed	N. Megrim (N)
Spanish Ondarroa VHVO pair trawlers in VIII	SP-PAIRT_ON8	Pair trawl	VIII		Hake	N. Hake
Spanish Pasajes VHVO pair trawlers in VIII	SP-PAIRT_PA8	Pair trawl	VIII		Hake	N. Hake
Spanish Pasajes VHVO pair trawlers in VII	SP-PAIRT_PA7	Pair trawl	VII		Hake	N. Hake (N)
Spanish Ondarroa "Baka" trawlers in VII	SP-BAKON7	Otter	VII		Mixed	N. Hake (N) N. *L. pisc* (N) N. *L. bude* (?)
Spanish Ondarroa "Baka" trawlers in VIII	SP-BAKON8	Otter	VIII		Mixed	N. Hake (N) N. *L. pisc* N. *L. bude* (?)

3.6.b The Irish Sea (Division VIIa)

3.6.b.1 The ecosystem

The Irish Sea ecosystem is relatively well studied with several major projects either ongoing or completed in recent years. The physical hydrography of the Irish Sea is reasonably well understood and there have been significant advances in the understanding of the circulation of the Irish Sea largely as a result of large-scale research and modelling programmes (DEFRA, 2000). A number of recent reports have described the Irish Sea ecosystem in a more holistic way; these include: *Quality Status Report of the Marine and Coastal Areas of the Irish Sea and Bristol Channel 2000* (DEFRA, 2000) and *Ireland's Marine and Coastal Areas and Adjacent Seas: An Environmental Assessment* (MI, 1999). The UK Government Review of Marine Nature Conservation set up the Irish Sea Pilot project in 2002 to test the potential for an ecosystem approach to managing the marine environment at a regional sea scale. This "*Irish Sea Pilot project*" has now completed its research and has reported to DEFRA, making 64 recommendations and producing various reports and thematic maps describing the ecosystem (JNCC, 2004).

3.6.b.2 The human use of the ecosystem

The fisheries and their impact

The majority of vessels in the Irish Sea target *Nephrops* with either single- or twin-rig otter trawls. These vessels use either 70-mm diamond mesh with an 80-mm square mesh panel or an 80-mm diamond mesh in their codends, and their catch must consist of at least 35% *Nephrops* by live weight. These vessels have bycatches of whiting (most of which are discarded), haddock, cod, and plaice. Twin-rig otter trawl were first introduced in the early nineties. Recent studies show that the use of twin-rigs increases the proportion of roundfish bycatch in *Nephrops* fisheries compared with single-rig otter trawls. *Nephrops* catches are highly seasonal with the highest *Nephrops* catches in the summer months. Catch rates are also dependent on tidal conditions, with higher catches during periods of weak tide.

The roundfish fisheries in the Irish Sea are conducted primarily by vessels from the UK and Ireland. A Northern Irish semi-pelagic trawling for cod and whiting developed in the early 1980s. As the availability of whiting declined this fleet switched to mainly targeting cod and haddock. Irish, Northern Irish, and English and Welsh otter trawlers target plaice, haddock, whiting, and cod, with smaller bycatches of anglerfish, hake, and sole. Some Irish vessels participate in a fishery for rays in the southern Irish Sea. Since 2001, these trawlers have adopted mesh sizes of 100–120 mm and other gear modifications, depending on the requirements of recent EU technical conservation regulations and national legislation.

Fishing effort in the semi-pelagic effort increased rapidly between the early 1980s and early 1990s before decreasing somewhat in the mid-1990s. Fishing effort in the England and Wales otter trawl vessels longer than 12 m declined rapidly after 1989, and over 1992–1995 was about 40% of the effort reported in the 1980s, although it has increased slightly in recent years. There has been a declining trend in fishing effort for Northern Irish otter trawlers also since the early 1990s. Fishing effort for Irish otter trawlers has declined in recent years as many vessels switched from targeting roundfish to *Nephrops*.

There is also a beam trawl fishery which mainly takes place in the eastern Irish Sea with vessels from Belgium, Ireland, and the UK. This fishery mainly catches sole with important bycatches of plaice, rays, brill, turbot, anglerfish, and cod. The fishing effort of the Belgian beam-trawl fleet varies according to the catch-rates of sole in the Irish Sea compared to other areas in which the fleet operates. Fishing effort peaked in the late 1980s following a series of strong year classes of sole, but is presently only about 60% of the peak value.

The other gears employed to catch demersal species are gillnets and tangle nets, notably by inshore boats targeting cod, bass, grey mullet, sole, and plaice.

The main pelagic fishery in the Irish Sea is for herring. In recent years, it has been predominantly operated by one pair of trawlers from Northern Ireland. The size of this fleet has declined to a very low level in recent years.

There are also a number of inshore fisheries in the Irish Sea that target stocks not currently assessed by ICES. These include pot fisheries for crab, lobster, and whelk, a hydraulic dredge fisheries for razor fish, and dredge fisheries for scallops.

Stock status

In the past ten years the state of the Irish Sea cod and whiting stocks has deteriorated further. Fishing mortality has remained well above the precautionary levels and the spawning stock biomasses have declined to the lowest in the time-series in recent years. Stocks of *Nephrops* and plaice remained relatively stable close to or above biologically acceptable limits. The sole stock has been low during the 1990s and fishing mortality is close to reference levels. The herring stock has increased in recent years from low levels in the early 1990s. The haddock stock increased during the 1990s following some strong recent recruitment, but the biomass has been lower in recent years with high fishing mortalities.

The stock of **cod** is outside safe biological limits. The spawning biomass is below $\mathbf{B}_{\mathrm{lim}}$ and fishing mortality above $\mathbf{F}_{\mathrm{lim}}$. Fishing mortality on cod increased progressively throughout the 1980s and has been close to or above $\mathbf{F}_{\mathrm{lim}}$ since 1987. As with stocks of cod to the west of Scotland and in the North Sea, the high rate of fishing mortality has caused a long-term decline in spawning stock biomass, slowed or reversed only temporarily by occasional strong year classes. During the early 1990s, the spawning stock declined rapidly and recruitment has since varied around a lower average than in earlier decades. Two of the weakest year classes on record were formed in 1997 and 1998 and caused the spawning stock biomass to decline sharply in 2000 to a historic low well below $\mathbf{B}_{\mathrm{lim}}$. Global warming is often citied as a reason for the decline of cod stocks around Ireland and in the North Sea. The link between recruitment levels and sea temperature is however weak, due to the complex and often indirect patterns with which environmental changes influence the biology of the species. A change in temperature affects the timing and area of spawning, which in turn causes different prevalent feeding conditions and altered ocean current transport routes between spawning grounds and nursery areas. Studies have shown that the effect of temperature on cod recruitment is less pronounced when spawning stock biomass is low, as the likelihood of good recruitment is diminished *per se*. It can therefore be concluded that high fishing pressure resulting in low spawning stock biomass is the primary cause of decline in recruitment in the Irish Sea and changes in the environment, such as global warming, were probably secondary factors.

Landings and catches of **whiting** in the main otter trawl fisheries, which now operate mostly in the western Irish Sea, have declined precipitously over time. This decline reflects lower abundance, and with a low biomass and fishing mortalities above reference levels the stock is outside safe biological limits. Total international landings in 2003 were only 400 t compared to over 10 000 t in the 1980s. The proportion of the catch which is discarded has been increasing in recent years, rising to over 60% of the total catch in the last three years. Research surveys commencing in the early 1990s show this substantial decline in catches of whiting to be a phenomenon mainly of the western Irish Sea, whereas average catch-rates of whiting above the commercial minimum landing size are not only higher in the eastern Irish Sea throughout this period, but show little trend over time. The Irish Sea whiting fishery has been characterised by high levels of fishing mortality throughout the 1980s and 1990s. At such high fishing mortalities, the spawning stock contains few age classes and is vulnerable to poor recruitment. Discarding of whiting is considered a major problem in the *Nephrops*-directed fishery, which continues to use 70-mm and 80-mm meshes. The increases in mesh size to 100 mm or more in the roundfish fisheries, required under recent EU and national legislation, should reduce discard rates in these fisheries.

A notable phenomenon in the Irish Sea, and also in the Celtic Sea, during the 1990s has been a growth in the stocks of **haddock**. Very strong 1994 and 1996 year classes caused a substantial increase in stock size in the Irish Sea, leading to the development of targeted haddock fisheries using pelagic and demersal trawls. The fish are confined mainly to the western Irish Sea where established roundfish and *Nephrops* fisheries take place. This concentration of the stock may be responsible for the very high rates of fishing mortality observed in the 1990s, three times higher than $\mathbf{F}_{\mathrm{pa}}$, and the stock is harvested outside safe biological limits. Due to the TAC arrangements for Subarea VII, some national quotas proved limiting in the 1990s, causing substantial misreporting as the stock and fishery expanded. To alleviate this problem, a separate TAC allocation for Irish Sea haddock has operated since 1999. Substantial discarding of small haddock has been observed in the otter trawl fisheries. The stock should benefit from the recent increases in mesh size in the roundfish fisheries. Due to the poor quality of landings data for this stock and the absence of complete data on discards, the recent trends in abundance and fishing mortality are relatively poorly defined. Although there is evidence that fishing mortality may have reduced in recent years it remains above $\mathbf{F}_{\mathrm{pa}}$ and the stock size remains heavily dependent on the strength of the recruiting year classes.

The stock of **plaice** is within safe biological limits. The landings declined in the 1990s. This resulted from a combination of declining fishing effort and a succession of below-average year classes recruited since 1987. The spawning stock is currently above $\mathbf{B}_{\mathrm{pa}}$ and the fishing mortality since 1998 has been below $\mathbf{F}_{\mathrm{pa}}$. The stock is expected to increase and will have a low probability of falling outside safe biological limits in the medium term.

The **sole** stock has benefited several times since 1970 from very strong year classes, and as a consequence has sustained fishing mortalities that are considered high for a sole stock. Fishing mortality in the last three years has been reduced and is around $\mathbf{F}_{\mathrm{pa}}$. SSB has recently increased from the historic low in 1997 to close to $\mathbf{B}_{\mathrm{pa}}$. The frequency of strong year classes has decreased since the mid-1980s. The recent recruitment is estimated to be below average.

The stocks of ***Nephrops*** in the Irish Sea are considered to be fully exploited. All stock indicators show a stable trend and results of recent underwater television surveys show very high *Nephrops* densities in the western Irish Sea relative to other areas. Account should also be taken of the impact of this fishery on the stocks of vulnerable species. There has been no assessment in recent years of the effects on *Nephrops* due to predation by cod, but the low abundance of the latter has probably reduced its impact.

The stock of Irish Sea **herring** is presently subject to low fishing mortality exerted by a small fleet of trawlers from Northern Ireland. The stock has recovered from a collapse that followed high fishing mortalities in the 1970s. However, its present state is uncertain because the series of survey estimates remains too short to establish the recent trends in biomass.

The official landings of **Hake** from Division VIIa have been less than 500 t in recent years.

3.6.b.3 Assessments and advice

Ecosystem impacts of fisheries

By its very nature and scale, fishing has an impact on target stocks, on non-target stocks of fish, and on other species through their incidental catch in fishing gear. It can also affect marine food webs. In the Irish Sea, several fish stocks are close to or below safe biological limits and some skate and ray species are threatened (Brander, 1981). There are indications of a downward trend in mean trophic index in the last few decades, with biomass of higher trophic level species declining. Certain towed gears, in particular beam trawls, twin rigs, and scallop dredges, have direct impacts on the seabed due to physical disturbance. Such disturbance is widespread in the northern Irish Sea.

Mixed fisheries and fisheries interactions

Demersal fisheries in the area are mixed fisheries, with many stocks exploited together in various combinations in different fisheries. In these cases management advice must consider both the state of individual stocks and their simultaneous exploitation in demersal fisheries. Stocks in the poorest condition, particularly those outside safe biological limits, necessarily become the overriding concern for the management of mixed fisheries where these stocks are exploited either as a targeted species or as a bycatch.

Four main fishery units can be described in the Irish Sea: these are *Nephrops* otter trawlers, roundfish otter trawlers, semi-pelagic trawlers, and beam trawlers. As trends in stocks of various species are generally not in synchrony, advice provided on the basis of the status of individual species may result in advised fishing mortalities for a group of co-harvested species that cannot be realized simultaneously within the context of mixed fisheries. Stocks in need of special conservation efforts, such as those affected by recovery plans, present particularly difficult challenges. For instance, the reduction of fishing mortality (and effort) required for cod, makes it very unlikely that TACs which would be sustainable for healthier stocks in the mixed fisheries could be taken. The needs of the stock(s) under recovery plans could be met most directly by simply setting the TACs for all species in mixed fisheries to correspond to the fishing mortality intended for the species under recovery plans, which would result in large foregone yields in many healthier stocks. The foregone yield could be reduced somewhat if effort could be adjusted on a fleet-by-fleet basis to comply with the total fishing mortality in the proposed recovery plan, while allowing as much harvesting of other species as possible. However, such an approach requires reliable information on the catch-at-age for all species in all fisheries, and is still likely to leave substantial potential harvestable biomass of several species unavailable to any fishery.

Possibly the strongest mixed fishery interaction in the Irish Sea is between the *Nephrops* fishery and the whiting stock. In recent years (1999–2002) vessels targeting *Nephrops* account for around two-thirds of the whiting landings in the Irish Sea. Although discard estimates for fleets targeting *Nephrops* are incomplete and considered imprecise, recent estimates suggest that around 60% of the total catch of whiting in *Nephrops* fisheries is discarded. The use of square mesh panels for vessels targeting *Nephrops* with 70-mm codend mesh have been obligatory since 1994. Despite this technical conservation measure the proportion of small whiting caught and discarded in this fishery has continued to increase. ICES points out that in addition to effort restrictions further technical measures (e.g. increased codend and square mesh panel mesh sizes, separator panels, and fixed grids) should be investigated and may substantially reduce bycatch and discarding of whiting in this *Nephrops* fishery. These measures as implemented do not seem to have improved the selection pattern in the fishery or the overall status of the stock. This implies that a more radical re-design of *Nephrops* trawls or the introduction of other fishing technologies (e.g. pot fisheries) to reduce whiting bycatch to the lowest possible level is required.

The cod fishery was traditionally carried out by otter trawlers targeting spawning cod in spring and juvenile cod in autumn and winter. Activities of these vessels have decreased, whilst a fishery for cod and haddock using large pelagic trawls increased substantially during the 1990s. In recent years the mixed otter trawl fleets accounted for 20% of the total VIIa cod, haddock, and whiting, and 43% of the plaice landings. In recent years the semi-pelagic fishery has also targeted cod during the summer. The semi-pelagic fleet accounted for around 44% of the cod and 43% of the haddock landings in recent years. Cod are also taken as a bycatch in the *Nephrops* directed fishery which accounted for around 22% of recent landings. Although discard estimates for cod in the Irish Sea are not available discard rates are not thought to be substantial. However, misreporting and under-reporting of cod is thought to occur in some VIIa fisheries. Estimates of mis-reporting for some nations are included in the assessment, but the scientific advice for zero catch of cod stock requires that the practice be terminated.

Beam trawl fisheries in the Irish Sea account for around 91% of the sole, 47% of the plaice, and 7% of the cod landings in recent years (1999-2001).

Single-stock exploitation boundaries

The state and the limits to exploitation of the individual stocks are presented in the stock sections (Sections 4.6.1a, 4.6.2a, 4.6.3a, 4.6.4a, 4.6.5a, 4.6.6a). The state of the stocks and single-stock exploitation boundaries are summarised in the table below.

Stock	State of the stock				ICES considerations in relation to single-stock exploitation boundaries		Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005 and % reduction in F
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	In relation to target reference points	
Cod in Division VIIa	Reduced reproductive capacity	Harvested unsustainably	Overfished	2 170 t	Zero		Zero
Haddock VIIa	Undefined	Harvested unsustainably	Overfished		1 370 t		1 370 t 60% reduction in F
Nephrops FU 15 & FU 14 (Management area J)	Acceptable	Acceptable	Fully exploited		9 550 t		9 550 t
Whiting in Division VIIa					Reduce catch to lowest possible		Zero
Plaice VIIa	Full reproductive capacity	Harvested sustainably			2 970 t		2 970 t 43% increase in F. Current F is well below F_{pa}
Sole VIIa	Increased risk of reduced reproductive capacity	Harvested sustainably	Overfished		1 000 t		1 000 t 7 % increase in F
Herring	Uncertain	Uncertain	Unknown		Estimates of SSB and fishing mortality for recent years are uncertain and ICES cannot advise on catch levels in relation to PA limits		*Status quo* catch ~ 4 800 t

Identification of critical stocks

The above table identifies the stocks outside precautionary reference points.

The critical stocks are cod and whiting. For these stocks the SSB is lower than $\mathbf{B}_{\text{lim}}$.

These stocks are the overriding concerns in the management advice for all fisheries where the interactions between stocks taken in the same fisheries should be considered:

- for cod the advice is for zero catch until SSB has been rebuilt above $\mathbf{B}_{\text{lim}}$;
- for whiting the advice is to reduce catch to the lowest possible levels.

Other stocks for which substantial reduction in exploitation is required are haddock (60% reduction) and plaice (45%).

Advice on fisheries management

Fisheries in the Irish Sea should in 2005 be managed according to the following rules, which should be applied simultaneously:

They should fish:

- **without bycatch or discards of cod and minimal catch of whiting;**
- **without jeopardizing the recommended reduction in fishing mortality of haddock and plaice;**
- **within the biological exploitation limits for all other stocks (see text table above).**

Furthermore, unless ways can be found to harvest species caught in a mixed fisheries within precautionary limits for <u>all</u> those species individually, then fishing should not be permitted.

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species outside precautionary limits. If industry-initiated programs aim at reducing catches of species outside safe precautionary limits to levels close to zero in mixed fisheries, then these programs could be considered the in management of these fisheries. Industry-initiated programs to pursue such incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of species outside safe biological limits are fully and credibly reported.

On a single-species basis reductions in fishing mortality have been advised for all stocks in the Irish Sea with the exception of *Nephrops*, where no increase in fishing mortality has been advised. The observed decline in SSB below the precautionary level is a clear indication of excessive effort. This, and the poor performance of TACs, as implemented, in reducing fishing mortality, leads ICES to reiterate that the required reductions in fishing mortality can only be achieved if reductions in effort are included in management, and effective deterrents to discarding are implemented. The cod recovery plan introduced in 2004 now allows managers to control effort using days-at-sea. Substantial discarding occurs in *Nephrops*, roundfish, and flatfish fisheries in the Irish Sea. These discards are largely composed of juvenile fish. They always result in foregone potential yield, and for depleted stocks they are a serious impediment to rebuilding.

Short-term implications

The catch options that would apply if single stocks could be exploited independently of others are summarized in the table above.

However, for the mixed fisheries management options must be based on the expected catch in specific combinations of effort in the various fisheries, taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, but must also result in catches that comply with the scientific advice presented above.

The information on the mix of species observed caught in fisheries in this area is not complete. An evaluation of the effects of any combination of fleet effort on depleted stocks would require that the catch data on which such estimates were based included discard information for all relevant fleets. Such data are not available to ICES. ICES is therefore not in a position to present scenarios of the effects of various combinations of fleet effort. If data including discards were available it would be possible to present a forecast based on major groupings of fleet/fisheries.

The extent to which the stocks are taken in the same fisheries cannot be quantified on the basis of the available data. The existing information suggest that the stocks are caught together to a high (H), medium (M), low (L) extent, or not at all (0), as indicated in the table below. The information in the table relates to catches and the linkage is thus indicated as high, also in cases where the catches of most of one stock taken in a fishery with another stock is discarded.

Technical Interactions Matrix	Cod in Division VIIa	Haddock VIIa	*Nephrops* FU 15 & FU 14	Plaice VIIa	Sole VIIa	Whiting VIIa	Rays VIIa	Herring VIIaN	Scallops	Whelks	Razor Fish
Cod in Division VIIa		H	M	M	M	M	L	0	0	0	0
Haddock VIIa	Whitefish trawl, Semi-pelagic trawl, Seine-net		M	M	L	M	L	0	0	0	0
Nephrops FU 15 & FU 14	*Nephrops* trawl fishery	*Nephrops* trawl fishery		M	L	H	L	0	0	0	0
Plaice VIIa	Flatfish beam trawl, *Nephrops* trawl	*Nephrops* trawl	*Nephrops* trawl		H	L	M	0	0	0	0
Sole VIIa	Flatfish beam trawl, *Nephrops* trawl	Flatfish beam trawl	*Nephrops* trawl	Flatfish beam trawl		L	M	0	0	0	0
Whiting VIIa	Semi-pelagic trawl, *Nephrops* trawl, Whitefish trawl	Whitefish trawl, Semi-pelagic trawl, Seine-net	*Nephrops* trawl	*Nephrops* trawl	Beam trawl		L	0	0	0	0
Rays VIIa	Ray otter and beam trawl fishery	Ray otter and beam trawl fishery	*Nephrops* trawl	Beam trawl	Beam trawl	Ray otter and beam trawl fishery		0	0	0	0
Herring VIIaN	None	None	None	None	None	None	None		0	0	0
Scallops	None	None	None	None	None	None	None	None		0	0
Whelks	None	None	None	None	None	None	None	None	None		0
Razor Fish	None	None	None	None	None	None	None	None	None	None	

Regulations in force and their effects

The EU has introduced several emergency measures and a recovery plan for Irish Sea cod:

- Commission Regulation (EC) No. 304/2000, of 9 February 2000, establishing measures for the recovery of the stock of cod in the Irish Sea (ICES Division VIIa).

- Council Regulation (EC) No. 2549/2000, of 17 November 2000, establishing additional technical measures for the recovery of the stock of cod in the Irish Sea (ICES Division VIIa).

- Council Regulation (EC) No. 300/2001, of 14 February 2001, establishing measures to be applied in 2001 for the recovery of the stock of cod in the Irish Sea (ICES Division VIIa).

- Council Regulation (EC) No. 1456/2001, of 16 July 2001, amending Regulation (EC) No. 2549/2000, establishing additional technical measures for the recovery of the stock of cod in the Irish Sea (ICES Division VIIa).

- Council Regulation (EC) No. 254/2002, of 12 February 2002, establishing measures to be applicable in 2002 for the recovery of the stock of cod in the Irish Sea (ICES Division VIIa). The technical conservation measures referred to in Articles 2, 3, and 4 of Regulation (EC) No. 254/2002 shall also temporarily apply in 2004.

- Council Regulation (EC) No. 2287/2003, established technical conservation measures in the Irish Sea.

- Council Regulation (EC) No. 423/2004, of 26 February 2004, establishing measures for the recovery of cod stocks.

The emergency spawning closure in 2000 aimed to maximise the cod egg production from the severely depleted spawning stock (Council Regulation (EC) No. 304/2000) and subsequently established additional technical measures to improve the selectivity of towed gears (Council Regulation (EC) No. 2549/2000). The spawning closure covered known cod spawning grounds in the Irish Sea from 14 February to 30 April 2000.

Within the closure it was prohibited to use any demersal trawl, seine, or similar towed net, any gillnet, trammel net, tangle net, or similar static net or any fishing gear incorporating hooks. Derogations were permitted for *Nephrops* trawlers within defined areas, and for certain beam trawls, and some limited experimental fisheries were permitted with observers to examine bycatch of cod in fisheries for haddock and flatfish.

The closure was continued in 2001, 2002, 2003, and 2004, but was restricted to the western Irish Sea west of 4°50′W on the evidence that the abundance of adult cod in the eastern Irish Sea was too low to justify the restrictions on fishing for other species. Derogations for *Nephrops* fishing were continued also in 2003. Although certain areas of the *Nephrops* grounds close to the centres of cod spawning were closed to all fishing, *Nephrops* vessels with observers were permitted provided the nets were fitted with recently developed inclined separator panels that had been shown to markedly reduce the bycatch of cod.

Annex V to Council Regulation (EC) No. 2287/2003 extended effort regulation to the Irish Sea in 2004. The maximum number of days in any calendar month for which a fishing vessel may be absent from port in the Irish Sea during 2004, varies for particular gears:

Gear:	Maximum days allowed in 2004:
Demersal trawls, seines, or similar towed gears of mesh size ≥ 100 mm, except beam trawls	10
Beam trawls of mesh size ≥ 80 mm	14
Static demersal nets including gillnets, trammel nets, and tangle nets	14
Demersal longlines	17
Demersal trawls, seines, or similar towed gears of mesh size between 70 mm and 99 mm, except beam trawls[1]	22
Demersal trawls, seines, or similar towed gears of mesh size between 16 mm and 31 mm, except beam trawls	20

[1] : With mesh size between 80 mm and 99 mm in 2004.

Additional days may be allocated to Member States by the European Commission on the basis of the achieved results of decommissioning programmes.

