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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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1 THE BALTIC SEA

1.1 Ecosystem Overview

1.1.1 Ecosystem Components

Bottom topography, substrates, and circulation

The Baltic Sea is one of the largest brackish areas in the world. It receives freshwater from a number of larger and smaller rivers while saltwater enters from the North Sea along the bottom of the narrow straits between Denmark and Sweden. This creates a salinity gradient from southwest to northeast and a water circulation characterised by the inflow of saline bottom water and a surface current of brackish water flowing out of the area.

The bottom topography features a series of basins separated by sills. The Gulf of Bothnia and the Gulf of Riga are internal fjords, while the Baltic Proper and the Gulf of Finland consists of several deep basins with more open connections. The western and northern parts of the Baltic have rocky bottoms and extended archipelagos, while the bottom in the central, southern, and eastern parts consists mostly of sandy or muddy sediment.

Physical and chemical oceanography

The water column in the open Baltic is permanently stratified with a top layer of brackish water separated from a deeper layer of saline water. This separation limits the transport of oxygen from the surface and as a result the oxygen in the deeper layer can become depleted due to breakdown of organic matter.

A strong inflow of new saline and oxygen-rich water from the North Sea can lead to a renewal of the oxygen-depleted bottom water. Strong inflows can occur when a high air pressure over the Baltic is followed by a steep air pressure gradient across the transition area between the North Sea and the Baltic. Such situations typically occur in winter. Strong inflows were frequent prior to the mid-1970s, but have since become rarer and as a result salinity has decreased over the last 25 years. Major inflows occurred, however, in 1976, 1983, and 1993. In 2003 an inflow of medium size (200 km^3; ICES, 2004a) introduced salty, cold, and well-oxygenated water into all main basins of the Baltic Sea, including the Gotland Deep. In 2005 an inflow of approximately 140 km^3 of water occurred between January 1 and 14 (http://www.smhi.se/oceanografi/oce_info_data/waterlevel/follow_up/waterlevel_uppfoljning.html).

The Baltic receives nutrients and industrial waste from rivers, and airborne substances from the atmosphere. As a result the Baltic has become eutrophied during the 20th century. In general, nutrient concentrations in the Baltic Sea have not decreased since the mid-1990s, and remain persistently high (HELCOM, 2003). Low oxygen conditions in deep water affect the amounts of nutrients in the water. Phosphorus is easily released from sediments under anoxic conditions. Nitrogen cycles in deepwater layers also change in anoxic conditions: mineralization eventually produces ammonium, and no oxidation occurs to form nitrates. Consequently, the process of denitrification, which needs oxygen from nitrates, will not occur. The resulting nutrient surplus in the deepwater layers is a potential source of nutrients for the surface layers, where primary production may be further increased (HELCOM, 2003). This effect may counterbalance the decrease in nutrient input into some parts of the Baltic Sea. In addition a long-term decrease in silicate concentrations is apparent in most parts of the Baltic, and silicate has recently been limiting the growth of diatoms in the Gulf of Riga in spring. Silicate limitation changes the structure of the phytoplankton community rather than limiting the total production (HELCOM, 2002: p. 181).

Furthermore, hypoxia in shallow coastal waters seriously affects biodiversity, and seems to be an increasing problem – especially in the archipelagos of the northern Baltic Sea. These irregular events are caused by local topography, hydrography, and drifting algal mats (HELCOM, 2002: p. 166).

Contaminants

The Baltic Sea is severely contaminated, and contamination status is regularly assessed through HELCOM (e.g., HELCOM, 2002; 2003), where details are available. Whereas DDT pollution has decreased substantially, the decline of PCB and dioxin concentrations has levelled off, suggesting that some input of these compounds continues (HELCOM, 2002). Contaminant levels in northern Baltic herring and salmon are so high that consumption is being regulated (HELCOM, 2002; 2004).

Broad-scale climate and oceanographic features and drivers

The oceanographic conditions in the Baltic are very much driven by meteorological forcing influencing inflow from the North Sea. Hydrographic characteristics and significant correlations have been demonstrated between NAO and total freshwater runoff, westerly winds, and salinity (Häninnen *et al.*, 2002), ice conditions (Koslowski and Loewe, 1994), as well as local circulation and upwelling (Lehmann *et al.*, 2002). Climate variability has been shown to affect the dynamics of many of the components of the Baltic ecosystem. The consequences of a recent severe winter (2002/2003) (ICES, 2004a) for commercial fish stocks remain to be quantified.

Phytoplankton

The species composition of the phytoplankton depends on local nutrients and salinity with a gradual change in the species composition going from the southwest to the northeast. Normally, an intense spring bloom starts in March in the western Baltic, but only in May–June in the Gulf of Bothnia. In the southern and western parts the spring bloom is dominated by diatoms, whereas it is dominated by dinoflagellates in the central and northern parts. Primary production exhibits large seasonal and interannual variability (HELCOM, 2002: p. 182), but downward trends were found for diatoms in spring and summer, whereas dinoflagellates generally increased in the Baltic proper, but decreased in the Kattegat. Chlorophyll *a*, a proxy indicator for total phytoplankton biomass, increased in the Baltic proper (Wasmund and Uhlig, 2003). Observed changes in trends during the two decades are discussed to indicate a shift in the ecosystem.

Summer blooms of nitrogen-fixing cyanobacteria ("blue-green algae") are normal in the central Baltic, Bothnian Sea, Gulf of Finland, and Gulf of Riga. Such blooms have occurred in the Baltic Sea for at least 7,000 years, but their frequency and intensity seems to have increased since the 1960s. Mass occurrences of blue-green algae are often made up of several species of blue-green algae. Since 1992 the relative abundance of the most common species has shown a clear trend in the Arkona Basin (southern Baltic) and in the northern Baltic Sea: the toxin-producing species *Nodularia spumigena* has become more abundant compared to the non-toxic *Aphanizomenon* flos-aquae.

Red tides (dinoflagellate blooms) are regularly observed, including blooms of the toxic *Gymnodinium mikimotoi* (HELCOM, 2002; 2003).

Zooplankton

The species composition of the zooplankton reflects the salinity with more marine species (e.g. *Pseudocalanus* sp.) in the southern part and brackish species (e.g. *Eurytemora affinis* and *Bosmina longispina maritima*) in the northern areas. As a result of the declining salinity, the relative abundance of small plankton species has increased in some parts of the Baltic (Viitasalo *et al.*, 1995). The abundance of *Pseudocalanus* sp. has declined since the 1980s in the central Baltic, whereas the abundance in spring of *Temora longicornis* and *Arcartia* spp. increased (Möllmann *et al.*, 2000; 2003a). This change is unfavourable for cod recruitment (Hinrichsen *et al.*, 2002) and herring growth (Möllmann *et al.*, 2003a; Rönkkonen *et al.*, 2004), whereas it favours sprat, the fish species presently dominant in the Baltic.

Gelatinous zooplankton is being monitored, but its impact is not thought to be important for recruitment of the principal commercial fish species in the central Baltic because the bulk biomass only develops in mid-summer in the upper water layer, whereas spawning of pelagic takes place in spring, and spawning of cod in summer, but in the deep water.

Benthos

The composition of the benthos depends both on the sediment type and salinity, with suspension-feeding mussels being important on hard substrate while deposit feeders and burrowing forms dominating on soft bottoms. The major parts of the hard bottoms are inhabited by communities of *Fucus vesiculosus* and *Mytilus edulis*, while the main parts of the Baltic soft bottom have been classified as a Macoma community after the dominating marine mussel *Macoma balthica* (Voipio, 1981). In shallow areas seaweed and seagrass form important habitats (including nursery grounds) for many animals. The distribution of seaweed and seagrass has changed over time, in some cases in response to eutrophication (HELCOM, 2003: p. 114).

In the Bothnian Bay and the central part of the Bothnian Sea the isopod *Saduria entomon* and the amphipod *Pontoporeia* spp. dominate the zoobenthos. The species richness of the zoobenthos is generally poor, and declines from the southwest towards the north due to the drop in salinity, but species-poor areas and low biomasses are also found in the deep basins in the central Baltic due to the low oxygen content of the bottom water. After major inflows a colonisation of some of these areas can, however, be seen.