In 2004 derogations may be allocated by Member States to vessels that provide track records indicating an historic catch composition of less than 5% cod. The Regulation for 2004 explicitly assumes that there will be a reduction in fishing mortality on cod in the Irish Sea due to the area closure for the protection of spawning fish. An additional two days will be available for demersal trawls, seines, or similar towed gears (mesh ≥ 100 mm, except beam trawls), and beam trawls (mesh ≥ 80mm) who spend more than half of their monthly allocated days fishing in the Irish Sea.

ICES has previously evaluated recovery plan proposals from the European Commission. The starting point for these evaluations was the stock data resulting from the WGNSDS 2003 assessment (with further evaluations of possible bias in estimated stock numbers, but no error in the inputs). The results of these evaluations indicate that SSB can be recovered over a time frame of 7–8 years but are considered to be overly optimistic. These simulations assume 100% implementation efficiency which has not been seen in the past management of the stock and hence are likely to underestimate the time needed for recovery. Recovery periods could be further attenuated by negative impacts on recruitment during a prolonged recovery period.

The EU Cod Recovery Plan regulation implemented in the Irish Sea from 2004 will impact the management measures for 2005, which will be formulated with reference to the estimates and forecasts of SSB in relation to limit and precautionary reference points. For stocks above $\mathbf{B}_{lim}$, the harvest control rule (HCR) requires:

1. setting a TAC that achieves a 30% increase in the SSB from one year to the next,

2. limiting annual changes in TAC to ± 15% (except in the first year of application), and,

3. a rate of fishing mortality that does not exceed $\mathbf{F}_{pa}$.

For stocks below $\mathbf{B}_{lim}$ the Regulation specifies that:

4. conditions 1–3 will apply when they are expected to result in an increase in SSB above $\mathbf{B}_{lim}$ in the year of application,

5. a TAC will be set lower than that calculated under conditions 1–3 when the application of conditions 1–3 is not expected to result in an increase in SSB above $\mathbf{B}_{lim}$ in the year of application.

The regulation is complemented by a system of fishing effort limitation. This is done by adjustment to the number of fishing days for vessels deploying gear of mesh size equal to or greater than 100 mm in direct proportion to the annual adjustments in fishing mortality that are estimated by ICES and STECF as being consistent with the application of the TACs established according to the above.

Information from the fishing industry

Some information was available from the fishing industry, but this was not yet in a format that could be incorporated into the assessment.

Factors affecting fishing operations

Technical measures in the Irish Sea fisheries in 2003 remained more or less the same as in 2002, with a western Irish Sea cod closure from mid-February to the end of April (with derogations for *Nephrops* trawlers) and a minimum mesh size of 100 mm for vessels targeting whitefish. A further round of decommissioning at the end of 2003 removed 19 out of 237 UK vessels that operated in the Irish Sea, representing a loss of 8% of the fleet by number and 9.3% by tonnage. The previous round of decommissioning removed 29 UK(NI) *Nephrops* and whitefish vessels and 4 UK(E&W) vessels registered in Irish Sea ports at the end of 2001.

Fishing operations for *Nephrops* in the Irish Sea show distinct patterns, with highest effort and LPUEs observed during periods of weak tides and during the summer months. This is related to the emergence patterns of *Nephrops* from their burrows.

Quality of assessments and uncertainties

Up until 2003 the biological data available from scientific sources for the assessment of roundfish, flatfish, herring, and *Nephrops* are relatively good. The level of biological sampling of most of the commercial landings has been maintained or improved with the introduction of the Data Collection Regulation (EC 1543/2001). In 2003 sectors of the fishing industry in the UK (Northern Ireland) denied scientist access to the port sampling, information necessary for the estimation of landings and catch composition. If this is to continue it will likely result in higher uncertainties in the stock status in the future and thus a more precautionary advice. Since August 2004 scientists have been allowed to sample in one North Irish port. Discard data are only used directly in assessments for *Nephrops* and whiting. Discard data are available for some UK and Irish fleets but are currently not used in many assessments because of short or incomplete time-series and because of concerns about raising methods and precision of the estimates.

Data on landings, fishing effort, and species composition are available for most fleets in the Irish Sea. However, it is uncertain how reliably these data reflect trends in effective effort, i.e. nominal effort after corrections for technological improvements. Restrictive management measures (TACs) have also resulted in changes in the fishing practice of some fleets and redirected their effort to other species. In a number of cases this has lead to relying less on, or completely disregarding the use of time-series of commercial CPUE data in the assessments (cod, haddock, whiting, and plaice). In some recent years there has been misreporting of roundfish landings associated with restrictive quotas. The landings of one nation have been corrected for mis-reporting, and the extent of mis-reporting by other countries is uncertain.

Several series of research vessel survey indices are available for most species. Otter-trawl surveys are presently undertaken in Division VIIa by UK(NI), UK(Scotland), and Ireland. The Scottish and Irish surveys in Division VIIa are extensions of surveys covering Divisions VI and VIIb-k, and data for VIIa are only available for a few years. Survey data are available from the UK(E&W) September beam trawl survey and the UK(NI) MIK net survey. The UK(NI) also undertake an acoustic survey for herring in VIIa and a trawl survey for *Nephrops*. In 2003 and 2004 the UK(NI) and Ireland also conduct underwater television surveys for *Nephrops* in VIIa.

Analytical assessments were performed on cod, haddock, plaice, sole, and herring. Multispecies considerations are not incorporated in the assessments or the forecasts for the Irish Sea stocks.

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3.7 The Iberian Region (Division VIIIc and Subareas IX and X)

3.7.1 The ecosystem

Coastal morphology, circulation and volume transport

Three different areas can be distinguished, (i) the Cantabrian Sea, with a diminishing Atlantic influence towards the interior of the Bay of Biscay, (ii) the west coast of the Iberian Peninsula with seasonal coastal upwelling in summer and constituting the northern limit of the Eastern North Atlantic Upwelling Region and (iii) the Gulf of Cadiz area with strong influence of the Mediterranean Sea. Within these zones the topographic diversity and the wide range of substrates result in many different types of coastal habitat. This diversity is reflected in the biological richness of the OSPAR Region IV- Bay of Biscay and Iberian Coast with a wide range of fish species (OSPAR, 2000).

The circulation of the west coast of the Iberian Peninsula is characterized by a complex current system subject to strong seasonality and mesoscale variability, showing reversing patterns between summer and winter in the upper layers of the slope and outer shelf.

Another important feature of the upper layer is the Western Iberia Buoyant Plume-WIBP which is a low salinity surface water body fed by winter-intensified runoff from several rivers from the northwest coast of Portugal and fjord-like lagoons (The Galician Rias). The intermediate layers are mainly occupied by a poleward flow of Mediterranean Water (MW), which tends to contour the southwestern slope of the Iberia, generating mesoscale features called Meddies, which can transport salty and warm MW over great distances in the North Atlantic.

During the spring and the summer the surface currents generally flow towards the south following the coastline in Portugal and Galicia. These currents, together with the persistent equatorwards winds, produce an important upwelling mainly on the Portuguese coast from Nazaré Canyon to the north-west corner of the Iberian Peninsula, where the coastline is more regular, there are no important capes, and northern wind stress is more constant. The upwelling phenomena provide nutrients and affect the thermal stratification, leading to an important biological production and important concentrations of zooplankton feeders in the shelf break, such as snipefish, blue whiting (especially younger stages), and boarfish. In Galicia, the nutrient fertilisation by the upwelling is enhanced because of the interaction of upwelling circulation and the coastal topography. The size and orientation of the rias favour the growth of phytoplankton near the coast, supporting large consumer populations, (e.g. >200.000 tonnes per year of mussels from raft aquaculture). Water circulation inside the rias causes the subsequent export of organic matter to nearby shelf areas, where inorganic nutrients are recycled and reentered into the rias, further enhancing organic production.

In the Cantabrian Sea, the surface currents generally flow eastwards during winter and spring and change westwards in the summer. These changes in the currents direction produce seasonal coastal upwellings and high biological production phenomena, with variable importance depending on the strength of the currents. However, upwelling events in the northern Iberian shelf are generally restricted to a narrow band near the coast in the western Cantabrian Sea. The deep currents move towards the north on the Portuguese and Galician shelf. With the end of the upwelling in autumn starts the influence of the Poleward Current in surface waters, which during the winter, coming from the Portuguese shelf and aided by south-westerly winds, gets into the Cantabrian Sea transporting warm and saline waters along the continental shelf. This flow, known as the “Navidad current”, extends its influence from the surface to waters below 400-m depth and is the main energy input in the Cantabrian Sea during the wintertime. In contrast to upwelling waters, the Poleward Current is associated with the remineralisation of organic matter and protozoan-based food webs. Furthermore, the interaction between the poleward flow and both coastal and oceanic waters produce fronts which determine the distribution of plankton, fish eggs, and larvae.

Community structure and the effects of climate

The topography of the seabed in the area is highly variable and this shapes the fish community structure. Most of the area is characterised by a narrow shelf with several submarine canyons entering into the continental margin. The Cap Breton Canyon delimits the northern border of the stocks studied, and has historically been considered a natural obstacle for benthic and demersal populations. This fact has not been proved and the Canyon probably does not have the same importance for all species; for more benthic species such as megrims it is probably a more important obstacle than for species such as hake. For more pelagic species, such as horse mackerel, it has been shown that the boundary between the southern and the western stock corresponds to Cape Finisterra in the northwest point of the Iberian Peninsula, which may be related to different oceanographic features between the areas to the south and to the north of Finisterra.

Studies on the biodiversity of the macrofauna of the Portuguese continental margin based in bottom trawl surveys in the area indicate that species richness seems to have increased slightly during the nineties, but no clear pattern of diversity has been detected over time. Besides, the highest richness is found in the south-eastern shallow area while highest diversity occurs on the south-western coast. Richness is highest at about 90 metres and lowest at about 200 m; on the other hand diversity is highest on deep grounds (~500 m) and in shallow ones (down to ~80 m).

A similar pattern in bathymetric variability of richness is described for the fish fauna in the Cantabrian Sea. The high richness is found in the inner shelf (71-120 m) and in the coastal strata (30-70 m), and the lowest in the shelf break (501-750 m) and the outer shelf (201-500 m). The diversity index shows a more variable pattern during the 1990s; the outer shelf presents the lowest values for most of the decade, while the inner shelf presents high values for all the decade and the shelf break only from 1994.

The effect of upwelling and the NAO index on horse mackerel and sardine recruitment variability has also been well studied. It has been seen that during the seventies and nineties winds increased during the winter, conditioning sardine to be at a low productivity regime. This occurred during the positive winter NAO index. Another environmental factor shaping fish communities is the temperature. Studies have shown that an increase in mean sea surface temperature over recent years has been related to a change in species composition due to a decline in zooplankton and phytoplankton in the North Atlantic.

Upwelling in the Iberian Peninsula has a large influence in the pelagic community, both in terms of productivity and thus food availability, and offshore transport and thus possible increase in mortality rates. Upwelling indexes, both based on wind data and hydrographical models have been used to improve environmental-stock-recruitment relationships. Seasonal upwelling, local upwelling and mesoscale induced upwelling have also been suggested as important environmental features affecting ecosystem production and fish recruitment, although measures of these features on a large scale are necessary to improve understanding of fish recruitment.

Sardine, anchovy, mackerel, and horse mackerel in waters off the Iberian Peninsula and the Bay of Biscay are all found in the stomachs of several cetacean and fish species (e.g., hake, tuna, John Dory, etc.). Sardine and anchovy are also eaten by mackerel and horse mackerel. There is a degree of cannibalism by adults on juveniles and/or eggs when food is scarce. Sardine was found to be one of the main prey species for common dolphins (*Delphinus delphis*) (observed in stranded specimens and in specimens obtained from bycatches in Galician (NW Spain) and Portuguese waters. Both anchovy and sardine were found to be the most abundant prey taken by common dolphins stranded on the Atlantic French coast, and mackerel and horse mackerel were also reported in the diet. Common dolphins are the most abundant cetacean species in the area with population sizes in numbers estimated to reach several thousands. Other less common cetacean species are also known to predate on sardine, anchovy, mackerel, and horse mackerel. The cetaceans include harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), striped dolphin (*Stenella coeruleoalba*), and white-sided dolphin (*Lagenorhynchus acutus*). Fish eaten by dolphins seem to be smaller than those targeted by the fishery, i.e., most predation concentrates on younger fish and thus potentially affects recruitment.

3.7.2 The human use of the ecosystem fisheries

Fisheries and their impacts

Description of the fisheries

A large number of commercial and non-commercial fish species are caught for human consumption in this region. The fisheries in the Atlantic Iberian Peninsula exploit demersal and pelagic fish species, crustaceans, and cephalopods. Different kinds of Spanish and Portuguese fleets operate in this area.

The main pelagic species in the Iberian Peninsula are sardine and anchovy (small pelagic) and mackerel and horse mackerel (middle-size pelagic). These species form the basis of important fisheries in the Iberian Peninsula and in the Bay of Biscay, which represent an important source of income for local economies. Also characteristic are other species more common to temperate and subtropical waters, such as chub mackerel (*Scombe. japonicus*), Mediterranean horse mackerel (*Trachurus mediterraneus*), and blue jack mackerel (*Trachurus picturatus*). Small pelagic fishes are generally caught by purse seiners, while a wider variety of gears are used to catch middle-sized pelagic fishes, hand-lines and bottom trawl gears.

The Southern demersal stocks, namely hake, megrim, four-spot megrim, and anglerfish (*Lophius. piscatorius* and *L. budegassa*), are distributed throughout along the Atlantic coast of the Iberian Peninsula. The megrim species are not evenly distributed in the area; megrim is common only on the northern oast of Spain, yet is scarce on the Portuguese coast.

Portuguese fisheries

The main Portuguese fisheries in the area are the trawl, artisanal, purse-seine, and longline fisheries.

The trawl fishery comprises two fleet components e.g., the trawl fleet catching demersal fish (65-mm mesh size) and the trawl fleet directed to crustaceans (55-mm mesh size and above 70 mm for Norway lobster). Around 100 vessels operate in this fishery, of which 35 are licensed for crustaceans.

The trawl fleet targeting fish operates off the entire Portuguese coast mainly at depths between 100 and 200 m while the fleet targeting crustaceans operates mainly in the Southwest and South in deeper waters, from 100 to 750 m. The main species landed are: hake, white and black anglerfish, megrim and four-spot megrim, horse mackerel, mackerel, Spanish mackerel, blue whiting, red shrimp (*Aristeus antennatus*), rose shrimp (*Parapenaeus longirostris*), and Norway lobster.

Trawl fishing effort in Portuguese continental waters has been recorded since 1950 until present as hours fishing. It can be seen that effort increased until the early 1970s, and has since then decreased to levels similar to those of the 1950s.

The artisanal fishery is composed of a large number (around 7500) of small boats, operating mainly inshore and using a variety of gears as gillnets (the majority), seines, beam trawls, longlines, traps, and dredges. Some of these boats are licensed for more than one type of gear. The main species landed are octopus, pouting, horse mackerel, hake, mackerel, and sardine.

The purse-seine fishery, the most important in landings volume, is composed of around 130 purse-seiners. This fleet targets mainly sardine, which constitutes more than 80% of their landings, using a mesh size of 35 mm. Other pelagic species landed are horse mackerel and Spanish mackerel.

The longline fishery, of artisanal nature, is composed of 22 vessels and targets black scabbardfish (*Aphanopus carbo*) in a limited area (hard grounds along canyon slopes off Sesimbra (South of Lisbon)). Fishing takes place at depths ranging from 800 to 1200 m.

Spanish fisheries

The Spanish fleets operating in the Atlantic Iberian Peninsula shelf catch also a variety of species: hake, white and black anglerfish, megrim and four-spot megrim, Norway lobster, blue whiting, mackerel, and horse mackerel. In the Gulf of Cadiz, the south-eastern border of the Atlantic Iberian region, two groups of trawlers can be distinguished: the most numerous group normally operates in shallow waters (30-50 m), for which the target species are a mixture of sparids, cephalopods, sole, hake, and horse mackerel, and the other group which operates between 90-500 m and mainly targets blue whiting, shrimp, horse mackerel, hake, and Norway lobster. The other group consists of smaller trawlers fishing for hake as well as crustaceans, molluscs, and cephalopods (Octopus etc.).

The number of trawlers has decreased since the early 1980s, resulting in a decreasing trend in the overall effort in the Portuguese and Spanish fleets. The number of boats in fleets operating with gillnets and longlines has also declined in recent years. Portuguese and Spanish boats using trawl, longline, or fixed nets are currently subjected to a restricted access system.

A summary of the Spanish fleets operating in the Iberian Peninsula waters is presented below.

Fishery	Area	Gear	Target species	Description
Small gillnet “Beta”	Division VIIIc and IXa North	Fixed nets	Hake.	Mesh size of 60 mm.
Gillnet “Volanta”	Division VIIIc			Mesh size of 90 mm.
Gillnet “Rasco”			Anglerfish	Mesh size of 280 mm.
Long line fleet	Division VIIIc	Long line	Hake + Great Fork beard + Conger	
North Spain Artisanal fleet		Miscellaneous		Miscellaneous fleet
Gulf of Cadiz_Artisanal fleet	South of Division IXa			Miscellaneous fleet
Baca Otter Trawl Mixed Fishery	Divisions VIIIc and IXa North.	Trawl	Horse mackerel + Blue whiting+ Mackerel+ White fish	Mesh size of 65 mm Opening: 1.2-1.5 m
Pair Bottom Trawl Fishery			Blue whiting	Mesh size of 55 mm Vertical opening of 25 m.
VHVO Bottom Trawl Fishery	Divisions VIIIc West and IXa North		Horse mackerel	Mesh size of 65 mm Vertical opening of 5-5.5 m
Gulf of Cadiz_Trawl fleet (<35 GRT)	South of Division IXa		Sparids+ Cephalopods+ Sole+ Hake + Horse mackerel	
Gulf of Cadiz_Trawl fleet (>35 GRT)			Blue whiting+ Shrimp+ Horse mackerel+ Hake+ Norway lobster	

Two stocks of anchovy **are considered in the Iberian Region, one in Subarea VIII and one in Division IXa. The Spanish and French fleets fishing for anchovy in Subarea VIII are well separated both geographically and in time. The Spanish fleet operates mainly in Division VIIIc and VIIIb in spring, while the French fleets operate in Division VIIIb later in summer and winter, and in Division VIIIa during summer.**

Changes in the catch-at-age composition between the 1984–1996 period and the earlier years could be related to a higher dependence of catches on recruitment in recent years and a change in the seasonality in this fishery. The number of Spanish purse seiners for anchovy has remained stable since 1990 and a slight increase in the number of French purse seiners has been observed in the last five years.

Traditionally the anchovy fishery in Division IXa is located in the Gulf of Cadiz (Division IXa South). However, in 1995 the bulk of the fishery was located in the North of Portugal and to the West of Galicia (Division IXa North) and was very reduced in the Gulf of Cadiz, owing to exceptional availability of anchovy in the northern part of Division IXa. In recent years the bulk of the anchovy fishery in IXa has again been located in the Gulf of Cadiz.

In Divisions VIIIc (East) and VIIIb the target species for the purse seine fleet change with the season – anchovy in spring and tuna in the summer. This fleet changes gear and uses trolling and bait boats to catch tuna.

Mackerel is a target species for the handline fleet during the spawning season in Division VIIIc, during which about one-third of the total catches are taken. It is also taken as a bycatch by the trawl fleets in Division VIIIc and IXa. The highest catches (80%) from the southern component are taken mainly from Division VIIIc in the first half of the year and consist of adult fish. In the second half of the year, catches consist of juveniles and are mainly taken in Division IXa, as bycatches of the trawl fisheries. Catches from the southern component have been increasing in recent years and reached a maximum of 50 000 t in 2002.

Stock status

Based on the most recent estimates of SSB, ICES classifies the stock of **southern Hake** as suffering reduced reproductive capacity. The SSB decreased sharply between 1982 and 1986 and has continued to decrease after that, reaching the lowest value in the time-series in the most recent years. Recruitment was high in the mid-1980s and has been at a much lower level since then. In most recent years fishing mortality has been around F_{lim}.

In absence of precautionary reference points and because the state of the stock of **anglerfish** could not be assessed in absolute terms, the state of the stock cannot be evaluated with regards to precautionary reference points. Although the state of the stock is uncertain, the exploratory assessments suggest that it is likely that current biomass is under $\mathbf{B}_{MSY}$ and current fishing mortality is above $\mathbf{F}_{MSY}$. In recent years, landings have declined to low levels.

In absence of defined reference points, the state of the two stocks of **megrims** cannot be evaluated with regard to biological reference points. There has been a decrease in landings since the late 1980s. SSB of both species decreased since the late 1980s and then stabilised at a lower level. Fishing mortality has declined in recent years. Recent recruitments have been below average.

Both stocks of ***Nephrops*** in ***North Galicia*** and in ***Cantabrian Sea*** suffer severe recruitment failure. In the absence of defined reference points, the state of the stocks cannot be evaluated in this regard.

Stocks of ***Nephrops*** in FUs 26-27 (***West Galicia*** and ***North Portugal***) and FUs 28-29 (***SW*** and ***South Portugal***) are in a poor condition; the stock in FUs 26-27 in particular. There are uncertainties about the sustainability of current levels of landings in FU 30 (Gulf of Cadiz).

The state of the stock of **southern horse mackerel** is unknown since the available information is inadequate to evaluate the spawning stock or fishing mortality relative to risk. Catches decreased from the early 1960s and have been rather stable for the last decade. The southern horse mackerel stock delimitation has been revised recently according to the conclusions of the HOMSIR project This revision resulted in data aggregation from Portugal and Spain that differed from previous years. Division VIIIc is now defined as part of the distribution area of the westem horse mackerel stock.

The state of the **sardine** stock cannot be evaluated with regard to biological reference points due to the absence of defined reference points. The assessment indicates an SSB in 2003 of 668 thousand tonnes, which corresponds to the highest value of the time-series. The spawning biomass is high due to the strong 2000 year class. The assessment indicates that the 2001 year class is also above average; however, there is some evidence of low 2002 and 2003 recruitments. Furthermore, the abundance of sardine in some areas of the stock continues to be low when compared to the mid-1980s. Fishing mortality has shown a decreasing trend since 1998.

The recent estimates of SSB and fishing mortality indicate that the stock of **anchovy in the Bay of Biscay** is at risk of reduced reproductive capacity and is harvested sustainably. The stock is very low in relation to the levels observed throughout the 1990s and this is mostly due to poor 2001 and 2002 year classes. There are some indications that the 2003 year class is below average, but higher than those of 2001 and 2002.

The state of the stock of **anchovy in Division IXa** is unknown since the available information is inadequate to evaluate the spawning stock or fishing mortality relative to risk.

The stock of **mackerel** is at risk of suffering reduced reproductive capacity and of being harvested unsustainably. SSB in 2003 was estimated at 1.9 million t, which is below the $\mathbf{B}_{pa}$ of 2.3 million t. The 2000 year class is very poor, while both the 2001 and 2002 year classes appear to be above average. SSB has been remarkably stable over the last two decades, with a slight decline since 2001.

The stock of **blue whiting** is at full reproductive capacity but is harvested unsustainably. Although the estimates of SSB and fishing mortality are not precise, it is certain that SSB is above $\mathbf{B_{pa}}$ and the estimated fishing mortality is well above $\mathbf{F}_{lim}$. Recruitments in the last decade appear to be at a much higher level than earlier.

The abundance of **black scabbardfish** in the southern area (Subareas VIII and IX) appears to have remained relatively stable during the past decade. This conclusion is based on stable CPUE data from the longliners in Division IXa.

The available information of **red (=blackspot) seabream** in Subareas X and IX is inadequate to evaluate spawning stock or fishing mortality relative to risk, so the state of the stock is unknown. In other Subareas (VI-VII-VIII) based on historical catches the stock seems severely depleted.

The state of individual stocks is presented in more detail in the stock Sections 4.7.1-4.7.8c, 4.9.4, 4.10.6, and 4.10.9.

The European Commission is discussing a proposal for recovery plans for southern hake and Iberian *Nephrops* stocks. The proposal is based on a recovery target for Hake of reducing F towards $\mathbf{F}_{0.1}$ (0.15). An overall effort reduction scheme would be applied to all vessels which land hake and *Nephrops* in these areas, as well as the closure of selected *Nephrops* fishing grounds to all fishing. ICES has not evaluated this proposal.

3.7.3 Assessments and advice

Assessments and advice regarding fisheries

Nominal catches

Table 3.7.3.1 presents total landings by stock.

Landings of demersal and pelagic species from the Iberian (ICES Divisions VIIIc and IXa). Some deepsea species have been included.

Species	Hake	Hake	Anglerfish	Anglerfish	Megrim	Megrim	Nephrops	Nephrops	Nephrops	Nephrops	Nephrops	Sardine	Horse	Horse	Mackerel	Anchovy	Anchovy	Blue whiting	ck Scabbard	Pagellus	TOTAL
			white	Black		Four spot	Cantabrian	N-G	WG-NP	SwP-SW	Cadiz		Mackerel	Mackerel							
		Csdiz	*piscatorius*	*budegass*	*whif*	*boscii*	31	25	26+27	28+29	30										
Area	VIIIc+IXa	IXa_south	VIIIc+IXa	VIIIc+IXa	VIIIc+IXa	VIIIc+IXa						VIIIc+IXa	IXa	VIIIc	VIIIc+IXa	VIII	Ixa	VIIIc+IXa	Ixa	?	
1972	26100	NA										151171				26917					204188
1973	34800	NA										157533				23614					215947
1974	22800	NA										117730				27282					167812
1975	29500	NA						731	622	1681		153324				23389					209247
1976	26100	NA						559	603	1914		134562				36166					199904
1977	15500	NA						667	620	1874		121236				44384					184281
1978	13400	NA						690	575	2144		145609				41536					203954
1979	17000	NA						475	580	1730		157241				25000					202026
1980	19500	NA	4816	2110				412	599	1640		194802			15964	20538					260381
1981	16500	NA	5568	2300				318	823	1431		216517			18053	9794					271304
1982	17100	500	5782	2369				431	736	1393		206946		1961	21076	4610					262904
1983	22400	600	6114	2379			63	433	786	244		183837		2558	14853	12242					246509
1984	21500	700	6032	1929			100	515	618	461		206005		23119	20308	33468					314755
1985	18200	800	6139	1833			128	477	765	509	251	208439		23292	18111	8481					287425
1986	16200	1000	6870	2563	659	1124	127	364	694	465	221	187363		40334	24789	5612					288385
1987	15200	1000	5141	3832	497	1688	118	412	742	509	302	177696		30098	22187	9863		32792			302077
1988	15700	1000	6321	3700	817	2223	151	445	727	420	139	161531		26629	24772	8266	4721	30826	2602	689	291679
1989	12900	900	4996	2578	714	2629	177	376	708	469	174	140961		2717	18321	8174	5944	33665	3473	678	240554
1990	12000	1200	3790	2334	977	1945	174	285	449	524	220	149429		25182	21311	23258	6487	32354	3274	594	285787
1991	11600	1200	3640	2163	614	1682	109	453	603	478	226	132587	21772	23733	20780	9573	5922	31993	3979	532	273639
1992	12800	1000	3382	2111	516	1916	94	428	636	470	243	130250	26492	24243	18046	22468	3166	28722	4389	797	282169
1993	10900	500	2329	2227	383	1384	101	274	522	377	160	142495	31945	25483	19719	19173	1984	32256	4513	1000	297725
1994	9500	300	2007	1580	479	1403	148	245	448	237	108	136582	25959	24147	25045	17554	3388	29468	3429	1004	283031
1995	11800	500	1834	1831	218	1652	94	273	511	273	132	125280	25147	27534	27549	18950	12956	27664	4272	829	289299
1996	8900	1000	2955	1629	329	1098	129	209	331	132	49	116736	22943	2429	34123	18937	4595	25099	3815	978	246416
1997	7600	900	3714	1813	356	896	98	219	433	136	99	115814	27642	29129	40708	9939	5295	30122	3556	1011	279480
1998	7100	600	2981	2089	446	1123	72	103	345	161	86	108924	41564	22906	44164	8455	10962	29390	3152	877	285500
1999	6900	600	1932	1885	343	1125	48	124	248	211	123	94091	27733	24188	43796	13145	7409	26402	2752	543	253597
2000	7300	600	1259	1369	253	1041	34	81	155	201	129	85786	27160	21984	36074	19230	2502	24654	2404	421	232637
2001	6400	1200	788	1013	175	931	26	147	132	271	178	101957	24912	20828	43198	23052	9098	24964	2767	374	262412
2002	5800	900	1032	770	169	668	26	143	87	359	247	99673	23663	2211	49575	6519	8806	19165	2725	359	222897
2003	5600	1300	2278	926	134	876	22	89	72	362	281	97831	19566	19979	25820	3002	5269	16476	2658	477	203018

Ecosystem impacts of fisheries

Anthropogenic impacts such as pollution may have local effects on fish communities. In November 2002 the "Prestige" oil spill occurred offshore from Galicia. This catastrophe affected most of the northern Spanish coast and in particular the northern part of Galicia. Nevertheless, the "Prestige" oil spill has not had any clear direct effects on the demersal stocks of the area, although possible long-term impacts through the food chain or fecundity reductions will require further research. The oil spill did have an indirect and immediate impact on the demersal exploited species due to the reduction in fishing effort in the Galician area as the fishery was closed in this area following the incident. It is difficult to quantify the effect of this closure, but when the fishery reopened an increase in hake LPUEs was detected for all the trawl fleets studied, except for the A Coruña pair trawl fleet.

Mixed fisheries and fisheries interactions

Demersal fisheries in the area are mixed fisheries, with many stocks exploited together in various combinations in different fisheries. In these cases management advice must consider both the state of individual stocks and their simultaneous exploitation in demersal fisheries. Stocks in the poorest condition, particularly those with reduced reproductive capacity, necessarily become the overriding concern for the management of mixed fisheries where these stocks are exploited either as a targeted species or as a bycatch.

All fisheries should be considered in the management; the major fisheries in the area are:

- Bottom trawl fishery targeting *Nephrops*, but also taking hake and anglerfish as their main bycatch.
- Bottom trawl fishery for mixed fish, i.e. hake, anglerfish, megrim, horse mackerel, and blue whiting.
- Artisanal gillnet fishery for mixed demersal fish, i.e. hake, anglerfish, megrim.
- Baca trawl fleet for blue whiting, hake and horse mackerel and *Nephrops*, megrims.
- Trawl for horse mackerel by a small bycatch of other species (not *Nephrops*).
- Pair trawl for blue whiting.
- Fixed-net fisheries (Rasco directed at anglerfish, Beta and Volanta directed at hake).
- Longline fishery for hake and other demersal species.
- Longline fishery for black scabbardfish
- Artisanal fleet taking miscellaneous species.

ICES can offer the following comments on the fisheries:

1. Both megrim species are caught together in fisheries, which also take a large number of other commercial species, including southern hake. The decreasing catch of hake has modified the target species of some of the fleets and has reduced the effort on these species in recent years.

2. A portion of the catch of anglerfish (*L. piscatorius* and *L. budegassa*) is taken together with other species in mixed trawl fisheries.

3. Southern horse mackerel are mainly exploited by Spanish and Portuguese purse seiners and by Portuguese trawlers. While the purse seiners mainly catch juvenile fish, the catches taken by trawlers comprise also older fish. There is a significant bycatch of *Trachurus mediterraneus* and *Trachurus picturatus*, mainly in the trawl fishery.

4. For blue whiting most of the catches are taken in the directed pelagic trawl fishery in the spawning and post-spawning areas (Divisions Vb, VIa,b, and VIIb,c). Catches are also taken in a directed and a mixed fishery in Subarea IV and Division IIIa and in the pelagic trawl fishery in the Subareas I and II, and in Divisions Va and XIVa,b. These fisheries in the northern areas have taken 340 000–1 390 000 t per year in the last decade, while catches in the southern areas (Subareas VIII, IX, Divisions VIId,e and g-k) have been stable in the range of 25 000–34 000 t. In Division IXa blue whiting is mainly taken as a bycatch in the mixed trawl and in the case of the Portuguese trawl is discarded at sea.

5. Fisheries for anchovy are targeted by trawlers and purse seiners. The Spanish and French fleets fishing for anchovy in Subarea VIII are well separated geographically and in time. The Spanish fleet operates mainly in Division VIIIc and VIIIb in spring, while the French fleets in Division VIIIa operate in summer and autumn and in Division VIIIb in winter and summer. There is fishing for anchovy throughout the year.

6. At present the Spawning Stock Biomass of sardine is considered high due to the strong 2000 year class; however, the abundance of sardine in some areas of the stock continues to be low when compared to the mid-1980s.

7. There is a regular fishery for anchovy in Division IXa South (Gulf of Cadiz). The fleets in the northern part of Division IXa occasionally target anchovy when abundant, as occurred in 1995. The anchovy in Division IXa South has different biological characteristics and dynamics compared to anchovy in other parts of Division IXa. The anchovy population in Subdivision IXa South appears to be well established and relatively independent of populations in other areas.

Single-stock exploitation boundaries

The state and the limits to exploitation of the individual stocks are presented in the stock sections (Sections 4.7.1-4.7.8c, 4.9.4, 4.10.6 and 4.10.9).

The state of stocks and single-stock exploitation boundaries are summarized in the table below.

Stock	State of the stock			ICES considerations regarding single-stock -based exploitation limits			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionar y limits**	**Fishing mortality in relation to highest yield**	**In relation to agreed management plan**	**in relation to precautionary limits**	**in relation to target reference points**	
Southern stock of hake (Div. VIIIc and Ixa)	Reduced productive Capacity.	Increased risk.	Overfished.	A recovery plan for this stock is under discussion, including as one of the objectives a 10% annual decrease on F towards a F_{target} of =0.15 ($F_{0.1}$).	F_{sq} =0.52 above F_{pa} and SSB below B_{lim} .A recovery plan should be implemented as a prerequisite to reopening the fishery.	F_{sq} = 0.52, cannot support optimal long-term yield and provide low risk of stock depletion ($F_{0.1}$ = 0.17 and F_{max} = 0.27).	Zero catch in the absence of a recovery plan.
Megrim (*L. boscii* and *L. whiffiagonis*) in Div. VIIIc and IXa	Not defined.	Not defined.	Appropriate (*whiffiagonis*), Overfished (*boscii*).	No management plan.	At recent levels of fishing mortality for both species (*L. whiffiagonis* 0.11 and *L. boscii* 0.20), SSB has been stable or possibly slightly increasing. This level of exploitation would correspond to landings in 2005 of around 190 t for *L. whiffiagonis* and 870 t for *L. boscii*. The combined landings at the current exploitation level would be around 1 050 t.	Fishing at $F_{0.1}$ is estimated to give landings in 2005 of 240 t (*L. Whiffiagonis*) and 820 t (*L. boscii*).	No increase in F. This corresponds to landings in 2005 of less than 190 t for *L. whiffiagonis* and less than 870 t for *L. boscii* ~ a total of 1 050 t.
Anglerfish (*L. piscatorius* and *L. budegassa*) in Div. VIIIc and IXa	Not defined.	Not defined.	Overfished.	No management plan.	Fishing mortality equal to zero in 2005 is required to bring SSB back to $\mathbf{B}_{MSY}$ in the short term. If this is not possible then a recovery plan should be established that will ensure rapid and safe recovery of the SSB above $\mathbf{B}_{MSY}$.		F = 0 or recovery plan.

*Southern horse mackerel (*Trachurus trachurus*) in Div. IXa*	Unknown.	Unknown.	Unknown.	No management plan.	Fishing effort must not increase and catches in 2005 should not exceed the recent average of 25 000 t (2000-2002). Previous proposed reference point to be revised as a consequence of changes in stock delineation.	No target reference points.	Should not exceed the recent average (2000-2002)˜~ 25 000 t.
Southern Mackerel Component of NEA Mackerel	Increased risk.	Harvested unsustainably.	Overfished.	The agreed management plan (F between 0.15 and 0.20) would imply catches between 330 000 t and 420 000 t in 2005 which is expected to lead to an SSB between 2.35 million tonnes and 2.5 million tonnes by 2006, i.e. would bring SSB above the $\mathbf{B}_{pa}$ (assuming catches to the order of 550 000 t in 2004).			
Nephrops in Div. VIIIc – Cantabrian Sea (FU25-31) (Management Area O)	Reference points not defined.	Reference points not defined.	Overfished.	The proposed recovery plan will be beneficial but given the severity of the recruitment failure, it is not evident that this will be sufficient to restore the stock.	Given the severity of recruitment failure a zero TAC is advised for this Management Area, until there is a substantial improvement of the recruitment.		Reduce catches to zero.
Nephrops in Div IXa . Galician West and North of Portugal (FU26-27)	Reference points not defined.	Reference points not defined.	Overfished.	For FUs 26-27 a recovery plan for hake and *Nephrops* has been proposed but not so far adopted.	In FUs 26-27, there has been a progressive recruitment failure, and there should be no fishery unless recruitment improves.		Zero catches for FUs 26-27.
Nephrops in Div IXa – SW and South of Portugal (FU28-29) (Management Area Q)	Reference points not defined.	Reference points not defined.	Overfished.	For FUs 28-29 a recovery plan for hake and *Nephrops* has been proposed but not so far adopted.			Zero catches for FUs 28-29.

Nephrops in Div Ixa – Cadiz (FU 30) – (Management Area Q)	Reference points not defined.	Reference points not defined.	Overfished.		For FU 30, the information is sparse, and the state of the stock is unclear. As the stock clearly is at least fully exploited, it is recommended not to increase the catches above the current level.		Catch at the lowest recent level for FU 30.
Blue whiting combined stock (Subareas I-IX, XII and XIV)	Acceptable.	Harvested unsustainably.	**Overfished.**	The management plan implies catches of less than 1.075 million t in 2005 which is expected to keep fishing mortality less than 0.32 with 50% probability. This will also ensure a high probability that the spawning stock biomass in 2006 will be above $\mathbf{B_{pa}}$. The management plan point 4 calls for a reduction of the catch of juvenile blue whiting which has not taken place. ICES recommends that measures be taken to protect juveniles.	**Exploitation boundaries in relation to precautionary limits are the same as the exploitation boundaries in relation to existing management plans.**	F (management plan) = 0.32.	1 075 000 t.
Sardine in Divisions VIIIc and IXa	Ref. points not defined.	Ref. points not defined.	Uncertain.	No management plan.	**Fishing mortality should not increase above the level in 2002-3 of 0.20, corresponding to a catch of less than 106 000 t in 2005.**		No increase in F ~ 106 000 t.
Anchovy- Subarea VIII	Increased risk.	Acceptable.	Unknown.	No management plan.	A preliminary TAC for 2005 should be set to 5 000 t. A catch of this size will, even in the case of poor recruitment, allow the SSB to rebuild in 2005. The TAC could be re-evaluated in the middle of the year 2005, based on the development of the fishery and on the results from the acoustic and egg surveys in May-June 2005.		Rebuilding SSB. A preliminary TAC for 2005 be set to 5 000 t.

Anchovy in Division IXa	Unknown.	Unknown.	Unknown.	No management plan.	At present, there is not sufficient information to estimate appropriate reference points.		*The catches in 2005 should be restricted to 4 700 t (mean catches from the period 1988–2002 excluding 1995, 1998, 2001 and 2002). This level should be maintained until the response of the stock to the fishery is known.*
Black scabbardfish in Div IXa	Unknown.	Unknown.	Unknown.	No management plan.			Effort should be reduced significantly. Any measure taken to manage this species in these areas should take into account the advice given for other species taken in the same mixed fishery. In Division IXa the adoption of a *status quo* exploitation level is advised.
Red (=blackspot) seabream in Subareas IX and X	Unknown. The stock structure is uncertain.	Unknown.	Unknown.	No management plan.			*Red seabream can only sustain low rates of exploitation.*

Identification of critical stocks

The first of the above tables identifies the stocks outside precautionary reference points.

The critical stock which is below $\mathbf{B}_{\mathrm{lim}}$ is the southern hake stock. ICES has advised that there is no catch on *Nephrops* from Divisions VIIIc and IXa and a fishing mortality equal to zero in 2005 is required to bring SSB back to $\mathbf{B}_{\mathrm{MSY}}$ in the short term for anglerfish. These should also be considered critical stocks.

Other stocks for which reduction in exploitation is required are the southern component of the NEA mackerel stock and blue whiting.

These stocks are the overriding concerns in the management advice for all fisheries where the interactions between stocks taken in the same fisheries should be considered.

ICES advice for fisheries management

The demersal fisheries in the Iberian Region should be managed in such a way that the following rules apply simultaneously:

1. **For southern hake: if a rebuilding plan is not implemented then there should be no catches ;**

2. **For Anglerfish and *Nephrops*: rebuilding plans should be established that will ensure rapid rebuilding to precautionary levels, and which ensure large reductions in F in 2005. Such rebuilding plans should imply no catch or discards of southern hake;**

3. **Regarding deep-sea species red seabream and black scabbardfish: the state of the stocks is unknown in Subareas IX and X and for other areas is considered to be in a depleted state. Red seabream can only sustain low rates of exploitation. Fisheries on such species should be permitted only when they are accompanied by programmes to collect data and should expand very slowly until reliable assessments indicate that increased harvests are sustainable.**

4. **The fishing of each species should be restricted within the precautionary limits as indicated in the table of individual stock limits above.**

Furthermore, unless ways can be found to harvest species caught in a mixed fisheries within precautionary limits for all those species individually then fishing should not be permitted.

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species outside safe biological limits. If industry-initiated programs aim at reducing catches of species outside safe biological limits to levels close to zero in mixed fisheries, then these programmes could be considered in the management of these fisheries. Industry-initiated programmes to pursue such incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of species outside safe biological limits are fully and credibly reported.

Short-term implications

The catch options that would apply if single stocks could be exploited independently of others are summarized in the table above.

However, for the mixed fisheries management options must be based on the expected catch in specific combinations of effort in the various fisheries, taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, but must also result in catches that comply with the scientific advice presented above.

The information on the mix of species observed caught in fisheries in this area is not complete. An evaluation of the effects of any combination of fleet effort on depleted stocks would require that the catch data on which such estimates were based included discard information for all relevant fleets. Such data are not available to ICES. ICES is therefore not in a position to present scenarios of the effects of various combinations of fleet effort. If data including discard were available it would be possible to present a forecast based on major groupings of fleet/fisheries.

There is information which indicates that the exploitation of some stocks are linked. There is no database for a precise estimate of this linkage. The implications of the linkages regarding management of stocks taken in mixed fisheries would be as summarized in the table below:

IBERIAN – Divisions VIIIc and Subareas IX and X

Demersal stocks

	Hake VIIIc+IXa	Anglerfish * VIIIc+IXa	Megrims* VIIIc+IXa	Nephrops Cantabrian FU 31	Nephrops North Galiza FU 25	Nephrops West Galiza + North Portugal FUs 26+27	Nephrops SW and South Portugal FUs 28+29	Nephrops Cadiz FU 30	Horse mackerel IXa	Blue whiting VIIIc+IXa	Black scabbardfish IXa	Red seabream IX and X
Hake VIIIc+IXa		**H**	**H**	**L**	**H**	**H**	**H**	**H**	**H**	**M**	**L**	**L**
Anglerfish VIIIc+IXa	PT-SP-trawls and PT-SP-gillnets		**H**	**L**	**H**	**H**	**H**	**0**	**M**	**L**	**0**	**L**
Megrims VIIIc+IXa	PT-trawl, PT-gillnets	PT-trawl, PT-gillnets		**L**	**L**	**L**	**H**	**0**	**M**	**L**	**0**	**L**
Nephrops Cantabrian FU 31	SP-Trawl	SP-Trawl	SP-Trawl		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Nephrops North Galiza FU 25	SP-Trawl	SP-Trawl	SP-Trawl	None		**0**	**0**	**0**	**0**	**0**	**0**	**0**
Nephrops West Galiza + North Portugal FUs 26+27	SP-Trawl PT- trawl	SP-Trawl PT-trawl	SP-Trawl PT-trawl	None	None		**0**	**0**	**L**	**L**	**0**	**0**
Nephrops SW and South Portugal Fus 28+29	Crustacean PT-trawl	Crustacean PT-trawl	Crustacean PT-trawl	None	None	None		**0**	**L**	**M**	**0**	**0**
Nephrops Cadiz FU 30	SP-Trawl	None	None	None	None	None	None		**M**	**H**	**0**	**0**
Horse mackerel IXa	PT-trawls, PT-artisanal, SP-trawl- H SP GOV -L	PT-trawl, PT-gillnets SP-trawl- H SP GOV -L	PT-trawl, PT-gillnets SP-trawl- H SP GOV -L	None	None	SP-Trawl PT-trawl	Crustacean PT-trawl	SP-Trawl		**M**	**0**	**0**
Blue whiting VIIIc+IXa	PT-trawls SP-trawl SP pair trawl	Crustacean PT-trawl SP-trawl	Crustacean PT-trawl SP-trawl	SP-Trawl-L	SP-Trawl-L	SP-Trawl-L	Crustacean PT-trawl	SP-Trawl	PT-trawls SP-trawl SP-pair Trawl SP GOV -L		**0**	**0**
Black scabbardfish IXa	PT- Longline	None	None	None	None	None	None	None	None	None		**0**
Red seabream IX and X	PT-artisanal	PT-artisanal	PT-artisanal	None	None	None	None	None	PT-artisanal	None	None	

IBERIAN – Divisions VIIIc and Subareas IX and X

Pelagic stocks

	Horse mackerel VIIIc	**Horse mackerel IXa**	**Mackerel**	**Sardine**	**Anchovy VIII**	**Anchovy IXa**
Horse mackerel VIIIc		**H**	**M/L**	**H**	**L**	**M**
Horse mackerel IXa	SP-trawl, SP-purse seine, SP-GOV		**H**	**H**	**0**	**L**
Mackerel	SP- purse seine **(M)** SP- artisanal **(L)**	PT fish trawl, PT-artisanal, PT-purse seine, SP-trawl, SP-purse-seine, SP-GOV		**H**	**L**	**L**
Sardine	SP-purse seine	PT-artisanal, PT-purse seine, SP- purse seine	PT-artisanal, PT- purse seine, SP-purse seine, SP-artisanal		**L**	**H**
Anchovy VIII	SP- purse seine	None	SP- purse seine SP-artisanal	SP- purse seine SP-artisanal		**0**
Anchovy IXa	None?	PT purse seine	PT-artisanal, PT purse seine SP- purse seine SP-artisanal	PT-artisanal, PT purse seine SP- purse sein**e** SP-artisanal	None?	

Regulations in force and their effects

The fisheries in the Iberian Region are managed by a TAC system and technical measures. In 2000 a new EU regulation was established defining mesh sizes. Other technical conservation measures are minimum landing sizes and seasonal area closures to protect juvenile hake.

At national level there are management measures to limit the number of vessels fishing for crustaceans. Management measures are also enforced in the sardine fishery including restriction of days of absence from the ports, number of purse seiners in activity, annual catch restrictions, and seasonal closures. A minimum landing size is adopted internationally, but the national minimum landing size for rose shrimp is higher.

A TAC for southern mackerel is in place, as a part of the Northeast Atlantic mackerel TAC.

In recent years data quality has improved, including landing statistics and length composition, notably in the Gulf of Cadiz. Now, discards sampling programmes are included in the routine monitoring. For most of the stocks the sampling level of the landings is considered adequate for assessment purposes; however, there are only few samples of discards, particularly of undersized hake.

The Iberian Region is an important nursery ground for hake, sardine, horse mackerel, mackerel, and blue whiting. Catches by fleets operating gears with low selectivity therefore include significant quantities of juvenile fish.

Quality of assessments and uncertainties

The level of biological sampling of most of the commercial landings has been maintained or improved with the recent introduction of the Data Collection Regulation (EC 1543/2001). In recent years data quality has improved, including landing statistics and length composition, notably in the Gulf of Cadiz.

Several series of research vessel survey indices are available for most species.

Analytical assessments were performed on hake, *Nephrops*, megrims, sardine, mackerel, and blue whiting.

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3.8 The Baltic

The Baltic Sea has a long history of study and investigation, and there are numerous reviews and analyses of the Baltic ecosystem, its variability and how it has been influenced by man (Voipio, 1981; Helcom, 2002; Frid *et al.*, 2003). In addition, ICES annually provides ecosystem and environmental advice (ICES, 2003a; ICES, 2003b) regarding the Baltic Sea to management authorities and other organisations. The overview below emphasizes those aspects of the ecosystem that have been documented to have direct and major effects on Baltic fish populations and on the fisheries, and vice versa. Readers interested in a broader perspective of the Baltic ecosystem and its components are encouraged to consult the literature cited above. Readers interested in scientific details of the interactions outlined in the sections below can find relevant literature in ICES working group (ICES, 2004a) and study group reports (ICES, 2003c; ICES, 2004b).

3.8.1 The ecosystem

The Baltic ecosystem is one of the world's largest estuarine areas. Freshwater outflow from rivers and saltwater inflow through the Øresund and Belt Sea lead to stratification in the deeper areas and a salinity gradient from southwest to northeast. The horizontal salinity gradient imposes severe restrictions on species distributions, and nearly all species in the Baltic Sea suffer physiological stress in some parts of the Baltic (e.g., reduced growth, reproduction) due to salinity conditions. The biodiversity of the Baltic fauna is low compared to more saline ecosystems such as the North Sea.