Fish community

The distribution of the roughly 100 fish species inhabiting the Baltic is largely governed by salinity. Marine species (some 70 species) dominate in the Baltic Proper, while freshwater species (some 30–40 species) occur in coastal areas and in the innermost parts (Nellen and Thiel, 1996 – cited in HELCOM, 2002). Cod, herring, and sprat comprise the large majority of the fish community in biomass and numbers. Commercially important marine species are sprat, herring, cod, various flatfish, and salmon. Sea trout and eel, once abundant, are of very low population sizes. Sturgeons, once common in the Baltic Sea and its large rivers are now extinct from the area. Recruitment failures of coastal fish, e.g. perch (*Perca fluviatilis*) and pike (*Esox lucius*) in Sweden have been observed along the Swedish Baltic coast (Nilsson *et al.*, 2004; Sandström and Karås, 2002).

Cod is the main predator on herring and sprat, and there is also some cannibalism on small cod (Köster *et al.*, 2003a). Herring and sprat prey on cod eggs, and sprat are cannibalistic on their eggs, although there is seasonal and inter-annual variation in these effects (Köster and Möllmann, 2000a).

The trophic interactions between cod, herring and sprat may periodically exert a strong influence on the state of the fish stocks in the Baltic, depending on the abundance of cod as the main predator. To accommodate predator-prey effects, information (e. g., predation rates by cod on herring and sprat) multispecies assessments 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, have not yet been quantified and are therefore not directly included in the present ICES fisheries advice.

Birds and mammals

The marine mammals in the Baltic consist of grey (*Halichoerus grypus*), ringed (*Phoca hispida*), and harbour seals (*Phoca vitulina*), and a small population of harbour porpoise (*Phocaena phocaena*). Seals and harbour porpoise were much more abundant in the early 1900s than they are today (Elmgren, 1989; Harding and Härkönen, 1999) where their fish consumption may have been an important regulating factor for the abundance of fish (MacKenzie *et al.,* 2002). Baltic seal populations – harbour seals, grey seals and ringed seals – are generally increasing. Little is known about recent changes in the abundance of the harbour porpoise (HELCOM, 2001).

The seabirds in the Baltic Sea comprise pelagic species like divers, gulls and auks, as well as benthic feeding species like dabbling ducks, seaducks, mergansers and coots (ICES, 2003). The Baltic Sea is more important for wintering (c.10 million) than for breeding (c.0.5 million) seabirds and seaducks. The common eider exploits marine waters throughout the annual cycle, but ranges from being highly migratory (e.g., in Finland) to being more sedentary (e.g., in Denmark).

Population trends for seabirds breeding within the different countries of the Baltic Sea show an overall decrease for nine of the 19 breeding seabird species. Black-headed gulls are assessed as decreasing throughout the Baltic Sea, whereas the eight other species are considered decreasing in parts of the Baltic Sea. The status of other species, which predominantly breed in the archipelago areas, like common eider, arctic skua, Caspian tern and black guillemot, is uncertain, and populations of these species may be decreasing in parts of the archipelago areas (ICES, 2003).

1.1.2 The major environmental influences on ecosystem dynamics

Variations in the abiotic environment of the Baltic Sea are strong and depend on climate forcing. Populations of fish are affected by this variability both with respect to growth and recruitment. The growth rate of herring and sprat diminish with reduced salinity in the eastern and northern part of the Baltic (Flinkman *et al.,* 1998; Cardinale *et al.*, 2002; Möllmann *et al.*, 2003a; Cardinale and Arrhenius, 2000; Rönkkonen *et al.,* 2004). The recruitment of herring in the Gulf of Riga and sprat in the entire Baltic are positively related to spring temperatures and the North Atlantic Oscillation index (MacKenzie and Köster, 2004).

The recruitment of the eastern cod stock depends primarily on the volume of water with sufficient oxygen content and salinity available in the deeper basins (Sparholt, 1996; Jarre-Teichmann *et al.*, 2000; Hinrichsen *et al.*, 2002; Köster *et al.*, 2003a; and see below). The present hydrographic situation in the central basins of the southern Baltic suggests that during the spawning season in 2005, the most favourable conditions for cod egg survival are expected still to be restricted to the Bornholm Basin and the Slupsk Furrow, and not in the more eastern basins.

1.1.3 The major effects of the ecosystem on fisheries

Central Baltic cod

The spawning areas for Central Baltic cod have in the past been the Bornholm, Gdansk, and Gotland Deeps (Figure 1.1.3.1). The Bornholm Deep has been important in all years, while the Gdansk and Gotland Deeps have been important only in years where the salinity and oxygen conditions have allowed successful spawning, egg fertilisation, and egg development, and when the spatial distribution of the cod stock has included these areas.

The volume of water suitable for cod spawning and egg survival ("reproductive volume", RV) has been very low or zero since the mid-1980s in the Gotland Deep (Figure 1.1.3.2) except 1994 (as a result of the 1993 inflow, MacKenzie *et al.*, 2002). The same is true for the Gdansk Deep except that for 1995–1999 there have been several positive RV values. Prior to the mid-1980s there were many periods where the RV was high in both areas and cod reproduction took place.

The present hydrographic situation has deteriorated in the Bornholm Basin, Gdansk Deep, and Gotland Deep throughout the last year. While oxygen concentrations in the Gdansk Deep are relatively similar in February 2004 and 2005, the location of the halocline is deeper and salinity lower in 2005, narrowing down the water layer available for successful cod eggs.

In spring 2005 the hydrographic situation in the central basins of the southern Baltic suggests that cod egg survival is possible in the Bornholm Basin. However, areas with sufficient oxygen conditions for successful cod egg development are mainly restricted to the southern part of the basin. Within the central and northern part of the Bornholm Basin, it appears unlikely that cod egg survival will occur at relatively high levels.

In general, the 2005 hydrographic situation in the Bornholm Basin appears to be relatively unfavorable, which excludes a further introduction of saline, oxygenated water into the eastern basins from the Bornholm Basin in the near future. Normally major inflow situations into the Bornholm Basin occur in winter and are very seldom later than March, thus making a substantial improvement of the present conditions in the Bornholm Basin within the next months unlikely.

The Baltic Sea is characterised by a series of deep basins separated by shallow sills, and an inflow will usually fill up the first basin (the Bornholm Deep) only, with little or no transport in an eastern direction. Only under exceptional circumstances will the eastern Baltic basins benefit from the water exchange. Thus, hydrographic monitoring and the unique topography make predictions of RV in each area possible in a given year, when conducted after the inflow period in January to March. The additional 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.

Central Baltic cod peak spawning time was in July–August during the first half of the 20th century, but changed to May until the mid-1980s when it slowly moved backwards in time year-by-year to June and July by around 1995 (Wieland *et al.*, 2000). It is likely that for 2004 the main spawning time was June–July–August. The distribution of spawning effort, egg mortality (Wieland *et al.*, 1994; Wieland and Jarre-Teichmann, 1997; Köster and Möllmann, 2000b), larval and early juvenile mortality and atmospheric forcing conditions post spawning (Hinrichsen *et al.*, 2002) all contribute to uncertain recruitment predictions (Köster *et al.*, 2001; 2003a,b). The dynamics of maturation influence the estimation of reference points, and values of SSB relative to these reference points (Köster *et al.*, 2003b).

Clupeids

Sprat and herring are the dominant zooplankton predators in the ecosystem. However, it is not easy to differentiate the effects of changes in zooplankton predator abundance and consumption (Möllmann and Köster 2002) from the effects on zooplankton of changing nutrient availability and hydrographic conditions (Möllmann *et al.* 2003b).

The growth and condition of herring deteriorated along with the decline in the abundance of their main food, *Pseudocalanus* sp. (Möllmann *et al.*, 2003a; Rönkkonen *et al.*, 2004), and earlier than the sprat stock increased in abundance, The reason for the decrease in *Pseudocalanus* sp. have primarily been related to lower salinity and low oxygen conditions (Möllmann *et al.*, 2003a; Schmidt *et al.*, 2003), and subsequent increased predation by sprat may have amplified its decline (Möllmann and Köster, 2002; Möllmann *et al.*, 2004).