The dominant fish species are herring, sprat and cod, although flatfishes, salmon and some coastal (freshwater) species are also present. Cod is the main predator on herring and sprat, and there is also some cannibalism on small cod. Herring and sprat prey on cod eggs, although there is seasonal and inter-annual variation in these effects.

The multispecies interactions among cod, herring and sprat may periodically have a strong influence on the state of the fish stocks in the Baltic, depending on the abundance of cod as the main predator in the Baltic Sea ecosystem. To accommodate predator-prey effects, the data (e. g., predation rates by cod on herring and sprat) from multispecies assessment methods are used in the assessment of pelagic stocks. However, interactions with other potential top predators such as seals, which are potentially important in the northern Baltic Sea, are not yet quantified and are therefore not directly included in the present ICES fisheries advice.

Variations in the abiotic environment of the Baltic Sea are strong and depend on climate forcing (e. g., North Atlantic Oscillation affecting temperatures and salinities). Populations of fish are affected by this variability both in relation to growth and recruitment. The growth rate of herring diminishes with reduced salinity in the eastern and northern part of the Baltic (Flinkman *et al.*, 1998; Cardinale and Arrhenius, 2000; Ronkkonen *et al.*, 2004). The recruitment of herring in the Gulf of Riga and sprat in Subdivisions 22-32 are positively related to spring temperatures and the North Atlantic Oscillation index. The recruitment of the eastern cod stock depends on the volume of water with sufficient oxygen content and salinity available in the deeper basins. The present hydrographic situation in the Central basins of the southern Baltic suggests that during the spawning season in 2004, the most favourable conditions for cod egg survival are expected to be in the Bornholm Basin and the Slupsk Furrow, but not in the Gotland Basin. In general, hydrographic-climatic variability (i.e., low frequency of inflows from the North Sea, warm temperatures) and fishing during the past 10-15 years have led to a shift in the dominance of the fish community from cod to clupeids (herring, sprat; (Köster *et al.*, 2003; MacKenzie and Köster, 2004).

The M74 syndrome has lead to high mortality of salmon yolk-sac fry. It seems likely that M74 is linked to the diet of salmon in the Baltic and changes in the ecosystem. The incidence of M74 is statistically well correlated with parameters describing the sprat stock (Karlsson *et al.*, 1999), but any causal connection has not been shown. Mortality caused by M74 has been over 50% in many years in the 1990s. In the 2000s, mortality has been lower, and mortality in 2003 as well as the prediction for 2004 is below 10%.

Knowledge of ecosystem processes, in addition to the multispecies interactions mentioned above, has been and is being used in fisheries assessment and management (e.g., herring recruitment predictions, choosing appropriate time periods for reference points, evaluation of locations for closed areas and seasons in relation to hydrographic conditions). The impact of the environment on fish stocks is explained in more detail in relation to the individual stocks in Sections 4.8.2-11.

3.8.2 The human use of the ecosystem

The Baltic receives nutrients and industrial waste from rivers. Airborne substances are deposited by interaction with the atmosphere. As a result the Baltic has became eutrophied during the 20th century. The eutrophication has led to increases in primary production, changes in trophic flows through food webs, and intensified magnitude and frequency of oxygen-depletion events that occur due to the infrequent exchange of water with the Skagerrak and North Sea. The effects of eutrophication on the fisheries are complex and difficult to resolve, but any process leading to a reduction in oxygen concentration in the deep layers during cod spawning periods will affect cod egg survival, as well as the survival of benthic animals that are prey for demersal fish species.

Fisheries harvest a range of species including cod, herring, sprat, and salmon. Aside from affecting population dynamics of prey species, the removal of fish biomass by fishing has quantifiable impacts on the overall fluxes of nutrients (nitrogen, phosphorus: (Hjerne and Hansson, 2002) and toxic substances such as PCBs (MacKenzie *et al.*, 2004). Levels of these materials removed annually by fishing are 1 - 7% of the total loading.

Human society uses the Baltic for many other purposes including shipping, tourism, and mariculture. Shipping may pose threats due to transport and release of hazardous substances (e.g., oil) and non-indigenous organisms. The former would likely have only relatively short-term effects (e.g., direct mortality of individuals in a restricted time and area), whereas the latter are more likely to have longer-term and more widespread effects (e.g, influences on energy flows or species interactions in food webs).

The fisheries and their impact

The main target species in the commercial fishery are cod, herring, and sprat. They form about 95% of the total catch. Other target fish species having either local economical importance or ecosystem importance are Baltic salmon, plaice, flounder, dab, brill, turbot, pike-perch, pike, perch, vendace, whitefish, burbot, eel, and sea trout.

The main fisheries for cod in the Baltic use demersal trawls, pelagic trawls, and gillnets. There was a substantial increase in gillnet fisheries in the 1990s and because of the change in stock age composition in the late 1990s and early 2000, the share of the total catch of cod taken by gillnets has decreased and demersal trawl catches increased.

ICES considers that Baltic cod is best assessed and managed as two separate units and has for some years advised accordingly. With effect from 2004, IBSFC agreed to change its management units for cod in conformity with this advice and the agreement has been implemented in the EU legislation.

Herring of the Western Baltic, Skagerrak, and Kattegat stock are taken in the northeastern part of the North Sea, Division IIIa, and Subdivisions 22–24. Division IIIa has directed fisheries by trawlers and purse seiners (fleet C, see Section 4.5.8), while Subdivisions 22–24 have directed trawl, gillnet, and trapnet fisheries. The herring bycatches taken in Division IIIa in the small-mesh trawl fishery for Norway pout, sandeel, and sprat (fleet D) are mainly autumn spawners from the North Sea stock. After a period of high landings in the early 1980s the combined landings of all fleets have decreased to below the long-term average. Due to national regulations Danish landings of herring from Division IIIa have further decreased in the 2002 and 2003, whereas increasing German landings from Subdivisions 22 and 24 have counterbalanced recent decreasing Danish landings.

Pelagic fisheries in the Baltic are dominated by pelagic trawlers catching a mixture of herring and sprat. The proportion of the two species in the catches varies according to area and season. In addition, fisheries for predominantly herring are carried out with trapnets/poundnets and gillnets in coastal areas, and with trawls in some areas.

The catches of the pelagic species are used for human consumption, for reduction to oil and meal, and for animal fodder. The allocation of the catches into these categories differs not only by country, but also over time. The usage is to a large extent driven by the market conditions.

While feeding in the sea, salmon are caught by driftnets and longlines and during the spawning run they are caught along the coast, mainly in trapnets and fixed gillnets. Where fisheries are allowed in the river mouths, set gillnets and trapnets are used.

The coastal fishery targets a variety of species with a mixture of gears, including fixed gears (e.g. gill, pound, and trapnets, and weirs) and Danish seines. The main species exploited are Baltic herring, Baltic salmon, sea trout, flounder, turbot, cod, and freshwater and migratory species (e.g. whitefish, perch, pikeperch, pike, smelt, vendace, eel, and burbot). In addition there are demersal trawling activities for Baltic herring, cod, and flatfishes in some parts of the coastal area. Coastal fisheries are conducted along the entire Baltic coastline.

The very strong **cod** year classes in 1976, 1979, and 1980 formed the basis for an increase in the stock in the eastern Baltic and an expansion in the fisheries. Catch levels more than doubled and the fishery attracted vessels from other Baltic fisheries and from fleets normally operating outside the Baltic Sea.

The decline in stock size and landings started around 1985 and continued up to 1992. Since then the stock and catches have been low compared to earlier years. Fleet capacity and fishing effort have been reduced, but fishing mortality increased as the stocks declined.

The uncertainty of total catch figures in most recent years and conflicting information and trends in various survey indices, as well as problems in age determination, have resulted in a poorer quality and more variable assessments for the Eastern Baltic cod stock.

Herring and **sprat** are used mainly for human consumption when landed in the countries on the eastern Baltic coasts, but for the production of fishmeal and oil in the countries on the west coast. The landings of **sprat** for industrial purposes increased markedly during the last decade.

Herring in the Baltic is presently assessed as five stocks. This is to be regarded as a compromise between using the larger number of stocks/populations that have been identified for biological reasons and the practical constraints, e.g. in what units are catch figures available, and what are the possibilities for correctly allocating individual fish to particular stocks. Sprat is assessed as one unit for the entire Baltic.

The exploitation rate of pelagic stocks in the Baltic Main Basin increased in the mid-1990s and they have stayed at a higher level ever since. Due to the low abundance of cod the natural mortality of Baltic herring and sprat is low at present. The Baltic sprat is considered to be harvested inside safe biological limits. A decrease in the mean weight-at-age of sprat has been observed since 1993.

A continuous decreasing trend in mean weight-at-age has been observed in most of the herring stocks in the Baltic since the mid-1980s. This decline in mean weight-at-age partly explains the declining trend in biomass of the Central Baltic herring in Subdivisions 25–29, 32. At present the mean weight of herring is low. Still, there have been some indications in the last few years that the decreasing trend of the mean weight is slowing down. Due to the decreasing SSB and increasing trend in fishing mortality, the Central Baltic herring is assumed to be outside of biological limits. Different trends of stock development have been observed for herring in the Gulf of Riga and for herring in the Bothian Sea (Subdivision 30). Based on the prevalence of abundant year classes during the 1990s SSB of the Gulf of Riga herring has increased significantly and is historically high at the moment. After the increase of recruitment and consequently higher abundance during the 1990s, herring in the Bothnian Sea has also remained at a relatively high level.

For several reasons, it has been difficult to estimate the absolute stock size for the pelagic stocks, although the development of the stock size in relative terms is better described. The low precision in the estimates of species composition in the mixed fisheries has contributed to the variation in stock estimates given in the later years. However, the fourfold increase in sprat catches observed between 1991 and 1997 and the development of industrial fishery, and consequently the rate of fishing mortality, should be closely monitored.

The spring-spawning herring stock in Subdivisions 22–24 and Division IIIa migrates after the spawning season into the Kattegat, the Skagerrak, and the eastern parts of the North Sea, where it mixes with the North Sea autumn-spawning herring stock during the feeding period.

There are two IBSFC management areas for **salmon** in the Baltic Sea: (1) Main Basin and Gulf of Bothnia (Subdivisions 22-29 and 30–31) and (2) Gulf of Finland (Subdivision 32). There are 40–50 rivers in the Baltic Sea with natural salmon smolt production. The overall management objective of IBSFC is to increase the production of wild Baltic salmon to attain at least 50% of the natural production capacity of each river with current or potential production of salmon by 2010, while maintaining the catch level as high as possible. The status of many of the wild stocks in the Gulf of Bothnia, measured as parr densities, smolt production, and number of returning adults, has been improved since 1996. In the Gulf of Finland, there has been no improvement in the status of the wild stocks.

The wild smolt production in the Gulf of Bothnia and Main Basin has been increasing in the recent years; the smolt production estimate in 2003 was 1.5 million smolts. In the Gulf of Finland, the status of wild stocks is not improving and wild smolt production was estimated to be 23 thousand smolts. The number of the reared smolts was 6 million in the Gulf of Bothnia and 1.0 million in the Gulf of Finland in recent years, but the survival of the stocked smolts has been decreasing in the same time period. According to micro-satellite DNA–analysis and scale readings, approximately half of the salmon caught in the Baltic Sea originate from salmon of wild origin.

The production of **sea trout** in the Baltic Sea is dominated by reared production to a somewhat greater extent than for salmon. Wild stocks in several rivers in the Main Basin are considered to be in good or satisfactory condition. In the Gulf of Finland and Gulf of Bothnia many of the sea trout stocks are over-exploited and suffer from freshwater habitat loss and degradation.

Pollution

Contamination by toxic substances can affect fisheries if contaminant concentrations in fish exceed those determined to be safe for human consumption.

In 2004, Danish fisheries for two species were closed due to high dioxin concentrations in the landed fish. The Danish salmon fishery in the Baltic was closed on April 1 and in May, the Danish herring fishery east of Bornholm was closed.

3.8.3 Assessments and advice

3.8.3.1 Fisheries advice (including salmon and sea trout)

Nominal catches

Officially reported catches in the Baltic until 2002 are given in Table 3.8.3.1.1-5. These are the catches officially reported to ICES by national statistical offices for publication in the *ICES Fishery Statistics.*

For use in the assessments, the working groups estimate discards and slipped fish, landings which are not officially reported, and the composition of bycatches. These amounts are included in the estimates of total catch for each stock and are presented separately for each stock in the stock summaries in Section 4.8. These estimates vary considerably between different stocks and fisheries, being negligible in some cases and constituting important parts of the total removals from other stocks. Furthermore, the catches used in assessments are divided into subdivisions, whereas the officially reported catches by some countries are reported by the larger Divisions IIIb, c, and d. The trends in Table 3.8.3.1.1 may, therefore, not correspond to those on which assessments have been based, and are presented for information only, without any comment from ICES.

The 1990 catches listed under the Federal Republic of Germany and the German Democratic Republic refer to catches by vessels from the respective former territories during the whole of 1990, before and after the political union. Thus, catches taken by vessels registered in the former German Democratic Republic in the months after unification are included in the German Democratic Republic figures.

Ecosystem impact of fisheries

The reduction of the abundance of larger cod through fishing reduces the predation pressure on other fish populations. Fishing is partly responsible for the dominance of clupeid fishes (sprat, herring) seen in the Baltic during the past 10-15 years, although environmental factors have also contributed to this phenomenon.

Mixed fisheries and fisheries interactions

Baltic cod is taken in a targeted fishery with minimal bycatches.

Herring and sprat are taken in pelagic trawl fisheries, which include fisheries taking both species simultaneously. The actual composition of pelagic catches is poorly known for some fisheries because landings in some landings statistics are assigned to species according to the target species. In **Denmark** trawlers using mesh sizes below 32 mm fish for industrial purposes, and the species composition is determined by logbooks/sale-slips and corroborated by samples. The landings not sampled are allocated to species according to a “dominant species” rule. When using meshes larger than

31 mm trawlers are assumed to fish for human consumption and species composition is based on logbooks. The landings are allocated to fishing area according to information in logbooks. In **Estonia** species composition are based on logbooks. Some (mostly visual) estimation by the Environmental Inspection is carried out. In **Finland** species compositions are by catch notifications and logbooks. Some inspections are made in harbours by regional Employment and Economic Development Centres. In **Germany** landings of herring from gillnets and trapnets with negligible amounts of sprat dominated the pelagic fishery till 2001. Thereafter a substantial increase in trawling pelagic fish has occurred. Species composition is determined by logbooks. In **Latvia** and **Lithuania** species composition is based on logbooks. In **Poland** species composition is based on logbooks and landing declarations. In **Russia** species composition is based on logbooks and sporadically checked by fishery inspectors in harbours. In **Sweden** species composition is based on logbooks. The samples taken by the Coast Guard for control purposes have so far not been used for the officially reported landings.

Overall, estimates of pelagic catch compositions are mainly based on logbooks and landing declarations, with limited supplementary sampling of catches. This means that the actual composition is uncertain. A comparison between the composition of pelagic landings and acoustic survey data indicates large discrepancies in the proportion of herring. This could mean that commercial fleets are fishing more discriminatory than the research vessels, or that the reported proportions do not reflect the species composition particularly well.

Single-stock exploitation boundaries and critical stocks

The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan (MP)	In relation to precautionary limits	In relation to target reference points	
Cod in Subdivisions 22-24	increased risk	N/A	Overfished	Landings less than 24 700 tonnes in 2005 is in accordance with agreed management plan, which corresponds to a fishing mortality of 1.00. ICES will evaluate the management plan in relation to the precautionary approach in August 2004.	F below 0.92 in 2005 (landings = 23 400 t) to achieve $\mathbf{B_{pa}}$ in 2006.	No target reference points.	less than 23 400 t according to PA; or less than 24 700 t according to MP
Cod in Subdivisions 25-32	Reduced reproductive capacity	Increased risk	Overfished	Even though the assessment of the present state of the stock is uncertain it supports the conclusion that the SSB is below $\mathbf{B_{lim}}$. Also, the assessment is too uncertain to form the basis for a quantitative prediction of the SSB in 2006; indications are that to achieve an SSB equal to $\mathbf{B_{lim}}$ in one year is only possible if catches are zero. The management plan therefore implies that the TAC should be set at the lowest possible level. Since	As noted above SSB is below $\mathbf{B_{lim}}$ and indications are that to achieve a SSB equal to $\mathbf{B_{lim}}$ in one year is only possible if catches are zero.	No target reference points.	0 t according to PA or lowest possible F according to MP

				cod is taken in a targeted fishery the lowest catch which would be technically possible would be zero. ICES will evaluate the management plan in relation to the precautionary approach in August 2004.			
Herring in Subdivisions 22-24 and Division IIIa	Reference points not defined	Reference points not defined	Unknown	No MP		No target reference points.	less than 92 000 t (*status quo* landings) in 2005
Herring in Subdivisions 25-29 (excl GoR) and Division 32	Unknown	Increased risk	N/A	No MP	F below F_{pa} = 0.19	No target reference points.	less than 130 000 in 2005 according to PA
Herring in Gulf of Riga	Acceptable	Acceptable	Overfished	No MP	F below status quo = 0.363	No target reference points.	landings less than 35 300 t in 2005 according to PA
Herring in Subdivision 30	Acceptable	Acceptable	N/A	No MP	F below F_{pa}	No target reference points.	less than 60 200 t according to PA
Herring in Subdivision 31	Unknown	Unknown	N/A	No MP	Catches at recent average levels are within the long-term (1980-2003) range of yield for this stock and should not be exceeded.	No target reference points.	less than 3 500 t (recent average levels)
Sprat in 22-32	Acceptable	Acceptable	N/A	F = 0.4 from the agreed IBSFC management plan		No target reference points.	less than 614 000 t in 2005 according to MP and PA
Flounder	Unknown	Unknown	Unknown	No MP		No target reference points.	
Plaice	Unknown	Unknown	Unknown	No MP		No target reference points.	
Dab	Unknown	Unknown	Unknown	No MP		No target reference	

						points.	
Turbot in 22-32	Unknown	Unknown	Unknown	No MP		No target reference points.	
Salmon in Main Basin and Gulf of Bothnia	**Unknown**	Fishing mortality well above $\mathbf{F_{MSY}}$	Unknown	Strong stocks in the management areas 1, 2, and 4 are at the Salmon Management Plan target or may reach it by 2010, whereas weak stocks will not.		No target reference points.	Continued fishery at the current exploitation level will not impair the possibilities for reaching the management objective for the strong stocks. However, the possibility for reaching the productivity objective in 2010 for the weaker stocks seems slim. ICES further advises that the exploitation close to the river mouths and in rivers should be closely monitored and kept sufficiently low to allow the number of spawning fish to increase.
Salmon in Gulf of Finland	Unknown	Unknown	Unknown	All wild stocks in the Gulf of Finland are in a precarious state and it is highly unlikely that the stocks will reach the Salmon Action Plan target by 2010.		No target reference points.	Fisheries should only be permitted at sites where there is virtually no chance of taking wild salmon. It is particularly urgent that national conservation programmes to protect wild salmon be enforced around the Gulf of Finland.
Sea trout	Unknown	Unknown	Unknown	No MP	Many wild stocks in the SD 29-32 are in a precarious state and the wild smolt production is very low	No target reference points.	Area regulatory measures to safeguard the remaining wild sea trout populations in the SD29-32 should be enforced immediately.

Identification of critical stocks

The table above identifies the stocks outside precautionary reference points, i.e. Western and Eastern Baltic cod. These stocks are the overriding concerns in the management advice of all demersal fisheries.

ICES advice for fisheries management

Fisheries in the Baltic should in 2005 be managed according to the following rules:

- **For Baltic Cod:**
    - **for eastern Baltic cod, no catch in 2005;**
    - **for western Baltic cod, a catch in 2005 not exceeding 23 400 t;**
- **for Herring in Division IIIa and Subdivisions 22-24: the combined catch of spring-spawning herring in Division IIIa and the herring catch in Subdivision 22-24 should not exceed 92 000 t;**
- **for Herring in Subdivisions 25-29+32 (excl. Gulf of Riga): catches should be less than 130 000 t ;**
- **for Sprat in Subdivisions 22-32: the mixed pelagic fishery should be restricted so that herring catches in the Subdivisions 25-29+32 (excl. Gulf of Riga) are less than 130 000 t. Data on species compositions in the mixed pelagic fishery are not available from all participating countries and the sprat share of the mixed pelagic fishery cannot be calculated. However, the available indications are that this implies a sprat TAC for 2005 much below the PA limit of 614 000 t;**
- **for Salmon in the Main Basin: The fishery can be continued at the current exploitation level. Exploitation close to the river mouths and in rivers should be closely monitored and kept sufficiently low to allow the number of spawning fish to increase;**
- **for Salmon in the Gulf of Finland: Fisheries should only be permitted at sites where there is virtually no chance of taking wild salmon. It is particularly urgent that national conservation programmes to protect wild salmon be enforced around the Gulf of Finland;**
- **for other stocks (herring in the Gulf of Riga, in the Bothnian Sea, in the Bothnian Bay) fisheries should be managed according to the precautionary limits stated in the table of individual stock limits above.**

Regulations in force and their effects

The fisheries in the Baltic are managed through the International Baltic Sea Fisheries Commission (IBSFC). Management is based on annual TACs supplemented by gear regulations, minimum landing sizes, and closed areas.

For cod IBSFC adopted a long-term management strategy in 1999. The management strategy identified target fishing mortalities and included decision rules in relation to annual TACs dependent on the SSB. The management strategy also stipulated the introduction of technical measures. In 2001 a recovery plan was adopted which included more detailed measures to recover the eastern Baltic cod stock. In 2003 IBSFC adopted a new recovery plan for the Eastern and Western cod stocks:

IBSFC agrees to implement the following management plan for the two cod stocks, Eastern and Western Stocks, which is consistent with the precautionary approach, ensures sustainable exploitation and provides for stable and high yield. This management plan replaces IBSFC resolutions X and XVII.

1. Management targets

> *The management targets are to maintain the Spawning Stock Biomass (SSB) at levels greater than 23,000 tonnes for the Western stock and 240,000 tonnes for the Eastern stock.*

2. Management areas

The Contracting Parties agree to implement two management areas, one for the Western cod stock and one for the Eastern cod stock.

3. Setting total allowable catches

a) IBSFC shall only adopt TACs that are predicted by ICES to generate an annual fishing mortality rate not exceeding 0.6 for the Eastern stock and 1.0 for the Western stock.

b) Where the SSB is estimated by ICES to be greater than or equal to the target levels defined in chapter 1, the TACs shall not exceed a level which, according to ICES, will result in the SSB being below the target levels at the end of the year of the application of the TACs.

Within the constraints laid down in paragraph 3a, the TACs shall not be set at levels which are more than 15% less or 15% greater than the TACs of the preceding year.

c) Where the SSB is estimated by ICES to be less than the target levels defined in chapter 1 but above 9,000 tonnes for the Western stock and 160,000 tonnes for the Eastern stock, the following rules shall apply:

i) the TAC shall be fixed at a level which, according to ICES, will result in an increase of at least 30% in the SSB or in a SSB greater than the target levels, defined in chapter 1, at the end of the year of the application of the TAC;

ii) where it will not be possible, according to ICES, to achieve the increase in the SSB indicated in paragraph 3a, the TAC shall be set at the lowest possible level.

Within the constraints laid down in paragraph 3a, the TACs shall not be set at levels, which are more than 15% less or 15% greater than the TACs of the preceding year.

d) Where the SSB is estimated by ICES to be less than 9,000 tonnes for the Western stock or 160,000 tonnes for the Eastern stock, the following rules shall apply:

i) the TAC shall be fixed at a level which, according to ICES, will result in the SSB being above these levels at the end of the year of the application of the TAC and will give an increase of at least 30% in the SSB;

ii) where it will not be possible, according to ICES, to increase the SSB to 9,000 tonnes for the Western stock or 160,000 tonnes for the Eastern stock within one year, the TAC shall be set at the lowest possible level.

In 2001 IBSFC adopted a long-term management strategy for sprat which included a target mortality and decision rules for the annual TAC.

For salmon, IBSFC has agreed on a management plan. The overall objective of the plan is to increase the production of wild Baltic salmon to attain by 2010 at least 50% of the natural production capacity of each river with current potential production of salmon, while maintaining the catch level as high as possible.

Details of these two management plans are provided in the stock summaries in Section 4.8.

A ‘Bacoma’ cod-end with a 120-mm mesh was introduced by IBSFC in 2001. Evaluations of the effect have demonstrated that the expected effect of this change was nullified by compensatory measures in the industry. This was to some extent explained by the mismatch between the selectivity of the 120-mm Bacoma window and the minimum landing size. In 2003 the regulation was changed to a 110-mm Bacoma window which is predicted to be better in accordance with minimum landing sizes. This appears to have been accepted by the fishing industry, although it is not yet possible to evaluate its effects.

Information from the fishing industry

Information from the fishing industry and inspectors has been obtained in relation to estimates of unreported landings of cod.

Quality of assessments and uncertainties

There are considerable problems with the quality of recent catch data for several stocks. For herring and sprat the estimates of catch compositions of some pelagic fisheries remain imprecise. For cod there have been significant unreported landings in recent years similar to the situation in the early 1990s. Age readings of cod have been uncertain. Commercial fishing effort data for some species is poorly resolved due to unknown and variable levels of targeting and this affects the data quality of tuning fleet data series. Details of data quality and uncertainties are provided for each stock in the stock summaries in Section 4.8.

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Table 3.8.3.1.1 Nominal fish catches in the Baltic from 1973-2002 (in '000 t). Anadromous species, except salmon, are not included. (Data as officially reported to ICES.)

Year	Species							Total
	Cod	Herring	Sprat	Flatfish	Salmon	Freshwater species	Others	
1973	189	404	213	18	2.7	23	55	905
1974	189	407	242	21	2.9	21	54	937
1975	234	415	201	24	2.9	20	60	957
1976	255	393	195	19	3.1	21	46	932
1977	213	413	211	22	2.4	22	42	925
1978	196	420	132	23	2.0	22	44	839
1979	273	459	78	24	2.3	20	47	903
1980	388	453	57	18	2.4	14	29	961
1981	380	419	47	16	2.4	13	31	908
1982	361	442	45	17	2.2	13	30	910
1983	376	459	31	16	2.4	13	20	917
1984	442	426	52	15	3.7	13	17	969
1985	344	431	69	17	4.0	11	16	892
1986	271	401	75	18	3.5	12	19	800
1987	238	373	91	16	3.8	13	24	759
1988	225	407	86	14	3.2	13	31	779
1989	192	414	89	14	4.2	14	18	745
1990	167	360	92	12	5.6	11	18	666
1991[1]	139	295	111	14	4.6	17	19	600
1992[1]	72	339	146	12	4.7	8	13	595
1993[1]	41	352	194	12	3.4	10	7	619
1994[1]	75	353	301	18	2.9	9	8	767
1995[1]	117	343	326	22	2.7	9	17	837
1996[1]	164	326	464	22	2.6	9	6	994
1997[1]	134	370	520	20	2.6	12	7	1,066
1998[1]	103	383	446	18	2.1	11	3	966
1999	117	343	408	18	1.7	11	4	903
2000[2]	105	371	369	20	2.0	20	4	891
2001[2]	103	339	354	23	1.7	20	4	845
2002[2]	74	281	345	24	1.5	20	4	750
2003[1]								

[1]Preliminary
[2]Includes recreational catches from Finland

Table 3.8.3.1.2 Nominal catch (tonnes) of HERRING in Divisions IIIb,c,d 1963-2002. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	14,991	48,632	10,900	16,588	28,370	27,691	78,580[1]	225,752
1964	29,329	34,904	7,600	16,355	19,160	31,297	84,956	223,601
1965	20,058	44,916	11,300	14,971	20,724	31,082[2]	83,265	226,216
1966	22,950	41,141	18,600	18,252	27,743	30,511	92,112	251,309
1967	23,550	42,931	42,900	23,546	32,143	36,900	108,154	310,124
1968	21,516	58,700	39,300	16,367	41,186	53,256	124,627	354,952
1969	18,508	56,252	19,100	15,116	37,085	30,167	118,974	295,202
1970	16,682	51,205	38,000	18,392	46,018	31,757	110,040	312,094
1971	23,087	57,188	41,800	16,509	43,022	32,351	120,728	334,685
1972	16,081	53,758	58,100	10,793	45,343	41,721	118,860	344,656
1973	24,834	67,071	65,605	8,779	51,213	59,546	127,124	404,172
1974	19,509	73,066	70,855	9,446	55,957	60,352	117,896	407,081
1975	18,295	69,581	71,726	10,147	68,533	62,791	113,684	414,757
1976	23,087	75,581	58,077	6,573	63,850	41,841	124,479	393,488
1977	25,467	78,051	62,450	7,660	60,212	52,871	126,000	412,711
1978	26,620	89,792	46,261	7,808	63,850	54,629	130,642	419,602
1979	33,761	83,130	50,241	7,786	79,168	86,078	118,655	458,819
1980	29,350	74,852	59,187	9,873	68,614	92,923	118,074	452,873
1981	28,424	65,389	56,643	9,124	64,005	84,500	110,782	418,867
1982	40,289	73,501	50,868	8,928	76,329	92,675	99,175	441,765
1983	32,657	83,679	51,991	9,273	82,329	86,561	112,370	458,860
1984	32,272	86,545	50,073	8,166	78,326	65,519	105,577	426,478
1985	27,847	88,702	51,607	9,079	85,865	57,554	110,783	431,437
1986	21,598	83,800	53,061	9,382	77,109	39,909	115,665	400,524
1987	23,283	82,522[3]	50,037	6,199	60,616	36,446	113,844	372,947
1988	29,950	92,824[3]	53,539	5,699	60,624	41,828	122,849	407,313
1989	26,654	81,122[3]	54,828	5,777	58,328	65,032	121,784	413,525
1990	16,237	66,078[3]	40,187	5,152	60,919	55,174	116,478	360,225

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	23,995	27,034[4]	51,546[3]	16,022	33,270	6,468[5]	45,991	59,176	31,755	295,257[6]
1992	33,855	29,556	72,171[3]	17,746	25,965	3,237[6]	52,864	75,907	27,979	339,280[6]
1993	34,945	32,982	77,353[3]	20,143	21,949	3,912[6]	50,833	86,497	23,545	352,159[6]
1994	45,190	34,493	97,674[3]	12,367	22,676	4,988[6]	49,111	70,886	15,904	353,411[6,7]
1995	37,762	43,482	94,613[3]	7,898	24,972	3,706[6]	45,676	68,019	16,970	343,099[6]
1996	34,340	45,296	93,337[3]	7,737	27,523	4,257[6]	31,246	67,116	14,780	325,632[6]
1997	30,876	52,436	90,334[3]	12,755	29,330	3,321[6]	28,939	110,463	11,801	370,255[6]
1998	38,800	42,721	85,545[3]	9,514	24,417	2,368[6]	21,873	147,706	10,544	383,488[6]
1999	37,974	44,039	82,237[3]	10,115	27,163	1,313	19,229	108,316	12,756	343,142
2000	49,727	41,735	81,648[3]	9,475	26,768	1,198	24,516	120,887	15,063	371,017
2001	46,297	41,737	82,867[3]	11,447	26,652	1,639	37,611	75,194	15,797	339,241
2002	18,406	36,251	76,242[3]	22,661	25,284	1,539	35,512	51,194	14,168	281,257
2003[6]										

[1]Including Division IIIa.
[2]Large quantity of herring used for industrial purposes is included with "Unsorted and Unidentified Fish".
[3]Includes some by-catch of sprat.
[4]As reported by Estonian authorities; 32,683 t reported by Russian authorities.
[5]As reported by Lithuanian authorities; 6,456 t reported by Russian authorities.
[6]Preliminary.
[7]Includes catches from the Faroe Islands of 122 t.

Table 3.8.3.1.3 Nominal catch (tonnes) of SPRAT in Divisions IIIb,c,d 1963–2002. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	2,525	1,399	8,000	507	10,693	101	45,820[1]	69,045
1964	3,890	2,111	14,700	1,575	17,431	58	55,753	95,518
1965	1,805	1,637	11,200	518	16,863	46	52,829	84,898
1966	1,816	2,048	21,200	66	13,579	38	52,407	91,454
1967	3,614	1,896	11,100	2,930	12,410	55	40,582	72,587
1968	3,108	1,291	10,200	1,054	14,741	112	55,050	85,556
1969	1,917	1,118	7,500	377	17,308	134	90,525	118,879
1970	2,948	1,265	8,000	161	20,171	31	120,478	153,054
1971	1,833	994	16,100	113	31,855	69	133,850	184,814
1972	1,602	972	14,000	297	38,861	102	151,460	207,294
1973	4,128	1,854	13,001	1,150	49,835	6,310	136,510	212,788
1974	10,246	1,035	12,506	864	61,969	5,497	149,535	241,652
1975	9,076	2,854	11,840	580	62,445	31	114,608	201,434
1976	13,046	3,778	7,493	449	56,079	713	113,217	194,775
1977	16,933	3,213	17,241	713	50,502	433	121,700	210,735
1978	10,797	2,373	13,710	570	28,574	807	75,529	132,360
1979	8,897	3,125	4,019	489	13,868	2,240	45,727	78,365
1980	4,714	2,137	151	706	16,033	2,388	31,359	57,488
1981	8,415	1,895	78	505	11,205	1,510	23,881	47,489
1982	6,663	1,468	1,086	581	14,188	1,890	18,866	44,742
1983	2,861	828	2,693	550	8,492	1,747	13,725	30,896
1984	3,450	374	2,762	642	10,954	7,807	25,891	51,880
1985	2,417	364	1,950	638	22,156	7,111	34,003	68,639
1986	5,693	705	2,514	392	26,967	2,573	36,484	75,328
1987	8,617	287[2]	1,308	392	34,887	870	44,888	91,249
1988	6,869	495[2]	1,234	254	25,359	7,307	44,181	85,699
1989	9,235	222[2]	1,166	576	20,597	3,453	53,995	89,244
1990	8,858	162[2]	518	905	14,299	7,485	59,737	91,964

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	21,781	14,124[3]	99[2]	736	17,996[4]	3,569	23,200	8,328	20,736	110,569[5]
1992	28,210	4,140	893[2]	608	17,388	1,697[5]	30,126	53,558	9,851	146,471[5]
1993	27,435	5,763	206[2]	8,267	12,553	2,798[5]	33,701	92,416	10,745	193,884[5]
1994	69,644	9,079	497[2]	374	20,132	2,789[5]	44,556	135,779	16,719	300,535[5,6]
1995	76,420	13,052	4,103[2]	230	24,383	4,799[5]	37,280	150,435	14,934	325,636[5]
1996	123,549	22,493	14,351[2]	161	34,211	10,165[5]	77,472	163,087	18,287	463,776[5]
1997	153,765	39,692	19,852[2]	428	49,314	6,000[5]	105,298	123,207	22,194	519,750[5]
1998	111,003	32,165	27,014	4,551	44,858	5,132[5]	59,091	141,209	21,078	446,122[5,7]
1999	97,686	36,407	18,886[2]	182	42,834	3,117	71,705	106,000	31,627	408,444
2000	55,521	41,394	23,242[2]	22	46,186	1,682	84,325	85,981	30,369	368,722
2001	53,189	40,776	15,849[2]	792	42,769	3,135	85,757	79,553	31,959	353,779
2002	47,630	40,717	17,258[2]	950	47,540	2,800	81,244	74,109	32,854	345,102
2003[5]										

[1]Including Division IIIa.
[2]Some by-catch of sprat included in herring.
[3]As reported by Estonian authorities; 17,893 t reported by Russian authorities.
[4]As reported by Latvian authorities; 17,672 t reported by Russian authorities.
[5]Preliminary.
[6]Includes catches from the Faroe Islands of 966 t.
[7] Includes catches from the Faroe Islands of 21 t.

Table 3.8.3.1.4 Nominal catch (tonnes) of COD in Divisions IIIb,c,d 1963–2002. (Data as officially reported to ICES.)

Year	Denmark	Faroe Islands	Finland	German Dem.Rep.	Germany Fed.Rep.	Poland	Sweden	USSR	Total
1963	35,851		12	7,800	10,077	47,514	22,827	30,550[1]	154,631
1964	34,539		16	5,100	13,105	39,735	16,222	24,494	133,211
1965	35,990		23	5,300	12,682	41,498	15,736	22,420	133,649
1966	37,693		26	6,000	10,534	56,007	16,182	38,269	164,711
1967	39,844		27	12,800	11,173	56,003	17,784	42,975	180,606
1968	45,024		70	18,700	13,573	63,245	18,508	43,611	202,731
1969	45,164		58	21,500	14,849	60,749	16,656	41,582	200,558
1970	43,443		70	17,000	17,621	68,440	13,664	32,248	192,486
1971	47,563		3	9,800	14,333	54,151	12,945	20,906	159,701
1972	60,331		8	11,500	13,814	56,746	13,762	30,140	186,301
1973	66,846		95	11,268	25,081	49,790	16,134	20,083	189,297
1974	58,659		160	9,013	20,101	48,650	14,184	38,131	188,898
1975	63,860		298	14,740	21,483	69,318	15,168	49,289	234,156
1976	77,570		278	8,548	24,096	70,466	22,802	51,516	255,276
1977	74,495		310	10,967	31,560	47,703	18,327	29,680	213,042
1978	50,907		1,446	9,345	16,918	64,113	15,996	37,200	195,925
1979	60,071		2,938	8,997	18,083	79,697	24,003	78,730	272,519
1980	76,015	1,250	2,317	7,406	16,363	123,486	34,089	124,359	388,186[2]
1981	93,155	2,765	3,249	12,938	15,082	120,942	44,300	87,746	380,177
1982	98,230	4,300	3,904	11,368	19,247	92,541	44,807	86,906	361,303
1983	108,862	6,065	4,677	10,521	22,051	76,474	54,876	92,248	375,774
1984	121,297	6,354	5,257	9,886	39,632	93,429	65,788	100,761	442,404
1985	107,614	5,890	3,793	6,593	24,199	63,260	54,723	78,127	344,199
1986	98,081	4,596	2,917	3,179	18,243	43,237	48,804	52,148	271,205
1987	85,544	5,567	2,309	5,114	17,127	32,667	50,186	39,203	237,717
1988	75,019	6,915	2,903	4,634	16,388	33,351	58,027	28,137	225,374
1989	66,235	4,499	1,913	2,147	14,637	31,855	55,919	14,722	191,927
1990	56,702	3,558	1,667	1,630	7,225	28,730	54,473	13,461	167,446

Year	Denmark	Estonia	Faroe Islands	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	50,640	1,805[3]	2,992	1,662	8,637	2,627	1,849	25,748	39,552	3,196	138,708[4]
1992	30,418	1,369	593	460	6,668	1,250	874[4]	13,314	16,244	404	71,594[4]
1993	10,919	70	558	203	5,127	1,333	904[4]	8,909	12,201	483	40,707[4]
1994	19,822	905	779	520	7,088	2,379	1,886[4]	14,426	25,685	1,114	74,604[4]
1995	34,612	1,049	777	1,851	14,681	6,471	3,629[4]	25,001	27,289	1,612	117,265[4,5]
1996	48,505	1,392	714	3,132	20,607	8,741	5,521[4]	34,856	36,932	3,304	163,993[4,5]
1997	42,581	1,173	33	1,537	14,483	6,187	4,497[4]	31,659	29,329	2,803	134,282[4]
1998	29,476	1,070	-	1,033	10,989	7,778	4,187[4]	25,778	17,665	4,599	102,575[4]
1999	38,169	1,060	-	1,570	15,439	6,914	4,371	26,581	17,476	5,211	116,791
2000	32,049	513	n/a	1,824	13,079	6,280	4,721	22,120	19,801	4,669	105,056
2001	29,126	755	n/a	1,724	12,738	6,298	3,852	21,992	21,120	5,032	102,637
2002	21,558	36	n/a	1,053	8,767	4,867	2,964	15,892	15,203	3,793	74,133
2003[4]											

[1]Including Division IIIa.
[2]Includes catches from United Kingdom (England & Wales) of 2,901 t.
[3]As reported by Estonian authorities; 1,812 t reported by Russian authorities.
[4]Preliminary.
[5]Includes catches from Norway of 293 t for 1995 and 289 t for 1996.

Table 3.8.3.1.5 Nominal catch (tonnes) of FLATFISH in Divisions IIIb,c,d 1963-2002. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	9,888	-	3,390	794	2,794	1,026	1,460[1]	19,862
1964	9,592	-	4,600	905	1,582	1,147	4,420	22,246
1965	8,877	-	2,300	899	2,418	1,140	5,471	21,105
1966	7,590	-	2,900	647	3,817	1,113	5,328	21,395
1967	8,773	-	3,400	786	2,675	1,077	4,259	20,970
1968	9,047	-	3,600	769	4,048	1,047	4,653	23,164
1969	8,693	-	2,800	681	3,545	953	4,167	20,839
1970	7,937	-	2,200	606	3,962	464	3,731	18,900
1971	7,212	-	2,500	553	4,093	415	4,088	18,861
1972	6,817	-	3,200	542	4,940	412	3,950	19,861
1973	6,181	-	3,419	655	4,278	724	2,550	17,807
1974	9,686	55[2]	2,390	628	4,668	653	2,515	20,595
1975	8,257	100	2,172	937	5,139	658	6,455	23,718
1976	7,572	194	2,801	836	4,394	582	3,018	19,397
1977	7,239	203	3,378	960	4,879	484	4,754	21,897
1978	9,184	390	4,034	1,106	5,418	396	2,500	23,028
1979	10,376	399	4,396	665	5,137	450	2,670	24,093
1980	8,276	52	3,286	460	3,429	427	2,305	18,235
1981	6,674	78	3,031	704	2,958	434	2,323	16,202
1982	5,818	50	3,608	543	4,214	250	2,596	17,079
1983	6,000	39	3,957	751	2,809	217	2,371	16,144
1984	5,165	43	3,173	662	3,865	176	1,859	14,943
1985	6,506	37	4,290	542	3,533	170	1,528	16,606
1986	6,808	52	3,480	494	5,044	250	1,438	17,566
1987	5,734	58	2,457	757	4,468	273	2,194	15,941
1988	5,092	69	3,227	759	3,030	281	1,605	14,063
1989	4,597	70	3,822	644	2,946	245	1,723	14,047
1990	5,682	59	1,722	820	2,253	257	1,427	12,220

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	5,583	248[3]	76	3,055	445[4]	n/a	4,009	224	317[5]	13,957[6]
1992	4,579	164	64	2,287	624	399[6]	3,906	337	75	12,435[6]
1993	3,275	165	85	2,156	475	155[6]	5,101	271	159	11,842[6]
1994	5,094	162	79	6,634	337	270[6]	4,900	314	173	17,963[6]
1995	6,556	102	89	5,146	411	209[6]	8,964	661	268	22,406[6]
1996	6,387	297	98	3,134	336	401[6]	8,836	1,597	774	21,860[6]
1997	6,357	334	85	3,311	413	696[6]	6,168	1,374	1,131	19,869[6]
1998	5,862	355	81	2,955	400	811[6]	5,835	677	1,188	18,164[6]
1999	5,579	416	82	3,239	563	571	5,787	439	1,013	17,689
2000	6,994	420	453	3,475	434	641	5,602	462	1,445	19,926
2001	8,183	482	503	2,919	619	1,155	6,725	565	1,420	22,571
2002	7,478	515	233	3,010	608	1,100	9,232	446	1,364	23,986
2003[6]										

[1]Including Division IIIa.
[2]Excluding subsistence fisheries.
[3]As reported by Estonian authorities; 236 t reported by Russian authorities.
[4]As reported by Latvian authorities; 466 t reported by Russian authorities.
[5]Includes 141 t reported by Russian authorities for Lithuania.
[6]Preliminary.

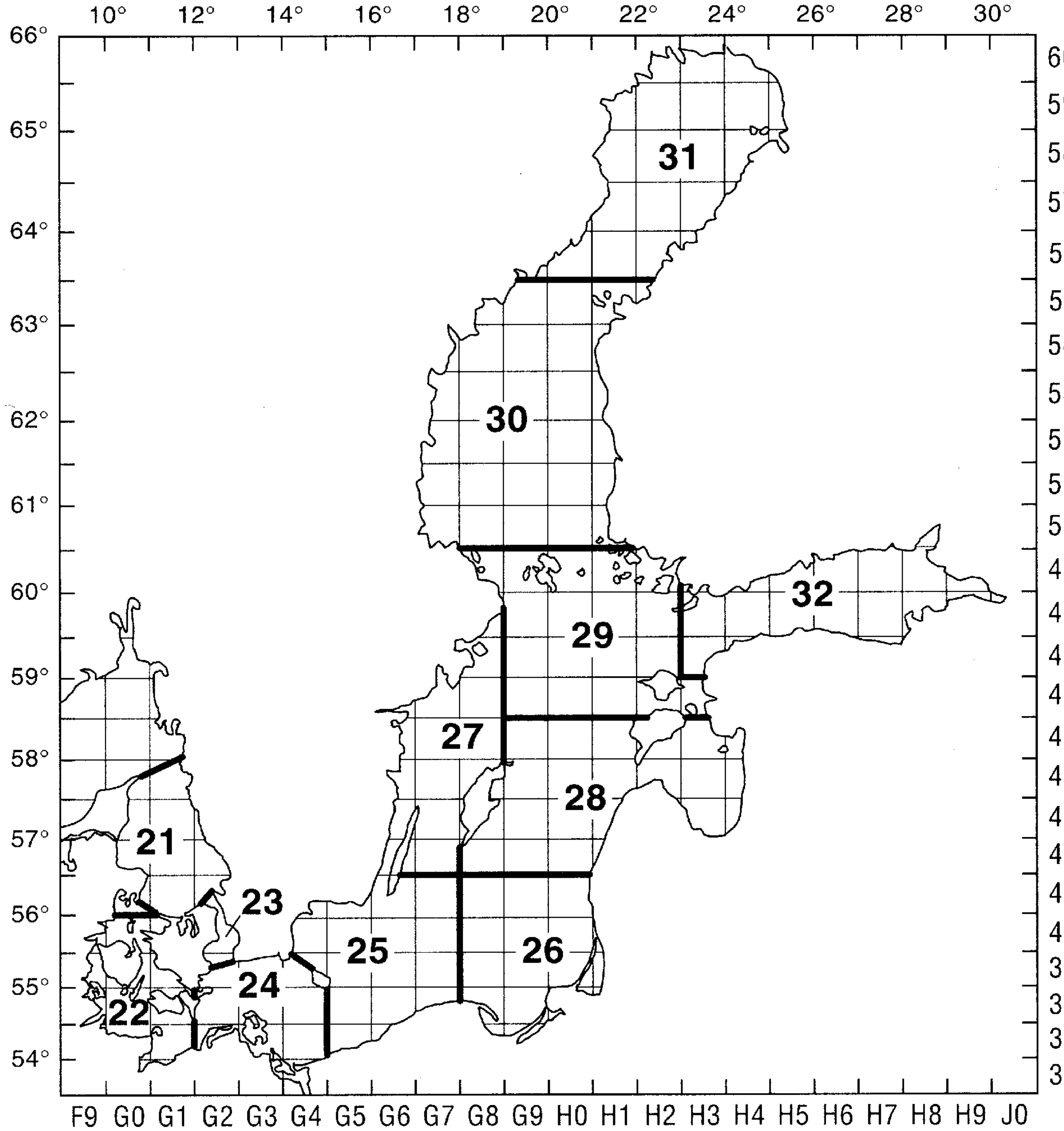
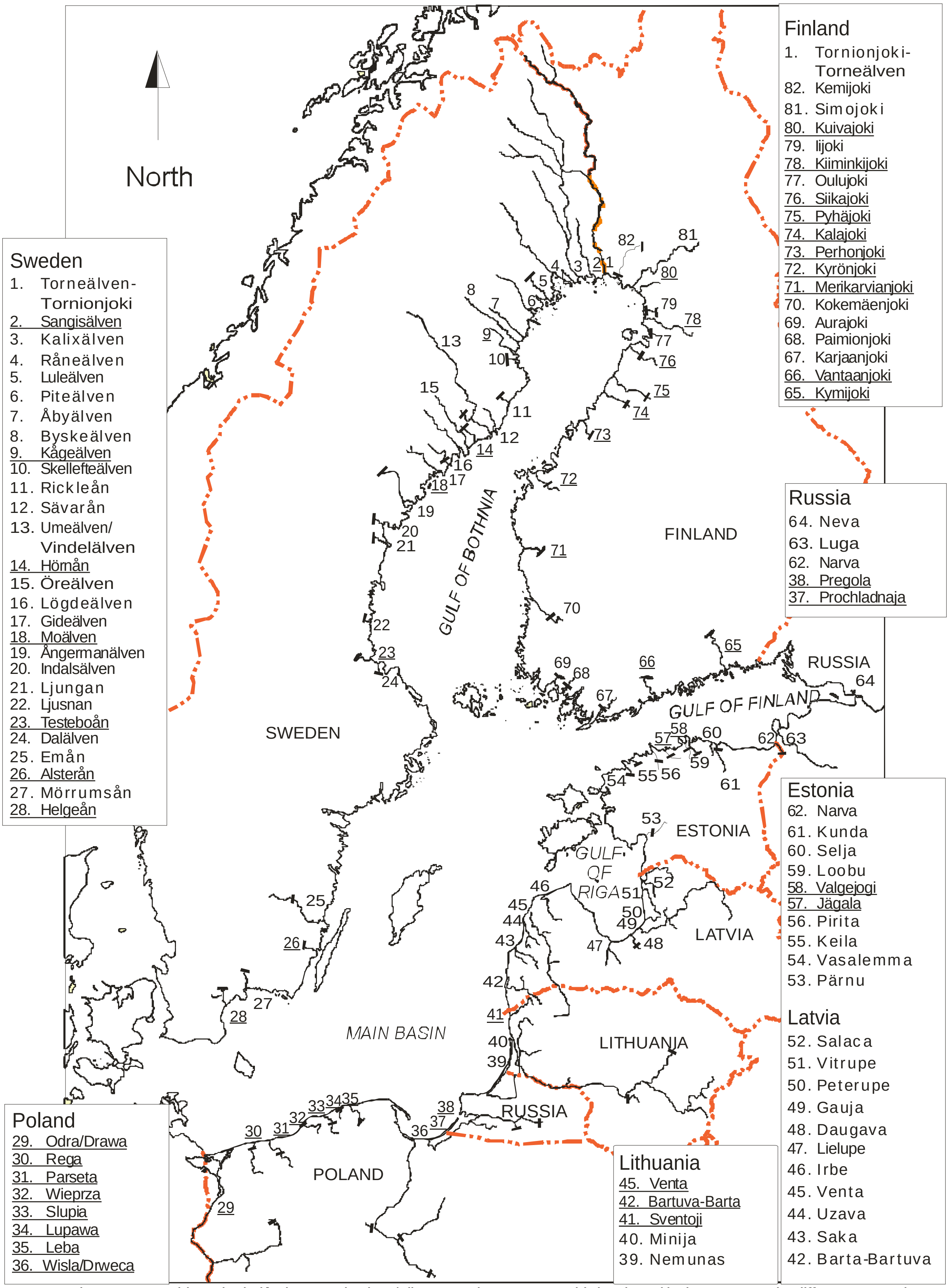