For Baltic sprat a strong coupling between the NAO index, ice/temperature conditions, and recruitment has been demonstrated by MacKenzie and Köster (2004). Köster *et al.* (2003b) were able to improve the S/R relationship presently used in the ICES assessment by almost 50% by incorporating SSB, temperature, and growth anomalies. However, the understanding of the underlying processes is still limited (ICES, 2004a).

Salmonids

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. It seems highly likely that M74 is linked to the diet of salmon in the Baltic and changes in the ecosystem. The occurrence of M74 has been linked to low levels of thiamine (vitamin B1), and yolk-sac fry suffering from M74 can be restored to a healthy condition by treatment with thiamine. The mean value of M74 can be estimated to have been below 5% in 2004, and a low level is predicted for 2005.

1.1.4 The major effects of fishing on the ecosystem

In the Central Baltic cod and sprat spawn in the same deep basins and have partly overlapping spawning seasons. However, their reproductive success is largely out of phase. Hydrographic-climatic variability (i.e., low frequency of inflows from the North Sea, warm temperatures) and heavy fishing during the past 10–15 years have led to a shift in the fish community from cod to clupeids (herring, sprat) by first weakening cod recruitment (Jarre-Teichmann *et al.*, 2000) and subsequently generating favorable recruitment conditions for sprat, thus increasing clupeid predation on early life stages of cod (Köster and Möllmann, 2000a; Köster *et al.,* 2003b; MacKenzie and Köster, 2004).The shift from a cod- to a sprat-dominated system may therefore be explained by differences in the reproductive requirements of both fish species in a changing marine environment. Additionally, the shift in dominance was supported by high fishing pressure on cod, a top-down effect which was also maintained after the severe reduction in biomass (see also Jarre-Teichmann, 1995). Possible factors leading to future destabilization of the sprat dominance include unfavourable hydrographical conditions for sprat reproduction, e.g. low water temperatures in spring following severe winter, or high fishing mortalities caused by the developing industrial fishery, with concurrent low fishing pressure on cod and inflow of oxygenated water from the North Sea.

Coastal fishery by anglers and commercial fishers has probably also influenced ecosystem structures (Hansson *et al.,* 1997). This impact is generally more local than that of the offshore fishery, however, since most of the coastal fish species are relatively sedentary.

Bycatch of fish

The total bycatch of fish in the Baltic fisheries is presently unknown. The EU has supported several very recent studies of bycatch, the results of which have been compiled by ICES (2000). These studies primarily concern the major fisheries for cod, herring, and sprat, and these have low bycatches. The less important smaller fisheries can have a high proportion of bycatch (HELCOM, 2002).

It is currently impossible to come up with quantitative accounts of the bycatch of cod in the small-meshed sprat and herring fishery in the cod spawning areas (ICES, 2004b (Advice on IBSFC request on closed areas)).

The occurrence of lost nets has been surveyed in areas where gillnet fishing is practiced, and lost nets are frequent (www.fiskeriverket.se/miljofragor/pdf/okt-rapp_webb.pdf). Lost gillnets in the Baltic cod fishery are most likely of concern for cod fishing mortality since 30–50% of the landings originate from the net fishery. Experiments show that during the first 3 months, the relative catching efficiency of "lost" nets decrease by around 80%, thereafter stabilising at around 5–6% of the initial level (Tschernij and Larsson, 2003).

Bycatch of seabirds and mammals

Fishing nets, in particular set nets, have caused considerable mortality for long-tailed ducks (*Clangula hyemalis*), velvet scoters (*Melanitta fusca*), eiders (*Somateria mollissima*), and black scoters (*Melanitta nigra*). There are also reports of guillemot and razorbill (*Alca torda*) mortality in the driftnet fishery for salmon (HELCOM, 2003).

Reports suggest that fisheries bycatches amount to 0.5–0.8% of the porpoise population in the southwestern part of the Baltic Marine Area each year, as well as 1.2% of the porpoise population in the Kiel and Mecklenburg Bays and inner Danish waters (Kock and Behnke, 1996). Estimates of the harbour porpoise population are uncertain, however, and the number of porpoises bycaught in fisheries is probably underestimated. The loss of porpoises to fishery in the Baltic Marine Area may be too high to sustain the population (ICES, 1997).

Seals have been recorded caught in fyke nets, set nets, and salmon driftnets, but although the recorded data almost certainly underestimate the total number of bycaught seals, the added mortality does not appear to restrain the seal populations from increasing (Helander and Härkönen, 1997).

1.1.5 Other effects of fishing on seabirds and mammals

Fishing activities will also affect the seabird community through the discarding of unwanted catch and fish offal. Studies indicate, for example, that over 50% of the offal discarded in the Baltic Marine Area will be consumed by seabirds (ICES, 2000).

Other effects of human use of the ecosystem

Human society uses the Baltic for many other purposes, including shipping, tourism, and mariculture. Overviews are given in HELCOM (2002; 2003) and Frid *et al.* (2003). 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.

1.1.6 Conclusions

Short term

The 2003 year class of cod will recruit to the fishery this year. The effect of the 2003 inflow on cod recruitment should be estimated by the Assessment WG, using different available recruitment models (i.e., comparison of effects) and spatial information.

Furthermore, winter temperatures have been shown to affect sprat recruitment. The Assessment WG should consider ways in which the consequences of severe winters on sprat recruitment can be implemented in stock projections, both in the short and medium term.

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.

Medium term

Depletion of cod in the Baltic has contributed to a shift in the trophic structure from a gadoid-dominated system to a clupeoid-dominated system. This has been accompanied by shift in zooplankton and phytoplankton, for which there is increasing evidence, and which may also be partially a consequence of eutrophication. The change in species dominance has far-reaching consequences for people living in coastal areas, and may be very difficult to reverse through management. Methodology needs to be developed for management advice to take regime changes into account.

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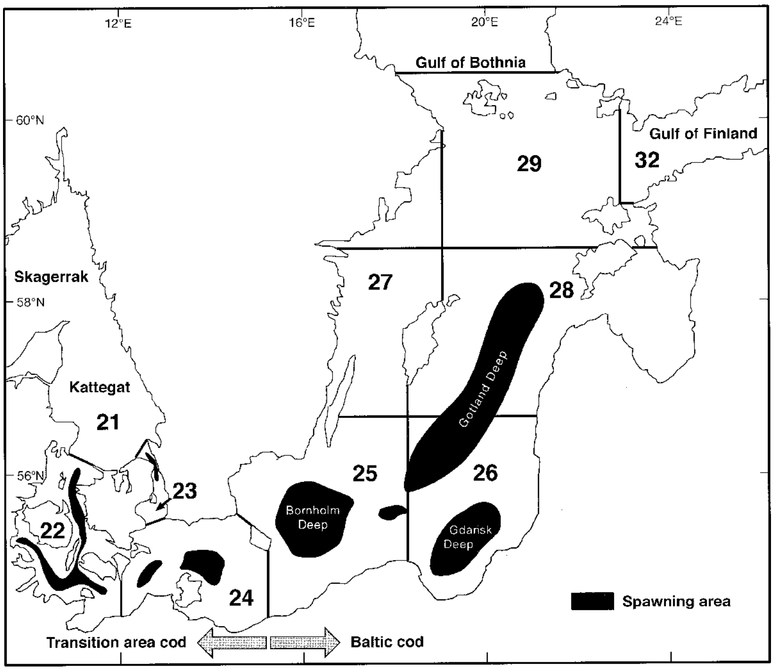

Figure 1.1.3.1 Historical spawning areas for cod in the Baltic Sea. From Bagge, O., Thurow, F., Steffensen, E., Bay, J. 1994. The Baltic Cod. Dana Vol. 10:1-28, modified by Aro, E. 2000. The spatial and temporal distribution patterns of cod (*Gadus morhua callarias*) in the Baltic Sea and their dependence on environmental variability – implications for fishery management. Academic dissertation. University of Helsinki and Finnish Game and Fisheries Research Institute, Helsinki 2000, ISBN-951-776-271-2, 75 pp.

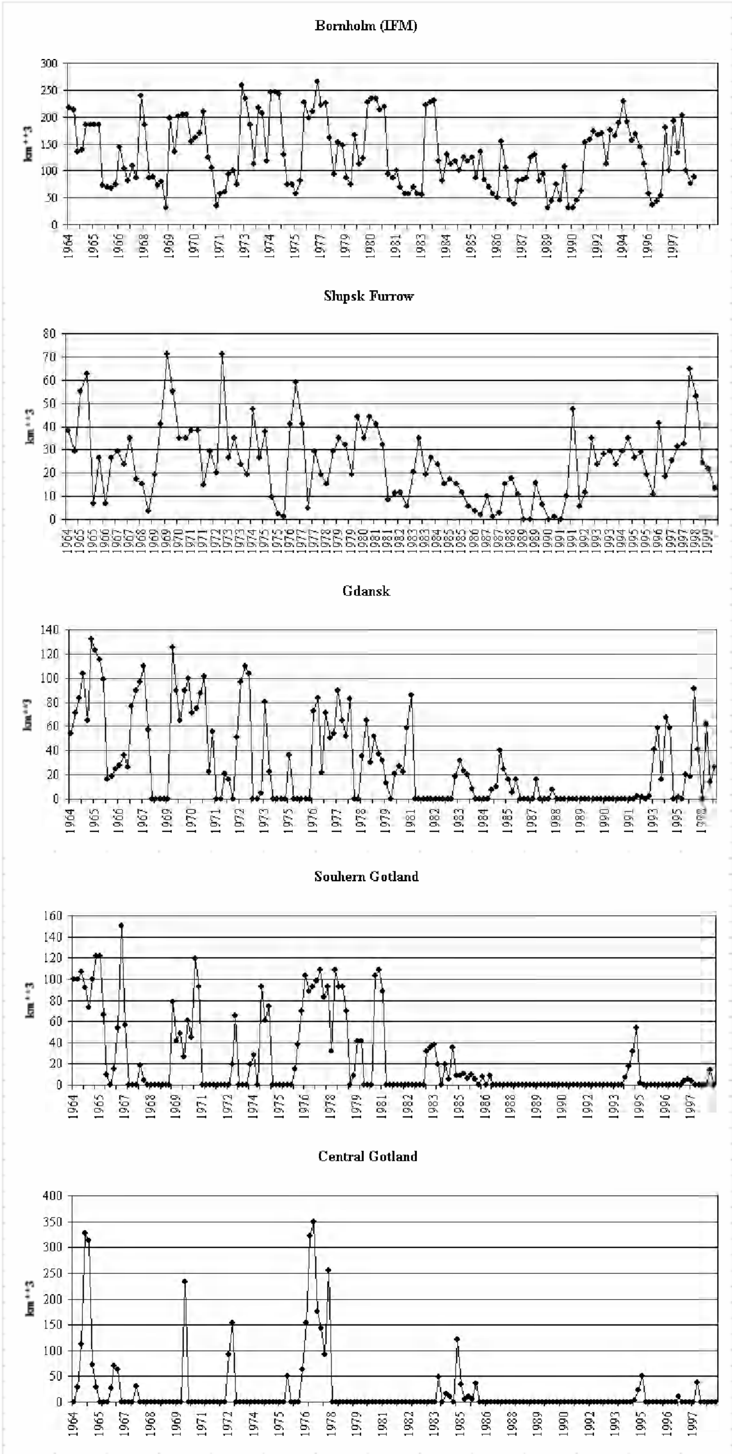

Figure 1.1.3.2 Time-series of reproductive volume for each spawning site. From MacKenzie, B. R., Hinrichsen, H.-H., Plikshs, M., Wieland, K., Zezera, A. 2000. Quantifying environmental heterogeneity: estimating the size of habitat for successful cod *Gadus morhua* egg development in the Baltic Sea. Marine Ecology Progress Series 193: 143-156. With updates by Maris Plikshs (Pers. Comm.).

1.2 The human use of the ecosystem

1.2.1 Overall impacts

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).

1.2.2 Fisheries

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 turbot). 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 overexploited 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.

1.3 Assessments and advice

Nominal catches

Officially reported catches in the Baltic until 2002 are given in Tables 1.3.1–1.3.5. 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 1.4. 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 1.3.1 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 compositions 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 2006
	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	At risk of reduced reproductive capacity	Not available	Overexploite d	Landings of less than 28 405 t in 2006 are in accordance with the agreed management plan, which corresponds to a fishing mortality of less than 1.00.	Management plan is precautionary.	No targets agreed	Less than 28 405 t, according to both PA and management plan
Cod in Subdivisions 25–32	Reduced reproductive capacity	Harvested unsustainably	Overexploite d	Landings of less than 14 900t in 2006 (including possible misreporting) are in accordance with the agreed management plan, which corresponds to a fishing mortality of 0.15.	Management plan is precautionary.	No targets agreed	Less than 14 900 t, according to both PA and management plan
Herring in Subdivisions 22–24 and Division IIIa	Unknown	Unknown	Unknown	No management plan	F=F*status quo*	No targets agreed	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 95 000 t in 2006.
Herring in Subdivisions 25–29 (excl GoR) and Division 32	Unknown	At risk of being harvested unsustainably	No targets agreed	No management plan	F below $\mathbf{F}_{pa}$ =0.19	No targets agreed	Landings less than 120 000 t in 2006 based on fishing below $\mathbf{F}_{pa}$.

Herring in Gulf of Riga	Full reproductive capacity	Harvested sustainably	No targets agreed	No management plan	F below $\mathbf{F}_{pa}$ =0.4	No targets agreed	Landings less than 39,900 t in 2006 based on fishing below $\mathbf{F}_{pa}$.
Herring in Subdivision 30	Full reproductive capacity	Harvested sustainably	No targets agreed	No management plan	F below $\mathbf{F}_{pa}$ =0.21	No targets agreed	Landings of less 93 400 t in 2006 assuming status quo $\mathbf{F}_{sq}$ = 0.14 has been applied in 2005. If F= $\mathbf{F}_{pa}$ has been applied in 2005, the F below $\mathbf{F}_{pa}$ corresponds to landings of less 88 100 t in 2006.
Herring in Subdivision 31	Unknown	Unknown	No targets agreed	No management plan	Unknown	No targets agreed	Catches at recent average levels (2002–2004) 4500 t are below the long-term average catches for this stock and should not be exceeded.
Sprat in 22–32	Full reproductive capacity	Harvested sustainably	Harvested sustainably	Applying the F (0.4) from the agreed IBSFC management plan implies catches of 439 000 t in 2006.	Management plan is precautionary.	No targets agreed	Landings of less than 439 000 t, in 2006 according to both PA and management plan.
Flounder	Unknown	Unknown	No targets agreed	No management plan	Unknown	No targets agreed	
Plaice	Unknown	Unknown	No targets agreed	No management plan	Unknown	No targets agreed	
Dab	Unknown	Unknown	No targets agreed	No management plan	Unknown	No targets agreed	
Turbot in 22–32	Unknown	Unknown	No targets agreed	No management plan	Unknown	No targets agreed	
Salmon in Main Basin and Gulf of Bothnia			A number of smaller salmon stocks are unlikely to reach the target. Some major stocks have already reached the target.				Continuation of the current exploitation pressure will not impair the possibilities for reaching the management objective for the larger stocks (units 1 and 4). The possibility for reaching the productivity objective in 2010 for the smaller stocks in units 2, 3 and 5 seems unlikely even under a complete fishing ban in 2006.

							Long-term benefits for the smaller stocks are expected from a reduction of the fishing pressure although it is uncertain whether this is sufficient to rebuild these stock to the level indicated in the SAP.
Salmon in Gulf of Finland			Wild stocks have not recovered and will not reach the IBSFC target.				Fisheries should only be permitted at sites where there is virtually no chance of taking wild salmon from the Gulf of Finland stocks along with reared salmon. It is particularly urgent that national conservation programmes to protect wild salmon be enforced around the Gulf of Finland.
Sea trout							There is an urgent need to decrease the exploitation of some sea trout stocks. A management plan should be considered established for sea trout stocks.

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.