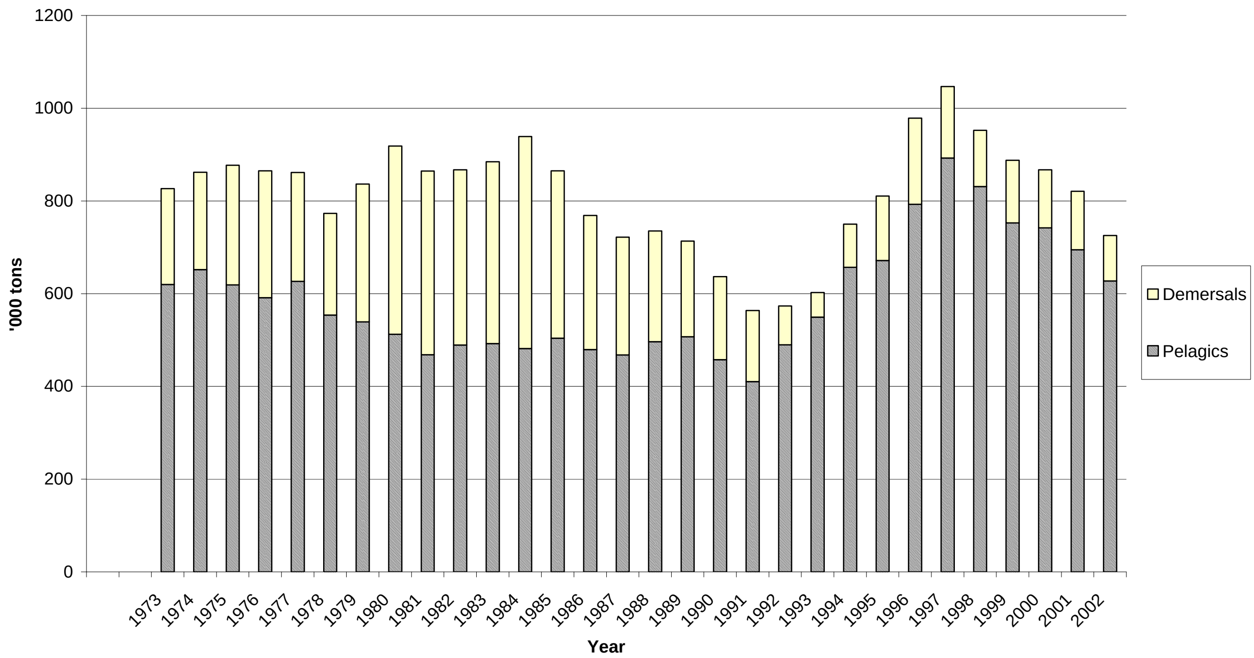
Figure 3.8.3.1 Subdivisions in the Baltic Sea.



River names with a slash (/) show main river/tributary. River names with hyphen (-) show names in different countries.

Figure 3.8.3.2 Baltic salmon rivers divided into three categories (see figure above). Only the lower parts of rivers with current salmon production or potential for production of wild salmon are shown. The presence of dams, which prevents access to areas, is indicated by lines across rivers. *Notation:* **river name in bold** = *river with wild smolt production*; <u>river name underlined</u> = *river with potential for establishment of wild salmon*; river name in normal font = *river with releases, no natural reproduction.*

Figure 3.8.3 Baltic Sea Catches



Herring

Catch options by Management Unit for herring

The assessments provide catch options by stock. However, in the Baltic Sea herring stocks overlap and in order to calculate catch options for herring in Subdivisions 22-29S and 32 some catches should be added from the western Baltic stock (Subdivisions 22-24, Division IIIa) and some catches should be subtracted to take into account the landings in Subdivision 29N (and added to MU III). The herring assessed in Subdivisions 25,29 and 32 is also caught in the Gulf of Riga, likewise is the Gulf herring assessed in the Gulf of Riga caught in Subdivision 28 outside the Gulf. These allocations may be based on proportions of landed amounts in the areas as indicated in the table below.

This Table was expanded with considerations on Division IIIa and includingg data on North Sea Autumn Spawnings. Furthermore the Table was also repeated using a possible revision. Percentages based on catches as presented in from ICES Working Group report (WGBFAS 2004) average 1999-2003 of the IBSFC management units (see IBSFC resolution XXI, September 2003).

Old management units ‘000 t
‘

Stock	Advised TAC for 2005			Management Unit I		Management unit III			Gulf of Riga
		North Sea	Div. IIIa	Subdivs 22-24	Subdivs 25-29S+32	Subdiv 29N	Subdiv 30	Subdiv 31	Part of Subdiv 28
NS Autumn spawners (Option =SQ)	**552000**	**96.20**	**3.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Div. IIIa+22-24	**92000**		**47.48**	**52.52**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Subdivs. 25-29+32	**130000**		**0.00**	**0.00**	**87.56**	**9.72**	0.00	0.00	**2.71**
Gulf of Riga	**35300**		0.00	0.00	**2.74**	0.00	0.00	0.00	**97.26**
Subdiv. 30	**60200**		0.00	0.00	0.00	0.00	**100.00**	0.00	0.00
Subdiv. 31	**3500**		0.00	0.00	0.00	0.00	0.00	**100.00**	0.00
Total		**531000**	**64682**	**48318**	**114795**	**12636**	**60200**	**3500**	**37856**
Calculated allocations Baltic Management Units	**277305**			**163114**		**76336**			**37856**

New Management Areas (IBSFC Resolution XXI) ‘000 tonnes

Stock	Advised TAC for 2005			Western Area	Central Area	Northern Area	Gulf of Riga
		North Sea	Div. IIIa	Subdivs 22-24	Subdivs 25-29+32	Subdivs 30-31	Part of Subdiv 28
NS Autumn spawners (Option = SQ)	**552000**	**96.20**	**3.80**	**0.00**	**0.00**	**0.00**	**0.00**
Div. IIIa+22-24	**92000**	**0.00**	**47.48**	**52.52**	**0.00**	**0.00**	**0.00**
Subdivs. 25-29+32	**130000**	**0.00**	**0.00**	**0.00**	**97.28**	**0.00**	**2.71**
Gulf of Riga	**35300**	**0.00**	**0.00**	**0.00**	**2.74**	**0.00**	**97.26**
Subdiv. 30	**60200**	**0.00**	**0.00**	**0.00**	**0.00**	**100.00**	**0.00**
Subdiv. 31	**3500**	**0.00**	**0.00**	**0.00**	**0.00**	**100.00**	**0.00**
Total (Baltic management areas)	**277305**	**531000**	**64682**	**48318**	**127431**	**63700**	**37856**

3.9 Widely distributed and migratory populations

A number of marine populations are not confined to the individual areas considered in other sections of this report. They include sea mammals and fish species with stock units that are distributed over much wider areas such as hake and a number of deepwater species, and migratory species such as mackerel, horse mackerel, and blue whiting.

3.9.1 The North East Atlantic ecosystem in relation to widely distributed populations

Hydrography sets the stage for the major ecosystems in the North East Atlantic. The upper water layers hosting the major pelagic stocks are characterized by two major current systems. Warm and saline waters that originate from the subtropical gyre are transported polewards by the North Atlantic Current and southwards by the Canary Current; these relatively warm waters dominate the eastern and southern parts of the area. In addition, the European Shelf Edge Current transports warm water northwards along the continental slope. Relatively cold and fresh Arctic waters, on the other hand, are transported southwards by the current systems in the west, e.g., by the East Greenland Current. These relatively cold waters dominate in the northwestern parts of the North East Atlantic. Detailed information on the hydrography of this area is available from the Annual ICES Ocean Climate Status Summary (Hughes and Lavin, 2004).

The overall circulation pattern outlined above is modulated by short- and long-term climatic variability. The most studied of these is the North Atlantic Oscillation (NAO). When the NAO is in the positive index phase there is a strengthening of the Icelandic low and Azores high. This strengthening results in colder and drier conditions over the western North Atlantic and warmer and wetter conditions in the eastern North Atlantic. During a negative NAO index phase, a weakening of the Icelandic low and Azores high tends to reverse these effects. A high NAO index is believed to lead to a weakening of the warm North Atlantic Current and a stronger poleward current along the European shelf break, as well as stronger cold Labrador Sea water inflow. A low NAO index suggests a stronger North Atlantic current penetrating further into the Norwegian Sea and a weaker slope current.

In most areas of the North Atlantic during 2003, temperature and salinity in the upper layers remained higher than the long-term average, with new records set in several regions. In Biscay, sea surface temperature in summer 2003 was the warmest in the time-series (1993–2003). Values were 1ºC above the mean from June to October and the thermocline was shallow. In the Rockall Trough there were high surface temperatures and salinities, continuing a rise which began in 1995. Salinity values over the top 800 m were the highest on record, and corresponding temperatures were more than 0.5°C above the long-term average. Surface waters in the Faroe Shetland Channel continued the general warming trend observed over the last 20 years. Modified Atlantic Waters in the Faroe Shetland Channel were warmer and saltier in 2003 than at any period during the last 50 years. The sea surface temperature in 2003 was higher than normal over most of the Norwegian Sea. The distribution area of Atlantic water has decreased since the beginning of the 1980s, while the temperature has shown a steady increase. Since 1978 the temperature of Atlantic water has increased by about 0.6°C.

The widely distributed migratory stocks mostly reside in the relatively warm waters in the eastern part of the North East Atlantic. The geographic distribution and properties of these water masses must therefore be important for the dynamics of these stocks. Probably the best-known factor impacting on fish stocks is the abundance of zooplankton (particularly copepods). In broad terms the long-term Continuous Plankton Recorder database provides useful data. Long-term trends in the North East Atlantic show a general decline in zooplankton abundance (Edwards *et al.*, 2004). A detailed examination of the demography of *Calanus* in the NE Atlantic is provided by Heath *et al.* (2000).

There is no fully comprehensive understanding of the links between the ecosystem and the fish stocks in this overview. However, some specific studies have illustrated particular examples:

- The distribution of mackerel prior to the pre-spawning migration and the timing of that migration appears to be related to water temperature in the northern North Sea in the winter. The temperature evolution in this area is largely modulated by the shelf edge current (Reid *et al.*, 2001a)
- The potential fecundity of mackerel appears to some extent to be modulated by feeding conditions in the Norwegian Sea in the previous autumn (Slotte and Iversen, 2004). Hence availability of zooplankton (*Calanus*) will affect the reproductive success of this species.

- The scale of the migration of western horse mackerel into the Norwegian Sea and the capture rate in the Norwegian fishery have been successfully correlated to Atlantic inflow to the North Sea and phytoplankton colour indices (Reid *et al.*, 2001b). This suggests that different patterns in the scale of inflow can influence the scale of the horse mackerel migration.
- The recruitment success and the long-term stock size fluctuations of Norwegian spring-spawning herring is highly correlated with the temperature in the Kola section in the Barents Sea, which in turn is related to the intensity of the inflow of Atlantic water masses to the northeast Atlantic region (Toresen and Østvedt, 2000).
- Condition (weight-at-length) in Norwegian spring-spawning herring in December is correlated with the measured zooplankton biomass in the Atlantic Water in the Norwegian Sea in May the same year. This suggests a positive effect of zooplankton biomass on the reproductive success. Similarly, herring condition is positively correlated with the NAO index the year before, presumably because a high NAO index tends to be associated with high zooplankton abundance.
- Other changes have occurred in the spatio-temporal pattern of migration in the western mackerel over the last 30 years, which are likely to have ecosystem correlates although these have yet to be clarified. Specifically, in the 1970s the mackerel migrated from the North Sea to the spawning areas in the autumn (September/October). By the 1990s this migration occurred in January/February. This required changes in management, and in a distinct change in the timing and location of the fishery.
- Hake belongs to a very extended and diverse community of commercial species. The main species concerned are megrim, anglerfish, *Nephrops*, sole, seabass, ling, blue ling, greater forkbeard, tusk, whiting, blue whiting, *Trachurus spp*, conger, pout, cephalopods (octopus, *Loligidae*, *Ommastrephidae*, and cuttlefish), rays, etc. (Lucio *et al.*, 2003, WD to WGHMM 2003). The relative importance of these species in the hake fishery varies largely in relation to the different gears, sea areas, and countries involved.

These relationships will be studied in more detail by the Study Group on Regional Scale Ecology of Small Pelagics (SGRESP) (ICES, 2004).

3.9.2 The populations and their exploitation

3.9.2.1 Fish and Fisheries

The fisheries and their impact

The Northern blue whiting stock is fished in Subareas II, V, VI, and VII and by a number of countries, mainly by Norway, Russia, Iceland, Denmark, Faroe Islands, United Kingdom, and Ireland. Most of the catches are taken in the directed pelagic trawl fishery in the spawning and post-spawning areas (Divisions Vb, VIa,b, and VIIb,c). Catches are also taken in the directed and mixed fishery in Subarea IV and Division IIIa, and in the pelagic trawl fishery in the Subareas I and II, as well as in Divisions Va and XIVa,b. These fisheries in the northern areas have taken 340 000–1 390 000 t per year in the last decade, while catches in the southern areas (Subareas VIII and IX, and in Divisions VIId,e and g-k) have been stable in the range of 25 000–34 000 t. In Division IXa blue whiting is mainly taken as bycatch in mixed trawl fisheries.

The Norwegian spring-spawning herring is fished in Subareas I and II and by a number of countries, mainly by Norway, Iceland, Russia, Faroe Islands, Denmark, Netherlands, UK, Germany, and Poland. The 2003 catches were almost
800 thousand t. Most of the catches were landed for human consumption. The spawning stock biomass was estimated at 7 million t in 2004.

The North Eastern Atlantic mackerel is fished in Subareas II, IV, V, VI, VII, VIII, and IX, by a number of countries, mainly Norway, Russia, Ireland, UK, Ireland, Denmark, Netherlands, Germany, and the Faroe Islands. Most of the catches are taken in directed trawl fisheries in the Norwegian Sea (between 50 000 and 150 000 tonnes), in the northern part of the North Sea (between 200 000 and 400 000 tonnes), and to the west of the British Isles (200 000 to 250 000 tonnes). There are smaller-scale fisheries in Biscay and the Iberian Peninsula, where they are often taken in mixed fisheries with other pelagic species; mainly horse mackerel, sardine, and anchovy – these are dealt with in more detail in the section covering Iberian stocks. The stock is divided into three spawning components; North Sea, Western, and Southern, based on the areas in which the fish spawn. The North Sea component is no longer assessed separately, but is considered as severely depleted with a spawning stock biomass around 200 000 tonnes. There are a variety of protection measures in place for this stock, including closure of the mackerel fishery in Divisions IVb,c and IIIa throughout the whole year, and in Divison IVa from February to July. This closure has unfortunately resulted in increased discards of mackerel in the non-directed fisheries (especially horse mackerel fisheries) in these areas as vessels at present are permitted to take only 10% of their catch as mackerel bycatch. The distribution area of the North Sea component overlaps with the western component particularly in the second half of the year, and may be implicated in the fishery at that time. The western and southern components are managed together and represent the bulk of the NEA mackerel fishery. The SSB was estimated at 1.9 million tonnes in 2004. The stock generally experiences good recruitment, although 2000 was an unusually weak year.

The western horse mackerel stock is fished in Subareas II, III IV, VI, VII, and VIII, by a number of countries, mainly Norway, Ireland, UK, Ireland, Denmark, France, Netherlands, and Germany. Most of the catches are taken in directed trawl or purse seine fisheries in the Norwegian Sea (decreasing from c. 150 000 tonnes in the early 1990s to 20 000 tonnes in recent years), along the western shelf edge and in the English Channel (between 120 000 and 400 000 tonnes), and in Biscay (30 000 to 75 000 tonnes). The major characteristic of this stock is the dependence of the stock abundance and the fishery on a single very strong year class (1982). Recruitment otherwise has generally been low, although 2001 may be better. The 1982 year class dominated the stock throughout the 1980s and early 1990s, and it is assumed that no major changes will occur unless another large year class appears. The SSB was not estimated in 2004 due to data inadequacy, but appeared to be still decreasing.

The northern hake stock is fished in Subareas II, III, IV, V, VII, VIII, XII, and XIV by a number of countries. Over the last five years, in Subareas II, III, and IV (EC zones only) catches have ranged from 1 600 to 2 750 tonnes. In Subareas Vb (EC Zone), VI, VII, XII, and XIV catches have ranged from 14 000 to 23 600 tonnes. In Subarea VIII catches have ranged from 7 000 to 15 750 tonnes. The fishery employs a variety of different gears in different areas, including longlines and gillnets. The SSB was estimated at 113 000 tonnes in 2004.

3.9.2.2 Ecosystem impact of fisheries

Sea mammals

Bycatch in fisheries has been acknowledged to be a threat to the conservation of cetaceans in the northeast Atlantic region (CEC, 2002; Ross and Isaac, 2004). Cetacean bycatch in the northeast Atlantic, as elsewhere, affects mainly small cetaceans – i.e. dolphins, porpoises, and the smaller toothed whales. Species caught in the region are primarily the harbour porpoise, common dolphin, striped dolphin, Atlantic white-sided dolphin, white-beaked dolphin, bottlenose dolphin, and long-finned pilot whale (CEC, 2002). However, other larger cetaceans, such as the minke whale, can also be affected.

An extensive review of the bycatch of cetaceans in pelagic trawls was carried out for Greenpeace in 2004 (Ross and Isaac, 2004). This report considered published and anecdotal information. In the context of the fisheries considered here, the report identified a small number of fisheries where cetacean bycatch could be documented. These were:

- Mackerel and horse mackerel trawling SW of Ireland;
- Hake trawling along the shelf edge in Biscay;
- Gillnetting for hake in the Celtic Sea.

In all cases, the number of animals caught was low. The report identified that many countries had initiated cetacean bycatch monitoring programmes, and had generally found little or no evidence that serious bycatch had occurred.

Other interactions between cetaceans as well as other sea mammals, undoubtedly occur. Many cetaceans predate on the fish covered in this overview, and may be regarded as competing with the fishery, but there is little or no data on this interaction. Anecdotal reports from observers in the mackerel fishery in the North Sea in the autumn suggest that killer whales associate with this fishery. The whales appear to target the fish discarded after the net is pumped out. The number of whales involved in this interaction is unknown, as is whether this is a subset of the population or whether it is more general.

Technical interactions between fish species

In general, mackerel and horse mackerel are caught in targeted, single-species fisheries. In the NEA mackerel fishery, particularly in the northern North Sea in quarter 4, there is some bycatch of herring. In the western area, there is relatively little interaction, except between mackerel and horse mackerel themselves. There may be interaction with blue whiting in this area as well, as the species spawn in the same area, but there is no evidence of this. The smaller-scale fishery in the Iberian Peninsula has interactions between mackerel and horse mackerel, as well as other pelagic species such as sardine, anchovy, and Spanish mackerel, and possibly some demersal species. This is covered in more detail in the Iberian overview, Section 3.7. There may be some technical interactions for mackerel in quarter 3 in the Norwegian Sea, where it may be implicated in the blue whiting fishery, but the scale of this is unclear.

As detailed by Lucio *et al* (WD to WGHMM 2003), the hake fishery is carried out as part of a general fishery on an extensive demersal assemblage including megrim, anglerfish, *Nephrops*, sole, seabass, ling, blue ling, greater forkbeard, tusk, whiting, blue whiting, *Trachurus spp*, conger, pout, cephalopods (octopus, *Loligidae*, *Ommastrephidae*, and cuttlefish), rays, etc.

3.9.3 Fisheries advice

The fisheries on the widely distributed stocks are largely taken in single-stock fisheries and single-stock exploitation boundaries as presented in Section 4.9 would therefore apply. They are summarised in the table below:

The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	In relation to target reference points	
Hake – Northern stock	Increased risk.	Increased risk.	Overfished.	Following the agreed management, a fishing mortality of F = 0.25 is expected to lead to an SSB of 130 000 t in 2006, with estimated landings in 2005 of 43 000 t. This implies a change in SSB of +7%.	The current fishing mortality, estimated at 0.27, is above fishing mortalities that are expected to lead to high long-term yields and low risk of stock depletion ($\mathbf{F}_{0.1}$ = 0.10 and $\mathbf{F}_{max}$ = 0.18). This indicates that long-term yield is expected to increase at fishing mortalities well below the historic values. Fishing at such a lower mortality is expected to lead to higher SSB and therefore lower the risk of observing the stock out-side precautionary limits.	The fishing mortality should be below $\mathbf{F}_{pa}$ and SSB should be above $\mathbf{B}_{pa}$. Therefore, ICES advises that in order to rebuild the spawning stock to 140 000 tonnes in 2006, fishing mortality should be reduced to 0.19 which would imply landings of less than 33 000 t in 2005.	33 000 t
Mackerel	Increased risk.	Harvested unsustainably.	Overfished.	The agreed management plan (F between 0.15 and 0.20) would imply catches between 320 000 t and 420 000 t in 2005, which is expected to lead to an SSB between 2.35 million tonnes and 2.5 million tonnes by 2006, i.e.	None.	None.	320 000 to 420 000 t

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	In relation to target reference points	
				it would bring SSB above the $\mathbf{B}_{pa}$ (assuming catches in the range of 550 000 t in 2004).			
Western Horse Mackerel	Uncertain.	Uncertain.	Uncertain.	No agreed management plan.	An $\mathbf{F}_{0.1}$ was calculated in an earlier assessment, but in view of the uncertainties in the selection profile it cannot be updated at the present time.	Last year, ICES advised that catches in 2004 be limited to less than 130 000 t. There is no basis to change that advice in light of the continuing decline in the stock. However, with the new definition of the stock unit which now includes VIIIc, the TAC should take into account catches in this area. Average catches in VIIIc have been in the range of 20 000 t since 2000. Accordingly, ICES recommend that catches of horse mackerel in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa-c,e-k, and VIIIa-e be limited to less than 150 000 t.	150 000 t
Blue Whiting	Acceptable.	Harvested unsustainably.		The management plan implies catches of less than 1.075 million t in 2005 which is	Exploitation boundaries in relation to precautionary limits are the same as the exploitation boundaries in		1 075 000 t

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	In relation to target reference points	
				expected to keep fishing mortality less than 0.32 with 50% probability. This will also ensure a high probability that the spawning stock biomass in 2006 will be above $\mathbf{B_{pa}}$. The management plan point 4 calls for a reduction of the catch of juvenile blue whiting which has not taken place. ICES recommends that measures be taken to protect juveniles.	relation to existing management plans.		
Norwegian spring-spawning herring	Acceptable.	Acceptable.		The management plan implies catches of 884 000 t in 2005, which is expected to lead to a spawning stock of 6.3 million tonnes in 2005.	The current long-term management plan is considered to be precautionary.	The target defined in the management plan is consistent with high-term yield and have a low risk of depletion production potential.	884 000 t

ICES advice for fishery management

For the blue whiting combined stock (Subareas I-IX, XII, and XIV): ICES recommends that catches should be less than 1 075 000 tonnes in 2005 in order to achieve a 50% probability that the fishing mortality in 2005 is less than F_{pa} (=0.32). This will also assure a high probability that the spawning stock biomass in 2006 will be above B_{pa}.