1.3.1 ICES advice for fisheries management

Fisheries in the Baltic should in 2006 be managed according to the following rules:

- **For Baltic Cod:**
  - **for eastern Baltic cod, a catch in 2006 not exceeding 14 900 t;**
  - **for western Baltic cod, a catch in 2006 not exceeding 28 400 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 95 000 t;**

- **for Herring in Subdivisions 25–29+32 (excl. Gulf of Riga): catches should be less than 120 000 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 120 000 t. Data on species compositions in the mixed pelagic fishery have not been available from all participating countries in the past and the expected sprat share of the mixed pelagic fishery can only be calculated if a proper monitoring system is in place. For EC member countries a monitoring system is required from 1 January 2005 (EC TAC and Quota regulation).**

- **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.

IBSFC adopted a long-term management strategy for cod in the Baltic in 2003. This management plan includes rules on setting the TAC, and also establishes a number of technical measures (Resolution XX on the Management Plan for the Cod Stocks in the Baltic Sea (adopted by the Extraordinary Session, June 2003)).

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 9000 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 9000 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.

4. Technical Measures Limiting Fishing Effort And Mortality

a) IBSFC shall provide for consistency between gear selectivity and the minimum landing size for cod, in order to reduce discards and fishing mortality on juvenile cod.

b) The minimum landing size of 38 cm for cod shall be kept under regular review. In accordance with the development in the stocks and the selectivity in the fisheries, the minimum landing size shall be revised no later than 2005 with a view to adopting an increase to apply from 2006.

c) IBSFC shall, for all fisheries targeting cod, from 2003 keep under regular review the development in the fishing activities, including the impact of closed areas and seasons, and gear regulations in terms of control, conservation and sustainable exploitation objectives. On the basis of scientific advice and any review carried out, IBSFC shall adopt, where appropriate, adjustments to the fishery rules.

5. Control And Enforcement

The Contracting Parties of IBSFC shall continue their co-operation on control and enforcement with the aim of establishing a comprehensive and efficient Control and Enforcement Scheme, which supports this management plan and ensures compliance with IBSFC recommendations and Fishery Rules.

6. Review Of The Management Plan

This management plan shall be reviewed as necessary, on the basis on scientific information and advice, not later than 2006.

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 1.4.

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.

A proposal for new technical measures is currently being discussed within the EC.

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 1.4.

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Table 1.3.1 Nominal fish catches in the Baltic from 1973–2004 (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	74	232	325	-	1.3	-	-	-
2004[1)]	65	228	355	-	-	-	-	-

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

Table 1.3.2 Nominal catch (tonnes) of HERRING in Divisions IIIb,c,d 1963–2004. (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	8,254	27,359	64,021	22,637	24,187	2,109	30,703	39,350	13,363	231,983
2004[6]	8,573	27,358	69,600	19,797	23,600	-	28,024	43,918	6,585	227,455

[1]Including Division IIIa.
[2]Large quantity of herring used for industrial purposes is included with "Unsorted and Unidentified Fish".
[3]Includes some bycatch 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 1.3.3 Nominal catch (tonnes) of SPRAT in Divisions IIIb,c,d 1963–2004. (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	39,528	29,366	8,961	18,023	41,743	3,032	84,097	71,188	28,663	324,601
2004[5]	44,290	37,307	16,750	27,649	52,400	-	95,852	81,067	25,109	355,315

[1]Including Division IIIa.
[2]Some bycatch 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 1.3.4 Nominal catch (tonnes) of COD in Divisions IIIb,c,d 1963–2004. (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	22,338	559	n/a	1,168	8,125	4,634	2,900	16,029	14,686	3.707	74,146
2004[4]	20,694	1,278	n/a	890	4,538	5	n/a	15,050	14,287	3,410	65,147

[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 1.3.5 Nominal catch (tonnes) of FLATFISH in Divisions IIIb,c,d 1963–2004. (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	-	-	-	-	-	-	-	-	-	-
2004[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.

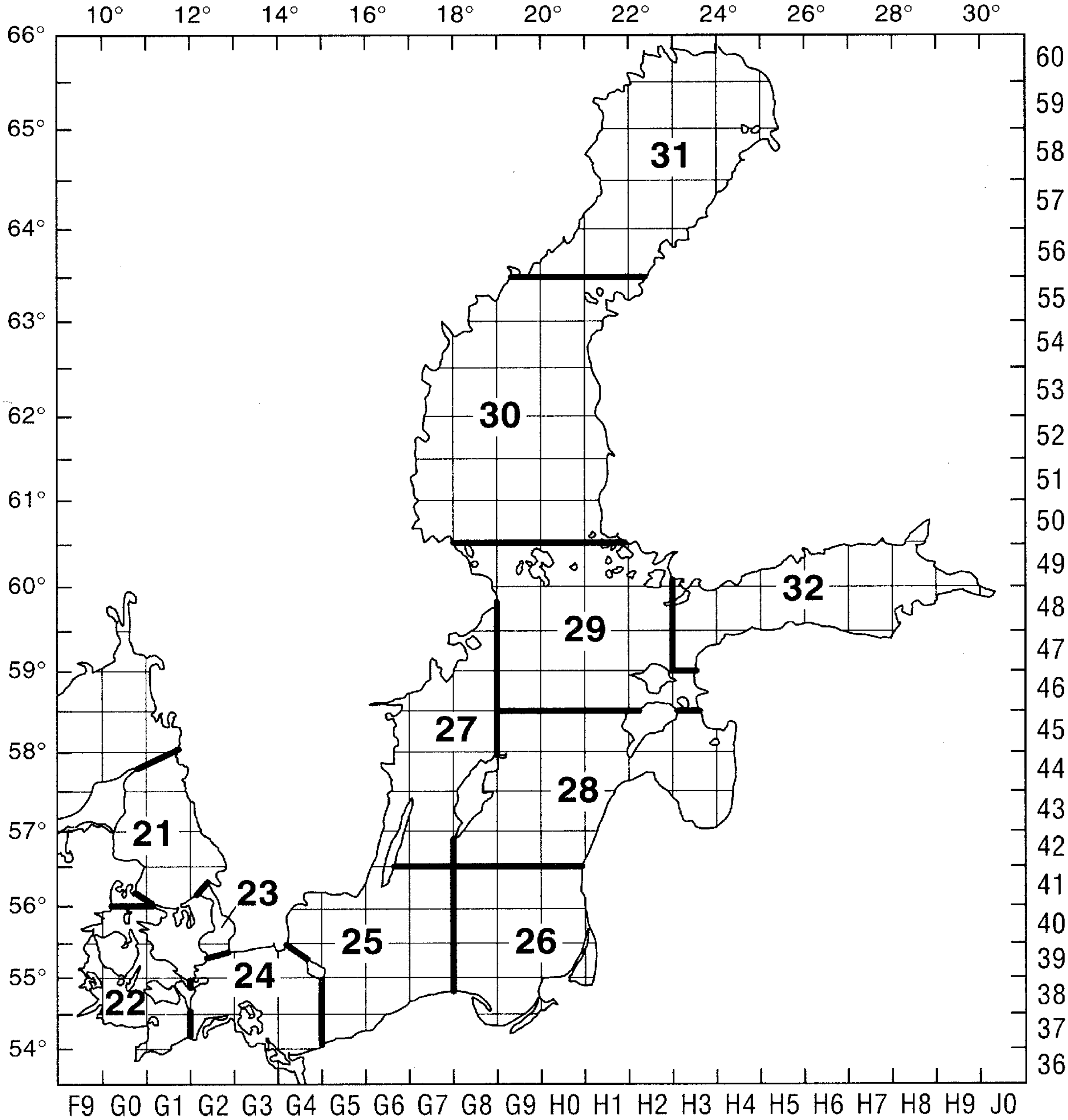
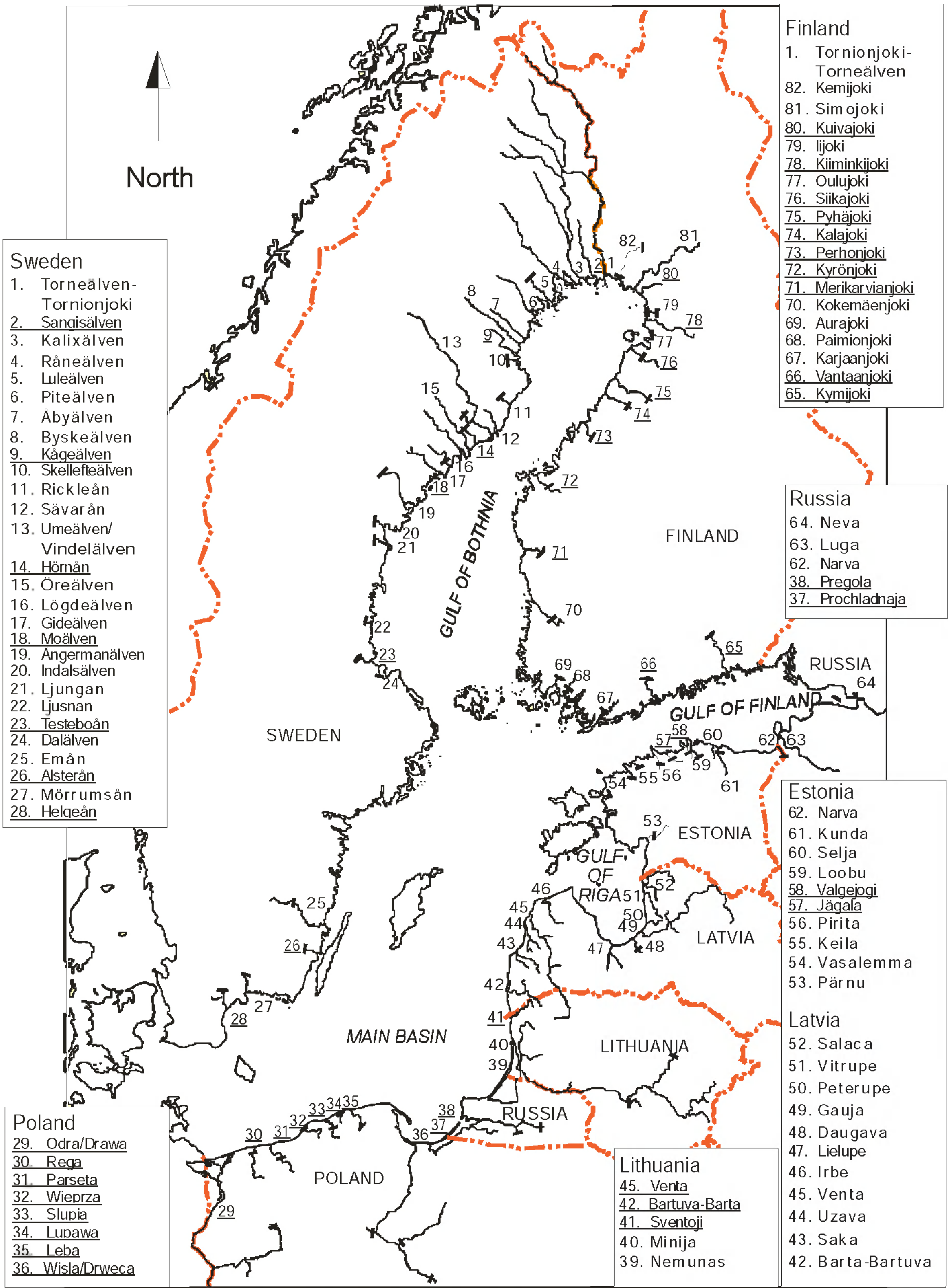