For Norwegian spring-spawning herring: ICES advises that this fishery should be managed according to the agreed management plan with a fishing mortality of no more than F=0.125, corresponding to landings in 2005 of less than 884 000 t.

For NEA mackerel ICES advises following the agreed management plan (F between 0.15 and 0.20), which would imply catches between 320 000 t and 420 000 t in 2005. This is expected to lead to an SSB between 2.35 million tonnes and 2.5 million tonnes by 2006, i.e. it would bring SSB above the B_{pa} (assuming catches in the range of 550 000 t in 2004).

For western horse mackerel ICES advised last year that catches in 2004 be limited to less than 130 000 t. There is no basis to change that advice in light of the continuing decline in the stock. However, with the new definition of the stock unit which now includes VIIIc, the TAC should take catches in this area into account. Average catches in VIIIc have been in the range of 20 000 t since 2000. Accordingly, ICES advises that catches of horse mackerel in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa-c,e-k, and VIIIa-e be limited to less than 150 000 t.

For northern hake, the fishing mortality should be below F_{pa} and SSB should be above B_{pa}. Therefore, ICES advises that in order to rebuild the spawning stock to 140 000 tonnes in 2006, fishing mortality should be reduced to 0.19 which would imply landings of less than 33 000 t in 2005.

Regulations in force and their effects

The blue whiting stock is not managed according to an agreed management plan. There is no international agreement on a TAC.

For the Norwegian spring-spawning herring, the coastal states (European Union, Faroe Islands, Iceland, Norway, and Russia) did not reach any agreement regarding the allocation of the quota at the meeting on Fisheries Consultation on the management of Norwegian spring-spawning (Atlanto-Scandian) herring stock in Reykjavik, Iceland, in October 2003. At a following NEAFC meeting in Copenhagen on the management of Norwegian spring-spawning herring stock, the parties were again unable to reach any agreement on quota allocations. However, there seemed to be an unwritten understanding between the parties to accept the TAC proposed by ACFM to limit the total catches to 825 000 t in 2004.

For NEA mackerel, Division IVa is closed to mackerel fishing from the 14th of February until late summer to protect the North Sea component. Management has aimed at a fishing mortality in the range of 0.15–0.2 since 1998. The fishing mortality realised since then has been in the range of 0.25 to 0.35.

For the western horse mackerel, the distributional range of this stock increased when the exceptional 1982 year class entered the fishery. This resulted in the development of unregulated fisheries outside the TAC area in the Northern North Sea. Catches outside the area covered by a TAC have been reduced in recent years. At present, the TAC for the Western areas includes Division Vb (EU waters only), Subareas VI and VII, and Divisions VIIIa,b,d,e. A separate TAC includes EU waters in Division IIa and Subarea IV. ICES allocates horse mackerel to the Western stock which is taken in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIe–k, and VIIIa-e.

For northern hake, the minimum mesh size was increased from 55/65 mm to 70 mm in the Bay of Biscay in 2000. Since June 2001 an Emergency Plan was implemented for the northern hake stock (Council Regulations Nos. 1162/2001, 2602/2001, and 494/2002). Firstly, a 100-mm minimum mesh size has been implemented for otter trawlers when hake comprises more than 20% of the total amount of marine organisms retained onboard. This measure did not apply to vessels less than 12 m in length and which return to port within 24 hours of their most recent departure. Secondly, two areas have been defined, one in Subarea VII SW of Ireland and the other in Subarea VIII Bay of Biscay, where a 100-mm minimum mesh size is required for all otter trawlers, whatever the amount of hake caught. ICES has not been able to quantify the likely impact of the changes in mesh size. However, since hake is a late maturing fish, any improvement in the selection pattern that reduces the catch of younger fish is only expected to increase SSB in the medium term.

The TAC for northern hake does not appear to be effective in controlling landings.

Council Regulation (EC) No. 1954/2003 established measures for the management of fishing effort in a ‘biologically sensitive area’ in areas of VIIb, VIIj, VIIg, and VIIh. Effort exerted within the ‘biologically sensitive area’ by the vessels of each EU Member State may not exceed their average annual effort (calculated over the period 1998–2002).

Quality of assessments and uncertainties

For blue whiting the point estimates of stock size and fishing mortality are considered uncertain. Therefore the catch forecast is based on a methodology which addresses the uncertainty and the interdependence between estimates of SSB and F.

For Norwegian spring-spawning herring there has been a tendency to overestimate the spawning stock historically. The standard deviation of the spawning stock, derived from bootstrap replicates, has increased considerably compared to last year’s deviation. The distribution is also more skewed than last year. However, there is an overall high consistency between this year’s assessment and that of last year.

For NEA mackerel, due to the lack of fishery-independent data and the absence of age-disaggregated information for the spawning stock index, the results of this assessment are uncertain. In recent years, there has been a tendency to overestimate the SSB and to underestimate fishing mortality. There is a broad perception that there are substantial undeclared landings in this fishery. The assessment is strongly dependent on the catch information, both recently and in the past. Managers are encouraged to obtain reliable catch information.

For western horse mackerel, no fishery-independent estimates of SSB or recruitment are currently available. Therefore, it is not possible to determine the absolute level of SSB, recruitment, and fishing mortality. Accordingly, only relative trends in these quantities have been derived.

For northern hake, several sources of uncertainties remain for this stock. This concerns mainly growth, discards estimation, and CPUE indices in the earlier years. The CPUE series and surveys do not cover the whole area. There is a lack of reliable recruitment indices for this stock, which has implications for the quality of short-term forecasts. Northern hake is a wide-ranging stock where the stock definition is considered to be problematic. There are concerns about the accuracy of aging data and the calculation of historic catch-at-age data.

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3.10 Deep water Populations and Habitats

The term deep water (or deep sea) includes the waters below the continental shelves. That is all the water deeper than about 200 meters. The deepwater fisheries are mainly conducted on depths greater than about 400 m. The deep water in the ICES area covers the deep parts of ICES Subareas I, II, III, V-X, XII, and XIV.

3.10.1 The deep water habitats

It can be questioned to what extent this area constitute a homegenenous ecosystem. It covers a huge area of several million km^2, spans from the arctic north to the sub-tropical south, and it covers ridges and underwater sea mountains often with a quite unique biology. However, in light of the present, very limited knowledge of the ecosystem(s) it seems to be a useful defintion for the purpose of management advice.

Productivity is very low in the deep water. Without light the deep water has no primary productivity via the photosynthesis of plants and algae except in the surface waters. Furthermore, the nutrient concentrations in the surface water is low, and overall there is very little food compared to the shallow seas. This, together with low temperatures in the deep water results in very low productivity of the organisms living here. Many animals migrate at night up into the surface waters to feed. Otherwise the deep-sea food web is fueled by a rain of dead plants and animals from surface waters.

The diversity of deep-sea life history strategies is considerable, but many species of fish targeted by fisheries and their communities are particularly vulnerable to disturbance because they grow slowly, mature late in life, and form aggregations easily accessible to fisheries. Recovery rates are much slower than in shallower waters. Examples are the archetypal long-lived fish species orange roughy and grenadiers, but also vulnerable benthic species such as cold-water corals that form important habitats for many fishes.

The knowledge of central biological characteristics such as stock identity, migration, recruitment, growth, feeding, maturation, and fecundity of most deep-sea species still lags considerably behind that of commercially exploited shelf-based species. Such information is required to expand our understanding of the population dynamics of deep-sea fishes, which in turn is needed to underpin stock assessments.

3.10.2 The stocks and their fisheries

The fisheries and their impact

The species

In some parts of the northeast Atlantic where the continental shelf is narrow, such as off Portugal (including Madeira and the Azores), there are traditional fisheries, for example for black scabbardfish (*Aphanopus carbo*) and red (=blackspot) seabream (*Pagellus bogaraveo*), which have been exploiting deepwater species for many years. Other traditional species are ling, blue ling, and tusk, which have supported large fisheries in wide areas for several decades. The existence of other potentially exploitable stocks in the ICES area has been known since the 1960s and 1970s. However, before the 1980s, with the exception of a fishery for species such as roundnose grenadier (*Coryphaenoides rupestris*) there was little interest from the fishing industry in exploiting stocks in international waters.

Since the 1980s, dwindling resources on the continental shelves of the North Atlantic have encouraged the development of fisheries in deeper waters. There has been a tendency for fisheries for species such as anglerfish and Greenland halibut to extend into deeper waters, and new fisheries have developed to target the new deepwater species that have been found there. Deepwater species such as the argentine or greater silver smelt (*Argentina silus*) and roundnose grenadier (*Coryphaenoides rupestris*), which were previously bycatch species have been targeted within the ICES area for the last two decades. Orange roughy (*Hoplostethus atlanticus*) has been a target species since the early 1990s.

The following were identified as some of the most important deepwater species for the commercial fishery.

List of deepwater species (species either targeted by deepwater fisheries or occurring as bycatch)

Alepocephalus bairdii	Baird's smoothhead
Aphanopus carbo	Black scabbardfish
Argentina silus	Argentine, greater silver smelt
Beryx splendens	Golden eye perch
Beryx decadactylus	Red bream, alfonsino
Brosme brosme	Tusk
Chimaera monstrosa	Rabbitfish
Coryphaenoides rupestris	Roundnose grenadier
Epigonus telescopus	Big eye, deepwater cardinal fish
Helicolenus dactylopterus	Bluemouth
Hoplostethus atlanticus	Orange roughy
Hoplostethus mediterraneus	Silver roughy
Lepidopus caudatus	Silver scabbardfish
Macrourus berglax	Roughhead grenadier
Molva molva	Ling
Molva dypterygia	Blue ling
Mora moro	Mora
Pagellus bogaraveo	Red (=blackspot) seabream
Phycis blennoides	Greater forkbeard
Polyprion americanus	Wreckfish
Trachyrhynchus trachyrhynchus	Roughnose grenadier
Chaecon (Geryon) affinis	Deepwater red crab
Aristeomorpha foliacea	Giant red shrimp

Advice on deepwater sharks is provided in *ICES Cooperative Research Report No. 225* (2002). The main shark species caught in deepwater fisheries are:

Centrophorus granulosus	Gulper shark
Centrophorus squamosus	Leafscale gulper shark
Centroscyllium fabricii	Black dogfish
Centroscymnus coelolepis	Portuguese dogfish
Centroscymnus crepidater	Longnose velvet dogfish
Dalatias licha	Kitefin shark
Deania calcea	Birdbeak dogfish
Etmopterus princes	Great lantern shark
Etmopterus spinax	Velvetbelly
Scymnodon ringens	Knifetooth dogfish

Advice on some other species, which might be considered as deepwater species, is already provided in Section 3.9:

Micromesistius poutassou	Blue whiting
Reinhardtius hippoglossoides	Greenland halibut
Sebastes spp	Redfish

In addition, there are other species which have been fished on the continental shelf, but whose distribution extends into deeper waters. This group includes hake (*Merluccius merluccius*), anglerfish (*Lophius* spp.), megrim (*Lepidorhombus* spp.), and conger (*Conger conger*). An extension of fishing into deeper waters for these species occurs in ICES Subareas VI, VII, VIII, and IX. Advice is provided on some of these species in Sections 3.5-3.7.

The fisheries

In ICES Subareas I+II there are directed longline and gillnet fisheries for ling (*Molva molva*) and tusk (*Brosme brosme*). There is also a directed bottom and pelagic trawl fishery for *Argentina silus* and a minor fjord fishery for roundnose grenadier (*Coryphaenoides rupestris*). Roughhead grenadier (*Macrourus berglax*) is taken as bycatch in the trawl, gillnet, and longline fisheries for Greenland halibut and redfish.

In ICES Division IIIa (Skagerrak) there is a targeted trawl fishery for roundnose grenadier and *Argentina silus*. These species are also a bycatch of the *Pandalus* and *Nephrops* fisheries with trawls, and probably only a minor part of this bycatch is landed.

In ICES Subarea IV there is a bycatch of *Argentina silus* from the industrial trawl fishery. There is a longline fishery for tusk and ling with forkbeard (*Phycis blennoides*) and some roughhead grenadier as a bycatch. There is a bycatch of some deepwater species in the trawl fisheries targeting *Lophius* spp. and Greenland halibut.

In ICES Subarea V there are trawl fisheries which target blue ling (*Molva dypterygia*), redfish, argentine (*Argentina silus*) and occasionally orange roughy (*Hoplostethus atlanticus*). Bycatch species are typically roundnose grenadier, roughhead grenadier, black scabbard fish (*Aphanopus carbo*), anglerfish (*Lophius piscatorius*), bluemouth (*Helicolenus dactylopterus*), mora (*Mora moro*), greater forkbeard (*Phycis blennoides*), argentine (*Argentina silus*), deepwater cardinal fish (*Epigonus telescopus*), and rabbit fish (*Chimaera monstrosa*). There are traditional longline fisheries for ling and tusk and these species are also bycatches in trawl and gillnet fisheries. There are also targeted trawl and gillnet fisheries for Greenland halibut and *Lophius* spp which have deepwater bycatch of, e.g. deepwater red crab (*Chaceon affinis*). There have also been trap fisheries for the deepwater red crab (*Chaceon* (formerly *Geryon*) *affinis*).

In ICES Subareas VI and VII there are directed trawl fisheries for blue ling, roundnose grenadier, orange roughy (*Hoplostethus atlanticus*), black scabbard fish and the deepwater sharks *Centroscymnus coelolepis* and *Centrophorus squamosus*. The *Argentina silus* and blue ling landings from directed fisheries increased until 2002, but then declined in 2003. Bycatch species in these areas include bluemouth (*Helicolenus dactylopterus*), mora (*Mora moro*), greater forkbeard (*Phycis blennoides*), argentine (*Argentina silus*), deepwater cardinal fish (*Epigonus telescopus*), and chimaerids, of which *Chimaera monstrosa* is the most important. There are directed longline fisheries for ling and tusk and also for hake. Deepwater sharks are a bycatch of the longline fisheries, but there are also targeted fisheries for sharks in Subareas VI and VII. There is a gillnet fishery in Subarea VII for ling.

In ICES Subarea VIII there is a longline fishery that mainly targets greater forkbeard (*Phycis blennoides*). There are also some trawl fisheries targeting species such as hake, megrim, anglerfish, and *Nephrops* that have a bycatch of deepwater species. These include *Molva* spp., *Phycis phycis, Phycis blennoides, Pagellus bogaraveo, Conger conger, Helicolenus dactylopterus, Polyprion americanus,* and *Beryx* spp.

In ICES Subarea IX some deepwater species are a bycatch of the trawl fisheries for crustaceans. Typical species are bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), conger eel (*Conger conger*), blackmouth dogfish (*Galeus melastomus*), kitefin shark (*Dalatias licha*), and gulper shark (*Centrophorus squamosus*). There is a directed longline fishery for black scabbard fish (*Aphanopus carbo*) with a bycatch of the *Centroscymnus coelolepis*. There is also a longline (Voracera) fishery for *Pagellus bogaraveo.*

In ICES Subarea X the main fisheries are by handline and longline near the Azores, and the main species landed are red (=blackspot) seabream (*Pagellus bogaraveo*), wreckfish (*Polyprion americanus*), conger eel (*Conger conger*), bluemouth (*Helicolenus dactylopterus*), golden eye perch (*Beryx splendens*) and alfonsino (*Beryx decadactylus*). At present the catches of kitefin shark (*Dalatias licha*) are made by the longline and handline deepwater vessels and can be considered as accidental. There are no vessels at present catching this species using gillnets. Outside the Azorean EEZ there are trawl fisheries for golden eye perch (*Beryx splendens*), orange roughy (*Hoplostethus atlanticus*), cardinal fish (*Epigonus telescopus*), black scabbard fish (*Aphanopus carbo*), and wreckfish (*Polyprion americanus*).

In ICES Subarea XII there are trawl fisheries on the mid-Atlantic Ridge for orange roughy, roundnose grenadier, and black scabbard fish. There is a multispecies trawl and longline fishery on Hatton Bank, and some of this occurs in this subarea, some in Subarea VI. There is considerable fishing on the slopes of the Hatton Bank, and effort may be increasing. Smoothheads were previously usually discarded but seem now to a greater extent to feature in the landings statistics.

In ICES Subarea XIV there are trawl and longline fisheries for Greenland halibut and redfish that have bycatches of roundnose grenadier, roughhead grenadier, and tusk.

Stock status and fisheries impacts

Fisheries on deepwater species have developed rapidly and the resources which they exploit are generally especially vulnerable to overfishing. Within the ICES area species/stocks have been depleted before appropriate management measures have been implemented. It is also of concern that the landings statistics that are available may not reflect the true scale of the recent fishing activity, especially in waters outside the national EEZs.

Experience shows that some deep-sea species with life history strategies characterised by long life-spans, high age at maturity, and slow growth (e.g. orange roughy, blue ling) can be depleted very quickly and that recovery will be slow. Regeneration and growth are so slow that abundance does not increase in the depleted populations in the short or medium term. Other species with higher productivity have also been severely impacted by fisheries, but show greater resilience and potential for recovery in the medium term.

The survival rates of discards and of fish encountering gears and escaping are unknown, but many species are expected to be very vulnerable to injury, and therefore would be expected to die even if they escaped through meshes. The body shape of many deepwater fish combined with a high age/length at maturity often means that there can be a high fishing mortality of immature fish. Some species, such as blue ling, orange roughy, red sea bream, and alfonsinos aggregate in shoals, often associated with seamounts, and the fisheries have high catch rates once the shoals are located. Localized sub-units of the population can be quickly depleted by fisheries, even within a single season. Sub-units of some species (e.g. red sea bream, blue ling, and orange roughy) are known to have collapsed in some ICES areas.

It is evident that high catch rates can be maintained by moving from one concentration to another and progressively depleting the stock. Furthermore, many deepwater fisheries are on mixtures of species, making it difficult to manage the species components individually.

Fisheries for deepwater species have been developing and changing in areas inside and outside national jurisdictions since the 1970s. But the actual exploitation rates have been difficult to assess and even the current level is unknown. During the last decade exploitation appeared to be increasing on a number of species, as fishing extended into deeper waters or new areas. However, the quantities recorded were not always well estimated, and some landings are reported in grouped categories because of difficulties in separating species. Effort data were frequently uncertain and incomplete. In many cases significant proportions of the catch are discarded at sea and not recorded. All these factors make it difficult to determine which level of exploitation is sustainable. Fisheries on deepwater species have often developed and expanded before sufficient information was available on which to base management advice.

In 2002 ICES concluded that most exploited deepwater species were considered to be harvested outside safe biological limits, and recommended immediate reductions in the fisheries unless they could be shown to be sustainable. New fisheries should be permitted only when they expanded very slowly, and were accompanied by programmes to collect data which would allow evaluation of the stock status. While there has been increasing research activity in deep water the fisheries have expanded more rapidly.

The development in the most recent years prior to 2003 was that some fisheries actually expanded (e.g. orange roughy), whereas most others continued at more or less the same levels of landings. Some fisheries were regulated by unilateral or internationally agreed TACs in 2003, and this may have curbed the expansions. In the NEAFC regulatory area, effort was recommended to be frozen in 2003 and 2004 and an effort regulation has been implemented in EU deep-sea fisheries. But as in 2002 few satisfactory stock assessments could be made in 2004, and information on exploitation rates remains uncertain. Under a precautionary approach regime, and given that no new assessments could be made, the conclusion on stock status in 2004 remains similar to that made in 2002.

ICES discussed in its advisory report for 2002 how precautionary reference points might be established. ICES found that the most appropriate approach would be to use an indicator U chosen among the indices of exploitable biomass; in practice this indicator would be CPUE from a commercial fleet where changes in efficiency are small, or CPUE from a survey. The reference points would then be established according to the following rule $U_{lim} = 0.2 * U_{max}$ (maximum observed CPUE in the time-series) and $U_{pa} = 0.5 * U_{max}$. Unfortunately, most indices cover only a proportion of the area of abundance and are therefore difficult to use.

A summary of the status of the exploited species for which at least some information exists to evaluate abundance is given in the table below.

Table 3.10.2.1.1. Stock summary for species considered by ICES. Stock units are not well defined for several species.

Species	ICES Subarea/division	Assessment type and final year of data	Salient features Indicators of stock status	Concerns / comments
Ling *(Molva molva)*	IIa,IVa,V,VI and VII	Catch curves in late 90s. Preliminary age-based assessment for Vb. Trends in CPUEs. 2003.	Average Z very high in late 90s. Survey indices declining in Va. Commercial CPUEs in other areas.	Continued limited provision of data from some major fisheries. Length and age data series still inadequate for analytical assessments.
Blue ling *(Molva dypterygia)*	I-XII and XIV	Indicative holistic assessment for V, VI & VII based on CPUE data. 2003.	Strong decline in CPUE. CPUEs probably not reliable as stock indicators due to fishing on aggregations.	Fishing on spawning concentrations implies that CPUE trend may underestimate the stock trends and should be treated with caution.
Tusk *(Brosme brosme)*	IIa,IVa,V,VI	Catch curves in late 90s and trends in CPUEs. CPUE series truncated in mid -1990s. 2003.	Historical CPUE data show strong decline over the past decade in most areas. Trends in most recent years uncertain.	Length and age data series still inadequate for analytical assessment.
Greater Silver Smelt *(Argentina silus)*	Mainly IIa,III,V,VI,VII	No recent assessment. 2003.	Available CPUEs from IIIa and Vb probably not indicative of stock development.	Decline in landings in recent years has been observed for all ICES divisions, except Div. IIa.
Orange Roughy *(Hoplostethus atlanticus)*	Mainly VI, VII, X and XII	No assessments. CPUE data only. 2003.	Strong fluctuations in CPUE. Due to the aggregational behaviour of this species CPUEs are not readily indicative of stock density .	The fluctuations in CPUE may reflect both fluctuations in fish density on successively exploited aggregations and sequential discovery of new aggregations Recent high landings in VII are unlikely to be sustainable.
Roundnose Grenadier *(Coryphaenoides rupestris)*	IIIa,V, VI VII and XII. Data mainly from V,VI & VII	Preliminary age-based assessment for stock in V,VI & VII indicates declining stock. Preliminary acoustic assessment for XII. 2003.	No clear trends in CPUEs for IIIa, V, VI, VII. Russian CPUEs for XII & XIV, 1975-2003, declining	Requirement for age data. Number of large fish declining. Discard data should be collected. Full review of data for area XII and X needed. Mis-reporting suspected in XII (Hatton Bank).
Black Scabbardfish *(Aphanopus carbo)*	Mainly V,VI,VII,VIII and IX	ASPIC model. CPUE data. 2003.	Consistent decline in CPUE in V, VI and VII, but increase in 2002 for VI and VII. CPUE in IXa stable.	Stock structure unknown. Information on reproductive tactics and dynamics is needed.
Golden Eye Perch *(Beryx splendens)*	Mainly X	No assessment, because of lack of satisfactory data. 2003.		Concern about sequential depletion and underreporting from international waters.
Red (blackspot) Seabream *(Pagellus bogaraveo)*	Mainly in X and IX, and residual in VI, VII, VIII	No assessment attempted due to lack of data. 2003.		
Greater forkbeard (*Phycis blennoides)*	All areas but mainly VI, VII, VIII and IX	No assessment 2003.	CPUE data not used because landings statistics may include landings of Morids and concerns about CPUE of bycatch species.	Mainly bycatch.

3.10.3 Assessments and advice

3.10.3.1 Fisheries advice

Nominal catches

The estimated landings of deepwater species by ICES Subareas and Divisions for the period 1988 to 2003 (preliminary data) are given in Table 3.10.3.1.1. The data in this table are derived from a variety of sources. ICES Working Group members have provided information that has filled some of the gaps in the STATLANT database, but the data are still somewhat incomplete. For this reason, some of the apparent trends and fluctuations during the time-series should be treated with caution. Some new data not available previously have been used to refine and correct landings data.

Mixed fisheries and fisheries interactions

Satisfactory comprehensive quantitative descriptions of fisheries exploiting deep-sea species have not been compiled, but efforts were initiated in 2004 to define fisheries by areas and fleets. This work will continue with an aim to develop future fisheries-based advice.

Most fisheries in outer shelf and continental slope waters have more than one target species, and may thus be considered mixed fisheries exploiting communities or suites of species. There are exceptions, however, e.g. the target fishery for *Argentina silus* by midwater or semipelagic trawls. Catches from most bottom trawl fisheries consist of 1-3 target species, a further few species that are marketable, and a variable unmarketable fraction that may eventually be discarded. Seamount fisheries or fisheries targeting aggregations (e.g. orange roughy, blue ling, alfonsino) may have catches that are less diverse than trawl fisheries targeting less aggregating slope species (e.g. grenadier, sharks). Longline fisheries for e.g. ling, tusk, and black scabbardfish, usually have more well-defined targets, but may also have a significant bycatch, some of which is unmarketable. Discarding practices vary, and data are being or have been collected from some major fisheries, but not always in a standardised and regular manner.