Figure 1.3.1 Subdivisions in the Baltic Sea.



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

Figure 1.3.2 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*; river name underlined = *river with potential for establishment of wild salmon*; river name in normal font = *river with releases, no natural reproduction.*

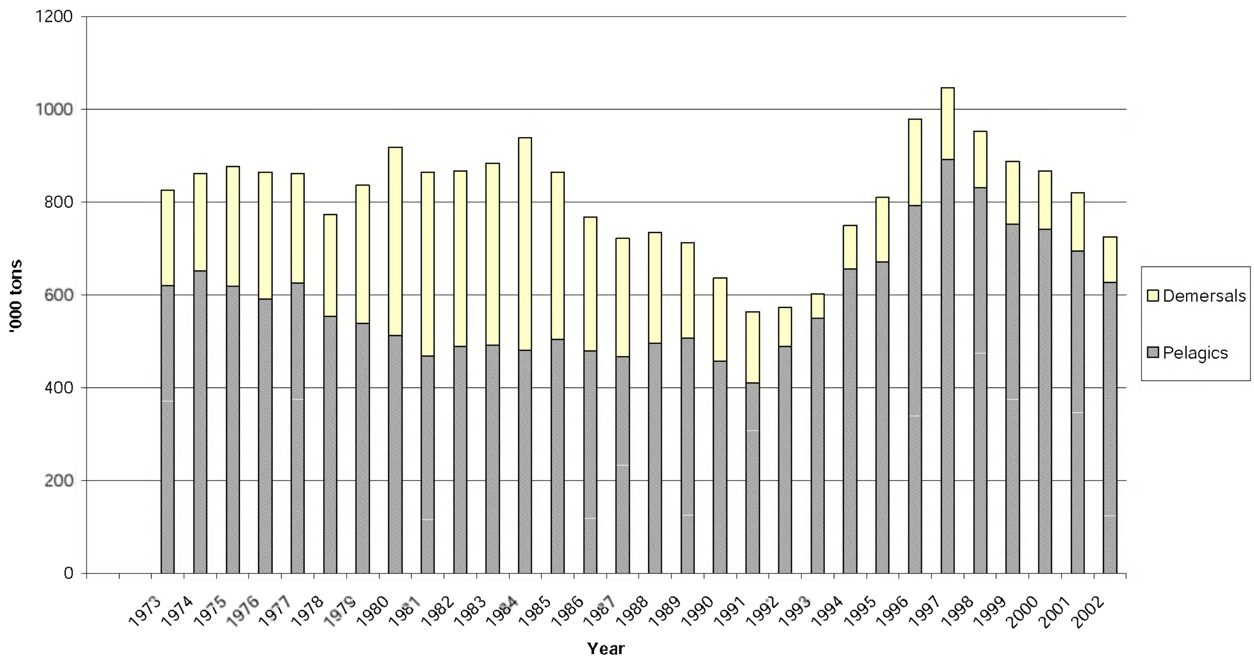


Figure 1.3.3 Baltic Sea catches.

1.3.2 Special Requests

1.3.2.1 Long-term management of Baltic cod (DG Fish)

ICES has received a request from the European Community regarding management plans for cod:

'Background

1. The Commission understands that ICES has requested the WGBFAS to investigate long-term management strategies for cod stocks in the Baltic Sea in the context of the current Memorandum of Understanding. This is a topic of urgent management interest, which the Commission had foreseen should be addressed in a meeting of STECF in July 2005. If, however, appropriate advice can be provided by ICES then it may prove possible to remove this topic from STECF's terms of reference.

2. The terms of reference being issued to STECF follow.

3. STECF is requested to provide advice concerning targets for sustainable exploitation, and harvesting rules for catch and/or fishing effort limits the Cod in the Baltic Sea.

4. Such targets and harvest rules should be commensurate with conservation status of the stocks. The rules should also be based on the precautionary principle (in that the absence of adequate scientific information should not be used as a reason for postponing or failing to take management measures to conserve the stocks concerned).

The detailed request

(1). STECF is requested to evaluate a range of harvest rules for the stocks named in paragraph 1. with respect to medium and long term yield, stability of yield and effort and stock status with respect to safe biological limits. Evaluations shall in the first instance be made on a single species basis but the experts shall, to the extent possible, quantify mutual compatibility of the rules for the target species with the conservation needs of other species caught in the same fisheries.
The types of harvest rule to be considered shall include :

(a) Target conservation reference points, and (where appropriate) limit reference points.
(b) Harvest rules where TACs and/or fishing effort are derived according to a target fishing mortality, supplemented with a rule for reducing the mortality if the spawning biomass is below a trigger level, to ensure avoiding a limit value for the spawning biomass.
(c) Harvest rules as in (a) but including an additional constraint on the year -to-year variation of the TAC including a +/- 15% limit on TAC variation.
(d) Evaluate alternative approaches to limit the year-to-year changes in TAC as considered appropriate.
(e) Where available data are not adequate to estimate stock size and fishing mortality by conventional techniques, identify adaptive harvest rules (such as those directly based on survey data) that are appropriate to reaching the conservation objectives.