A further complication in defining fisheries is that several of the species on the deep-sea species list are actually only, or to a very high degree, exploited as bycatch in target fisheries for other species such as e.g. cod, hake, monkfish, and redfish. This is particularly the case for deepwater species that during their life history inhabit a wide depth range from relatively shallow waters of the shelf and coasts into slope waters beyond 400 m. Ling (*Molva molva*) is an example, partly also tusk (*Brosme brosme*) which are valuable and marketed even when catches are small. While a high proportion of ling and tusk are landed from aimed longline fisheries where ling is the target, a significant fraction stems from landings by trawl and longliner fleets targeting other species. Greater forkbeard *Phycis blennoides* is an example of a species almost solely exploited as bycatch and is not landed consistently.

Single-stock exploitation boundaries and critical stocks

Deepwater species can only sustain low rates of exploitation. Fisheries should be permitted only when they are accompanied by programmes to collect data on both target and bycatch fish. In many cases the populations are already overexploited and ICES advises an effort reduction. Where expansion is possible this should be done very slowly until reliable assessments indicate that increased harvests are sustainable.

Species	**State of the stock**			**ICES considerations in relation to single-stock exploitation boundaries**			**Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2005**
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to target reference points**	**In relation to agreed management plan**	**In relation to precautionary limits**	**In relation to target reference points**	
Alfonsinos/Golden eye perch	Unknown	Unknown	Unknown				Due to their spatial distribution associated with seamounts and their aggregation behaviour, alfonsinos are easily overexploited; they can only sustain low rates of exploitation.
Ling (*Molva molva*)	Unknown	Unknown	Unknown				The overall fishing effort in Subareas II, IV, VI, VII, and VIII and Division Va should be reduced by 30% as compared to the 1998 level. For Division Vb, effort should not be allowed to increase compared with the present level.
Blue Ling (*Molva dypterygia*)	Reduced reproductive capacity (CPUE used a stock status indicator below 20 % of maximum observed level)	Unknown	Unknown				There should be no directed fisheries for this stock. Technical measures such as closed areas on spawning aggregations should be implemented to minimize catches of this stock in mixed fisheries.

Tusk (*Brosme brosme*)	Division Va: CPUE used as stock indicator and is between 20 and 50 % of the maximum observed level Remaining areas: Uncertain	Unknown	Unknown				Effort should be reduced by 30% compared to the 1998 effort.
Black scabbardfish (*Aphanopus carbo*)	Unknown	Unknown	Unknown				Effort should be reduced significantly. Any measure taken to manage this species in these areas should take into account the advice given for other species taken in the same mixed fishery. In Division IXa the adoption of a *status quo* exploitation level is advised.
Greater forkbeard (*Phycis blennoides*)	Unknown	Unknown	Unknown				No stock exploitation boundary can be suggested due to lack of assessment. Furthermore, the knowledge of the biology of the species is insufficient, and it is unclear how vulnerable it is to exploitation.
Roundnose grenadier (*Coryphaenoides rupestris*)	Unknown	Unknown	Unknown				For Subareas VI and VII and Divisions Vb and IIIa a reduction in effort of 50% from the 2000-2002 effort is required. In all other areas, the expansion of fisheries should not be allowed until reliable assessments indicate that increased harvests are sustainable.
Red (=blackspot) seabream (*Pagellus bogaraveo*)	Unknown	Unknown	Unknown				Red seabream can only sustain low rates of exploitation.
Greater Silver Smelt *(Argentina silus)*	Unknown	Unknown	Unknown				Greater silver smelt can only sustain low rates of exploitation.
Orange Roughy *(Hoplostethus atlanticus)*	Unknown	Unknown	Unknown				Orange roughy is heavily depleted in Subarea VI. In Subarea VII, the exploitation rate is considered to be much too high. Orange roughy can only sustain very low rates of exploitation.

Advice for fisheries management

The critical groups on which the advice is built are:

- Ling and tusk
- Blue ling
- Other deepwater species.

Most exploited deepwater species are considered to be harvested unsustainably; however, it is currently not possible to provide advice for specific fisheries for deep-sea species. Consistent with a precautionary approach, ICES recommends immediate reduction in established deep-sea fisheries unless they can be shown to be sustainable. Measures should also be implemented to reduce exploitation of deep-sea species by fisheries primarily targeting shelf species (hake, anglerfish, and megrim). New deep-sea fisheries or expansion of existing fisheries into new fishing areas should not be permitted unless the expansion is very cautious, and is accompanied by programmes to collect data which allow evaluation of stock status as the basis for determining sustainable exploitation levels.

Ling and tusk are in many fisheries taken together and therefore the advised effort reduction, calculated on the basis of ling should apply to all fisheries taking ling and tusk as their main catch. The advised reduction is 30% compared to the 1998 effort level.

Concerning blue ling, there should be no directed fisheries. Technical measures such as closed areas on spawning aggregations should be implemented to minimize catches of this stock in mixed fisheries.

Management considerations

For several species there is a concern that catch rates can only be maintained by sequential depletion of relatively isolated concentrations/sub-units of a stock. The smallest unit for which data are reported at present is the ICES Subarea and Division, and this spatial resolution may not be appropriate for monitoring or managing this type of fishing activity. The depth range within an area may be very wide, and the sizes of the areas are very different. It is therefore recommended that systems are developed and implemented for recording effort and catches at a finer temporal and geographical scale, and that management actions are implemented that take into account spatial resolution at a finer scale than at present.

For species-specific considerations see Section 4.10.

Short-term implications

Short-term implications will most probably be reduction in the activity and/or capacity of major fleets, in particular trawler fleets traditionally targeting the most long-lived target species (e.g. orange roughy, grenadier, blue ling) and aggregating species of which severe depletions have been documented. There are indications that some such fleets have already either changed targets or become inactive, others have continued more or less as in previous years.

It is likely that most target areas for deep-sea fisheries have been explored and that there is limited scope for expansion into new areas or development of new fisheries. In recent years, new developments have occurred mainly in relatively remote waters of, e.g. the Hatton Bank and the mid-Atlantic Ridge. The exploitation rate on the Hatton Bank seems now rather high and many nations are engaged in the fisheries there. On the mid-Atlantic Ridge, fisheries for e.g. roundnose grenadier have a long history back to the 1970s, but the interest seems now to increase. An implication of the current advice is that any further development in these areas (and other areas that are re-visited or explored) should not be permitted unless a proper evaluation of stock status and sustainable exploitation rate is available.

Regulations in force and their effects

National and international regulations have been introduced that to some extent regulate participation and landings. Some countries have licensing schemes for certain vessel categories and Iceland has introduced closed areas. An effort regulation system has been implemented in EU deep-sea fisheries. The regulation includes licences and stabilisation of effort at the recent level. NEAFC has in 2003 and 2004 proposed to freeze fishing effort for deep-sea species in the

NEAFC Regulatory Area; however, discussions on implementation is still ongoing. In 2003, for Subareas VI-X (EU waters) EU unilaterally introduced a TAC management as an interim measure. The effects were seen in the preliminary landings that declined for some species in that year. The EU TACs only limit EU vessels.

For many years bilateral TAC agreements have been made between, e.g. EU and Norway, Norway and Iceland, Norway and Faroes, potentially affecting fisheries for several deepwater species (e.g. ling, tusk, blue ling), but it is uncertain if these TACs have limited the fisheries. In many cases the TACs are not species-specific but valid for a suite of species, hence it is difficult to list the exact TACs by species.

ICES has called for a reduction of the effort in the deepwater fisheries and the regulations mentioned above all aim at stabilising or curtailing effort. The regulations are expected to improve stock status or at least to slow the rate of depletion. However, their actual effects on the stocks cannot be quantified at present.

Information from the fishing industry

For the deep-sea assessments data derived from the fisheries are essential, i.e. effort and landings statistics, and discard data. Virtually no fisheries-independent data are available.

There is some specific input from fisheries, e.g. the French discard data collected in a PROMA-sponsored scheme. In Norway a reference fleet of commercial vessels provide data regularly, and these will improve the basis of future assessments.

There have, however, not been any specific ICES-initiated meetings or other contact with the industry.

Quality of assessments and uncertainties

The situation has not changed substantially since assessments were attempted in 2002, 2000, and 1998. The quality of the input data remains unsatisfactory for many species, and time-series are short.

In 2004 several CPUE series were updated or new were calculated. The attempts at assessment continue to rely very heavily on CPUE data and analyses, especially from commercial fleets, and this is not satisfactory. Few extensive survey series are available, but if they are continued, several series may become useful in the future, at least for some species.

As mentioned earlier the smallest unit for which data are reported at present is the ICES Subareas and Divisions, and this spatial resolution is not appropriate for monitoring of the status of deepwater fish. The recent initiatives from Eurostat, NEAFC, and ICES on a redefinition of the divisions used for the reporting of fisheries catch and effort statistics may lead to more useful data.

Table 3.10.3.1.1 Estimated landings (tonnes) of deepwater species by ICES Subareas and Divisions, 1988-2003. Data for 2002 and 2003 are preliminary. Note: data for deepwater sharks has been discontinued after 2002. Source: Data officially reported to ICES by national authorities and data provided by WGDEEP members, 2004.

I+II	**Species**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	ALFONSINOS (Beryx spp.)																
	ARGENTINES (Argentina silus)	11351	8390	9120	7741	8234	7913	6807	6775	6604	4463	8261	7163	6293	14363	7407	8908
	BLUE LING (Molva dypterigia)	3537	2058	1412	1479	1039	1020	422	364	267	292	279	292	252	200	148	117
	BLACK SCABBARDFISH (Aphanopus carbo)																
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)			23	39	33	1								8	315	153
	LING (Molva molva)	6126	7368	7628	7793	6521	7093	6322	5954	6346	5409	9200	7651	5964	4951	7131	6144
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)																
	RABBITFISHES (Chimaerids)												1	6	5	15	15
	ROUGHHEAD GRENADIER (Macrourus berglax)			589	829	424	136				17	55		48	94	29	77
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)		22	49	72	52	15	15	7	2	106	100	46		2	12	4
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SHARKS, VARIOUS	37	15											1			
	SILVER SCABBARDFISH (Lepidopus caudatus)																
	SMOOTHHEADS (Alepocephalidae)																
	TUSK (Brosme brosme)	14403	19350	18628	18306	15974	17585	12566	11617	12795	9426	15353	17183	14008	12050	12191	7876
	WRECKFISH (Polyprion americanus)																
	ALFONSINOS (Beryx spp.)			1		2											
	ARGENTINES (Argentina silus)	2718	3786	2321	2554	5319	3269	1508	1082	3300	2598	3982	4319	2471	2925	1811	1166
	BLUE LING (Molva dypterigia)	385	482	522	648	592	438	442	503	202	291	292	271	144	276	385	108
	BLACK SCABBARDFISH (Aphanopus carbo)	2		57				16	2	4	2	9	6	5	12	24	4
	BLUEMOUTH (Helicolenus dactylopterus)												5				
	GREATER FORKBEARD (Phycis blennoides)	15	12	115	181	145	34	12	3	18	7	12	31	11	26	585	231
	LING (Molva molva)	11933	12486	11025	10943	12154	14249	12288	14112	14531	12325	14472	10472	9858	8397	9618	6857
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)																
	RABBITFISHES (Chimaerids)					122	8	167		14	38	56	45	33	20	24	19
	ROUGHHEAD GRENADIER (Macrourus berglax)					7					36			4	11	3	2
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)	618	1055	1439	2053	2754	1441	771	85	2284	177	1854	3187	2406	3121	4258	4315
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SHARKS, VARIOUS				3	133	78	86	20	14	32	359	201	36	62		
	SILVER SCABBARDFISH (Lepidopus caudatus)					27											
	SMOOTHHEADS (Alepocephalidae)																
	TUSK (Brosme brosme)	4490	6515	4319	4623	5029	5234	3433	3405	3576	2341	3474	2498	3411	3196	3082	2024
	WRECKFISH (Polyprion americanus)																

Table 3.10.3.1.1 (Continued)

Va	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)																
	ARGENTINES (Argentina silus)	206	8	112	247	657	1255	613	492	808	3367	13387	5518	4593	3043	4960	2683
	BLUE LING (Molva dypterigia)	2171	2533	3021	1824	2906	2233	1632	1635	1323	1344	1154	1877	1711	915	1349	1143
	BLACK SCABBARDFISH (Aphanopus carbo)							1			1		9	18	8	13	0
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)																
	LING (Molva molva)	5861	5612	5598	5805	5116	4854	4604	4192	4060	3933	4302	4647	3743	3343	3315	4123
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)				65	382	717	158	64	40	79	28	14	68	19	10	
	RABBITFISHES (Chimaerids)				499	106	3	60	106	21	15	29	2	5			
	ROUGHHEAD GRENADIER (Macrourus berglax)									15	4	1		5	3	11	
	ROUNDNOSE GRENADIER (Coryphaenoides	2	4	7	48	210	276	210	398	140	198	120	129	67	57	60	0
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SHARKS, VARIOUS		31	54	58	70	39	42	45	65	70	87	45	45	57		
	SILVER SCABBARDFISH (Lepidopus caudatus)																
	SMOOTHHEADS (Alepocephalidae)					10	3	1	1								
	TUSK (Brosme brosme)	6855	7061	7291	8732	8009	6075	5824	6225	6102	5394	5171	7264	6391	4831	5651	5404
	WRECKFISH (Polyprion americanus)																
Vb	**Species**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	ALFONSINOS (Beryx spp.)			5		4			1								
	ARGENTINES (Argentina silus)	287	227	2888	60	1443	1063	960	12286	9498	8433	17570	8214	8343	10461	8195	6321
	BLUE LING (Molva dypterigia)	9526	5264	4799	2962	4702	2836	1644	2440	1602	2798	2584	2932	2524	2532	2091	3098
	BLACK SCABBARDFISH (Aphanopus carbo)		166	419	152	33	287	160	424	186	68	180	172	311	800	1756	1465
	BLUEMOUTH (Helicolenus dactylopterus)												58	16			
	DEEPWATER CARDINAL FISH (Epigonus telescopus)												8	2	7		
	GREATER FORKBEARD (Phycis blennoides)	2	1	38	53	49	27	4	9	7	7	8	34	32	100	148	69
	LING (Molva molva)	4488	4652	3857	4512	3614	2856	3622	4070	4896	5657	5359	5238	3719	4588	4524	5374
	MORIDAE				5								1		100	19	2
	ORANGE ROUGHY (Hoplostethus atlanticus)			22	48	13	37	170	420	79	18	3	5	155	5		3
	RABBITFISHES (Chimaerids)								1				3	54	84	64	3
	ROUGHHEAD GRENADIER (Macrourus berglax)											9	58	1	4		
	ROUNDNOSE GRENADIER (Coryphaenoides	1	258	1549	2311	3817	1681	668	1223	1078	1112	1667	1996	1791	2017	1027	1181
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SHARKS, VARIOUS			140	78	164	478	192	262	380	308	433	470	409	543		
	SILVER SCABBARDFISH (Lepidopus caudatus)																
	SMOOTHHEADS (Alepocephalidae)																
	TUSK (Brosme brosme)	5665	5122	6181	6266	5391	3439	4316	3978	3310	3319	2710	3964	2974	3887	2839	3157
	WRECKFISH (Polyprion americanus)																

Table 3.10.3.1.1 (Continued)

VI+VII	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)		12	8		3	1	5	3	178	25	81	75	133	186	118	18
	ARGENTINES (Argentina silus)	10438	25559	7294	5197	5906	1577	5707	7546	5863	7301	5555	8856	13866	19050	15985	2280
	BLUE LING (Molva dypterigia)	9285	9434	6396	7319	6697	5471	4309	4892	6928	7361	8004	9471	8525	9296	6215	3343
	BLACK SCABBARDFISH (Aphanopus carbo)		154	1060	2759	3436	3529	3101	3278	3689	2995	1967	2166	3712	4623	6325	2651
	BLUEMOUTH (Helicolenus dactylopterus)												403	342	189	182	151
	DEEPWATER CARDINAL FISH (Epigonus telescopus)												279	241	349	976	986
	GREATER FORKBEARD (Phycis blennoides)	1898	1815	1921	1574	1640	1462	1571	2138	3590	2335	3040	3430	4919	4349	3343	2486
	LING (Molva molva)	28092	20545	15766	14684	12671	13763	17439	20856	20838	16668	19863	15087	14593	11528	10435	7968
	MORIDAE				1	25							20	146	190	158	265
	ORANGE ROUGHY (Hoplostethus atlanticus)		8	17	4908	4523	2097	1901	947	995	1039	1071	1337	1887	3692	5765	559
	RABBITFISHES (Chimaerids)							2					236	355	641	550	47
	ROUGHHEAD GRENADIER (Macrourus berglax)						18	5	2				34	9	44	12	2
	ROUNDNOSE GRENADIER (Coryphaenoides	32	2440	5730	7793	8338	10121	7860	7767	7095	7070	6364	6538	9790	15262	9028	5029
	RED (=BLACKSPOT) SEABREAM (Pagellus	252	189	134	123	40	22	10	11	29	56	17	25	20	51	25	32
	SHARKS, VARIOUS	85	40	43	254	639	1392	1864	2099	2176	3240	3023	1791	8			
	SILVER SCABBARDFISH (Lepidopus caudatus)						2						18	15		1	
	SMOOTHHEADS (Alepocephalidae)										7			978	4844	260	8
	TUSK (Brosme brosme)	3002	4086	3216	2719	2817	2378	3233	3085	2417	1832	2240	1654	4498	2687	1794	1700
	WRECKFISH (Polyprion americanus)	7		2	10	15				83		12	14	14	17	9	1
VIII+IX	Species	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	ALFONSINOS (Beryx spp.)			1		1		2	82	88	135	269	201	167	229	124	9
	ARGENTINES (Argentina silus)															191	37
	BLUE LING (Molva dypterigia)										14	33	4	4	6	29	7
	BLACK SCABBARDFISH (Aphanopus carbo)	2602	3473	3274	3979	4389	4513	3429	4272	3815	3556	3152	2752	2404	2767	2725	2658
	BLUEMOUTH (Helicolenus dactylopterus)												31	36	34	16	
	DEEPWATER CARDINAL FISH (Epigonus telescopus)												3	5	4	8	3
	GREATER FORKBEARD (Phycis blennoides)	81	145	234	130	179	395	320	384	456	361	665	378	411	494	489	135
	LING (Molva molva)	1028	1221	1372	1139	802	510	85	845	1041	1034	1799	451	331	577	439	357
	MORIDAE								83	52	88			26	20	11	10
	ORANGE ROUGHY (Hoplostethus atlanticus)					83	68	31	7	22	23	14	39	52	20	21	21
	RABBITFISHES (Chimaerids)												2	2	7	6	
	ROUGHHEAD GRENADIER (Macrourus berglax)																
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)			5	1	12	18	5		1		20	16	4	7	3	1
	RED (=BLACKSPOT) SEABREAM (Pagellus	826	948	906	666	921	1175	1135	939	1001	1036	981	647	691	552	489	500
	SHARKS, VARIOUS	3545	1789	1789	2850	6590	3740	4	43	64	1104	2890	2287	704	549		
	SILVER SCABBARDFISH (Lepidopuscaudatus)	2666	1385	584	808	1374	2397	1054	5672	1237	1725	966	3069	16	308	484	741
	SMOOTHHEADS (Alepocephalidae)										7						
	TUSK (Brosme brosme)	1										1					

Table 3.10.3.1.1 (Continued)

	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	WRECKFISH (Polyprion americanus)	198	284	163	194	269	338	409	393	294	214	227	151	121	167	156	224
X	Species	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	ALFONSINOS (Beryx spp.)	225	260	338	371	450	728	1500	623	536	983	228	175	229	199	242	172
	ARGENTINES (Argentina silus)																
	BLUE LING (Molva dypterigia)	18	17	23	69	31	33	42	29	26	21	13	10	13			
	BLACK SCABBARDFISH (Aphanopus carbo)				166	370	2		3	11	3	99	112	113	0	0	0
	BLUEMOUTH (Helicolenus dactylopterus)												320	452	301		
	DEEPWATER CARDINAL FISH (Epigonus telescopus)													3		14	
	GREATER FORKBEARD (Phycis blennoides)	29	42	50	68	81	115	135	71	45	30	38	41	94	83	57	45
	LING (Molva molva)																
	MORIDAE	18	17	23	36	31	33	42							1	267	316
	ORANGE ROUGHY (Hoplostethus atlanticus)						1			471	6	177	10	188	28	22	0
	RABBITFISHES (Chimaerids)																
	ROUGHHEAD GRENADIER (Macrourus berglax)												3				
	ROUNDNOSE GRENADIER (Coryphaenoides rupestris)									3	1	1	6	74	0	2	0
	RED (=BLACKSPOT) SEABREAM (Pagellus	637	924	889	874	1110	829	983	1096	1036	1012	1114	1222	947	1034	1193	1068
	SHARKS, VARIOUS	1098	2703	1204	3864	4241	1183	309	1246	1117	859	995					
	SILVER SCABBARDFISH (Lepidopus	70	91	120	166	2160	1722	373	789	815	1115	1186	86	28	44	10	25
	SMOOTHHEADS (Alepocephalidae)																
	TUSK (Brosme brosme)																
	WRECKFISH (Polyprion americanus)	191	235	224	170	237	311	428	240	240	177	139	133	268	229	283	270
XII	Species	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	ALFONSINOS (Beryx spp.)								2								
	ARGENTINES (Argentina silus)						6			1			2				
	BLUE LING (Molva dypterigia)	263	70	5	1147	971	3335	752	573	788	417	438	1353	594	1166	146	96
	BLACK SCABBARDFISH (Aphanopus carbo)					512	1144	824	301	444	200	154	112	244	121	1	5
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)					1	1	3	4	2	2	1		6	8	6	9
	LING (Molva molva)			3	10			5	50	2	9	2	2	7	59	8	19
	MORIDAE													1	87	13	15
	ORANGE ROUGHY (Hoplostethus atlanticus)					8	32	93	676	818	808	629	431	259	814	6	175
	RABBITFISHES (Chimaerids)										32	42	115	48	63	9	12
	ROUGHHEAD GRENADIER (Macrourus berglax)												39	7	10	7	2
	ROUNDNOSE GRENADIER (Coryphaenoides	10600	9500	2800	7510	1997	2741	1161	644	1728	8676	11978	9660	8528	7815	7251	9432
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)							75									
	SHARKS, VARIOUS				1	2	6	8	139	147	32	56	50	1069	1208		
	SILVER SCABBARDFISH (Lepidopus caudatus)		102	20			19										
	SMOOTHHEADS (Alepocephalidae)									230	3692	4643	6549	4146	3592	n.a.	n.a.
	TUSK (Brosme brosme)	1	1		1	1	12	1	18	158	30	1	1	5	52	27	83

Table 3.10.3.1.1 (Continued)

WRECKFISH (Polyprion americanus)

XII	Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	ALFONSINOS (Beryx spp.)																
	ARGENTINES (Argentina silus)			6										217	66		
	BLUE LING (Molva dypterigia)	242	71	79	155	110	3725	384	141	14	4	55	8	532	97	1	40
	BLACK SCABBARDFISH (Aphanopus carbo)											2		90	0	0	0
	BLUEMOUTH (Helicolenus dactylopterus)																
	GREATER FORKBEARD (Phycis blennoides)															23	
	LING (Molva molva)	3	1	9	1	17	9	6	17	0	61	6	1	26	35	20	83
	MORIDAE																
	ORANGE ROUGHY (Hoplostethus atlanticus)																
	RABBITFISHES (Chimaerids)																1
	ROUGHHEAD GRENADIER (Macrourus berglax)						52	5	2			6	14		26	4	
	ROUNDNOSE GRENADIER (Coryphaenoides	52	45	47	29	31	26	15	27	25	59	126	124	57	97	47	21
	RED (=BLACKSPOT) SEABREAM (Pagellus bogaraveo)																
	SQUALID SHARKS	2253	2151	3871	5610	7836	7985	7474	6801	7065	6158	6318	5636	7150	9175		
	SHARKS, VARIOUS including some squalids	3630	1860	2026	4453	10429	9044	5757	5383	5974	7579	9602	7655	6764	7874		
	SILVER SCABBARDFISH (Lepidopus caudatus)																
	SMOOTHHEADS (Alepocephalidae)													12			
	TUSK (Brosme brosme)	2	23	32	135	202	80	25	87	281	118	15	9	11	69	58	87