(2). STECF is requested to advise whether effort management is necessary to achieve the effective implementation of the harvest rule and the attainment of conservation targets.

(3) The rules shall be evaluated through simulations that take into account the variabilities and uncertainties considered appropriate by the scientists.

(4) The performance of the rules should be evaluated both with respect to the perceived state of the stock and to the state of the underlying operating model population. The performance criteria shall include :

> *Compatibility with the precautionary approach and relevant international standards and agreements.*
> *Probability distributions of yield, TACs, spawning stock biomass and fishing mortality and (where relevant) fishing effort.*
> *Year to to year variation in TACs, yield, spawning stock biomass and fishing mortality.*
> *The risk of entering rebuilding situations in simulations without the year-to-year limitations in TAC change.*

(5) Evaluations shall show the robustness of the harvest rules in assuring stock recovery and maintaining stocks inside safe biological limits, considering a plausible range of scenarios. '

ICES comments:

The Ad hoc Group on Long-Term Advice [AGLTA] met at ICES Headquarters, Copenhagen from 12–13 April 2005 to discuss and agree the technical basis for the ICES advisory response to this request from EC. The results of their evaluations and simulations are summarised in this response, but the AGLTA report should be consulted for full technical details (ICES CM 2005/ACFM:25).

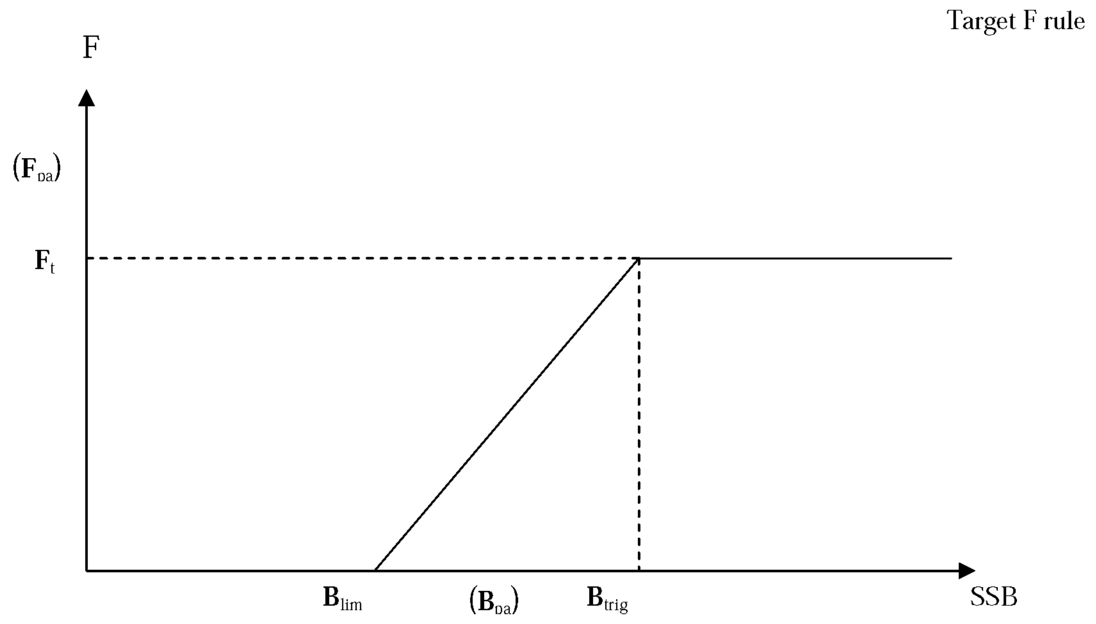
Evaluation framework

Based on the request, the objectives of the management strategies to be evaluated are assumed to be high medium- and long-term yields and good stock status with respect to safe biological limits (reflected by a low risk of SSB falling below a conservation limit). The hierarchy is assumed to be that high long-term yield will be conditioned by simultaneous low risk to SSB, which has overall priority. Important performance criteria are taken to be stability of yield and robustness to both assumptions concerning stock productivity (reflected in assumptions about a stock-recruitment relationship) and the precision and bias of stock assessments.

Note that for brevity, the phrase *low risk to reproduction* is used within the text of this response to replace *low risk of SSB falling below a conservation limit.*

The evaluations are based on simulations of stochastic medium-term projections over a 10-year period, taking into account uncertainty in initial stock numbers-at-age, future recruitments, and individual weights and maturities. The robustness of the simulated outcomes to uncertainty and bias in future assessments, assumptions about the recruitment regime and implementation error have been evaluated though sensitivity tests (ICES CM 2005/ACFM:25). Implementation error in this document is understood as including both failure to make decisions according to the management plan and failure to enforce management decisions. The evaluations of management strategies have been undertaken within the common framework presented next.

The management strategies evaluated included a harvest control rule (HCR) with three parameters – a target F ($\mathbf{F}_t$), a limit spawning stock biomass ($\mathbf{B}_{lim}$) and a trigger spawning stock biomass ($\mathbf{B}_{trig}$). Pictorially, depicted by:



The figure represents the decision rule and not the realised fishing mortality. The actual fishing mortality will be different due to assessment and implementation error. In the simulations, which have been part of the evaluation, such errors have been included. A small fishing mortality below $\mathbf{B}_{lim}$ has also been included to simulate a small unavoidable mortality which must be assumed to exist even if management decisions for closure of targeting and important mixed fisheries catching the species in question have been made.

In this framework values of $\mathbf{F}_t$ and B_{trig} are estimated which achieve objectives regarding low risk to SSB and high future yields whilst satisfying relevant performance criteria.

$\mathbf{F}_t$ and $\mathbf{B}_{trig}$ are conceptually different from the reference points $\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$ used in an earlier framework. $\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$ are signposts regarding the state of the stock and the fisheries within the precautionary approach where the concern is the need to maintain low risk that the actual spawning stock falls below the biomass level below which there is increased risk of impaired recruitment, $\mathbf{B}_{lim}$. Even though $\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$ are parameters of the state of the stock they have in practice been used as parameters in a decision rule which implicitly has had avoidance of risk to SSB as its sole objective. The new framework distinguishes between state of the stock parameters ($\mathbf{B}_{pa}$ and $\mathbf{F}_{pa}$) and management plan decision rule parameters ($\mathbf{F}_t$ and $\mathbf{B}_{trig}$). The management decision rule parameters should be selected such that all objectives and performance criteria are satisfied or balanced simultaneously. As low risk to SSB is a prioritised objective the normal assumption will be that $\mathbf{F}_t$ will be lower than $\mathbf{F}_{pa}$ and that $\mathbf{B}_{trig}$ will be higher than $\mathbf{B}_{pa}$.

While $\mathbf{B}_{lim}$ is supposed to be an estimate of a property of nature (namely, the spawning stock biomass below which reproduction is at risk of being impaired) both $\mathbf{B}_{trig}$ and $\mathbf{F}_t$ are only parameters of the decision rule. These parameters can be decided entirely on the basis of the desired objectives and performance of the management strategy.

In the past, prior to the mid-1980s, recruitment for both stocks was markedly higher than in recent years. In the simulations, recruitments representative of the recent period were assumed.

In some cases with fishing mortalities far below what has been observed in several decades, the simulated long-term spawning stock levels of both cod stocks grow well beyond what has been observed historically. It is emphasised that simulations which do not take biological interactions and density-dependent growth/maturity into account will not produce results which are reliable in an absolute quantitative sense. The results should therefore only be taken as indicative of the direction of change when simulations are well beyond the historical range of fishing mortalities. For that reason alone, this response does not include the quantitative graphical outputs of the simulations undertaken by ICES and reported in ICES CM 2005/ACFM:25.

Overall conclusions

Some overall conclusions regarding management strategies may be drawn across the two stocks studied and for which simulations were made:

- At low target Fs (considerably lower than the present F), low risk to reproduction and high long-term yields are achieved simultaneously. The general pattern is that there is no conflict between the two objectives. A low $\mathbf{F}_t$ will lead to high yield simultaneously with a low risk to reproduction that is lower than the 5–10% risk, which has generally been considered acceptable by managers.
- Once stocks have recovered and fishing mortality is around a low F target, the outcomes are insensitive to $\mathbf{B}_{trig}$. Criteria for the selection of $\mathbf{B}_{trig}$ in this situation are discussed below.
- Restrictions on ±15% variation in TAC from year to year are feasible, but result in lower long-term yield for the same risk to reproduction.
- At low target Fs there is low sensitivity to recruitment assumptions (recruitment model used in simulations).
- Implementation errors above 10–20% disrupt achievement of low risk to reproduction and high long-term yield.

The selection of $\mathbf{F}_t$ and $\mathbf{B}_{trig}$ is informed by evaluations of the simulated outcomes of management strategies in terms of the achievement of objectives and performance criteria. While the simulations provide clear indications of the relevant ranges of $\mathbf{F}_t$, the outcomes may be insensitive to choices of $\mathbf{B}_{trig}$ once low Fs have been achieved. Some general supplementary considerations in the choice of $\mathbf{B}_{trig}$ are:

- As low risk to SSB is a prioritised objective the normal assumption will be that $\mathbf{F}_t$ will be lower than $\mathbf{F}_{pa}$ and that $\mathbf{B}_{trig}$ will be higher than $\mathbf{B}_{pa}$.
- The main role of having a $\mathbf{B}_{trig}$ is to have an early response to a declining SSB. A high $\mathbf{B}_{trig}$ is more robust to implementation and assessment error and poor recruitment.
- As a rule-of-thumb, $\mathbf{B}_{trig}$ should be chosen to be well above $\mathbf{B}_{lim}$ and take into account the uncertainty in the annual SSB estimate.
- A low $\mathbf{B}_{trig}$ is expected to result in large interannual variations in the Fs prescribed by the decision rule. This will result when the variance in the biomass estimates results in estimates of SSB changing from one year to the next from being above $\mathbf{B}_{trig}$ to being below or close to $\mathbf{B}_{lim}$, and vice versa.
- A high $\mathbf{B}_{trig}$ will result in faster response and thus more proactive action in worst case situations of consecutive years with low recruitment.

Western Baltic cod stock SD 22–24 summary

The starting population for the simulations on western Baltic cod was taken from the last ICES assessment made in 2005 (ICES CM 2005/ACFM:19) which includes discards. The exploitation pattern used is thus based on assessments including landings and discards.

The evaluations of harvest control rules for western Baltic cod have demonstrated, under the assumption of the current exploitation pattern, that target fishing mortalities (including all catches) between 0.3–0.6 (ages 3–6) result in a low risk to reproduction and high long-term yields. There is presently not an estimate of $\mathbf{B}_{lim}$ available for this stock, but this conclusion is robust to assumptions of $\mathbf{B}_{lim}$ up to 30 000 t. A major improvement to the stock development and to the landings is expected if an additional reduction of juvenile mortality could be achieved. If juvenile mortality is halved the upper range of the target fishing mortality could be increased by 0.1.

The target mortality of 0.6 is higher than that which has been estimated for other stocks and this is associated with a stock-recruitment relationship that maintains recruitment at low spawning stock sizes.

A word of caution regarding the simulations is necessary. In the simulations with low fishing mortalities, the absolute stock sizes projected are very high and well outside of the historically observed ranges. It is unknown whether such high stock sizes can actually be achieved given the constraints within the natural system and what effects this would have on the dynamics of the stock. However, the numerical results of the simulations in terms of risk to reproduction and expected yield are conditional on these large stock sizes. The conclusions regarding the general direction required are not sensitive to density-dependent effects – i.e. significant reductions in fishing mortality to achieve simultaneously a low risk to reproduction and high long-term yield. It is therefore suggested that an implementation of long-term management plans is based on an adaptive approach whereby the development of the stock is monitored as the effects of the reduced fishing mortality are developing, and the specific numerical values within the management plan may then be modified on the basis of the outcome of the fishing mortality reductions.

Eastern Baltic cod stock SD 25–32 summary

The starting population for the simulations on eastern Baltic cod was taken from the last ICES assessment made in 2005 (ICES CM 2005/ACFM:19) which includes discards and estimates of misreporting. The exploitation pattern used is thus based on assessments including catches and discards.

Evaluations demonstrated that under the current exploitation pattern target fishing mortalities (all catches) close to 0.3 (ages 4-7) result in a low risk to reproduction and high long-term yields.

The management plan is only in accordance with the precautionary approach if effectively implemented and enforced. The situation in recent years with significant amounts of non-reported cod landings indicates that overall, enforcement has not been effective

The management plan assumes that there are estimates of fishing mortality (F) and spawning stock biomass (SSB) available. Such estimates are derived from time series of commercial catch data and of stock abundance indices obtained from scientific research cruises and proper estimates of F and SSB can only be provided if these input data are complete and reliable. The situation in recent years with significant amounts of non-reported cod landings renders scientific estimates next to being useless in the context of a management plan which assumes precise estimates of present stock parameters.

When catch data are unreliable only indices based on abundance survey time series of stock and mortality trends can be provided. The major survey time series includes a break in 2000 when gears and design were standardized. There has been significant work done on modelling the bridge before and after 2000 but there are uncertainties related to this break in the time series that are not and probably cannot be resolved. Therefore, a consistent time series is only available for 2000 and onwards.

The simulations have neither taken biological interactions nor density dependent growth/maturity into account and thus, are merely indicative of the direction of outcomes from the management strategies prescribed in the joint request. However, the conclusions regarding the general direction required – significant reductions in fishing mortality to achieve simultaneously a low risk of SSB falling below the conservation limit B_{lim} and high long-term yield – is not sensitive to density dependent effects.

It is therefore suggested that an implementation of long term management plans is based on an adaptive approach whereby the development of the stock is monitored as the effects of the reduced fishing mortality are developing and the specific numerical values within the management plan may then be modified on basis of the outcomes of the fishing mortality reductions.

Source of information

Report of the Ad hoc Group on Long-Term Advice, 12–13 April 2005 (ICES CM 2005/ACFM:25).
Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

1.3.2.2 Answer to special request from the European Commission on the usefulness of DNA analysis of Baltic salmon

EC has requested ICES to:

> *"Evaluate the usefulness of DNA analysis to estimated the share of wild and reared salmon in the Baltic Sea".*

<u>ICES comments</u>

Management objectives and background information

There are two 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). In most of the salmon fishery in the Baltic Sea, catches include fish from several river stocks; catches also include both wild and hatchery-reared salmon.

The Salmon Action Plan management objective is defined on an individual river stock basis; hence salmon fisheries should be managed accounting for catch compositions in such details. Furthermore, the Salmon Action Plan objective is specific for wild stocks and therefore management goals for wild and hatchery-reared fish differ, implying that appropriate harvest strategies could differ between wild and reared salmon.

Therefore, management needs tools that allow distinction in the catches between wild and reared salmon and can identify the river of origin for wild salmon.

The main sources of information used for the assessment of the wild salmon stocks fall into three groups according to where data collection takes place:

- **River surveys:** (parr density estimates by electrofishing, smolt trapping, monitoring of spawning runs and river catches)
- **Sea surveys:** (catch data, fishing effort data, and stock-proportion estimates (DNA-analyses))
- **Joint river and sea surveys:** (traditional tagging data (tagging in rivers and sea, recaptures from sea and river fishery)

Usefulness of genetic methods to distinguish wild and reared salmon

Genetic differences among fish stocks can be used for estimating stock proportions. These techniques have several advantages compared to other techniques, e.g. external tags:

- Practically all fish are marked and the tag remains for the lifetime of the fish;
- Genetic tags have no effect on the viability and catchability of the fish;
- Results are independent of the tag return rate;
- Wild stocks in particular can be studied on an equal basis with hatchery reared stocks;
- No laborious tagging is needed, i.e. there is no costs associated with tagging.

Since 2000 no external tagging data have been available for Swedish salmon stocks, reducing the usefulness of the remaining tagging data.

In recent years, genetic information available for Baltic salmon stocks has increased and 8 to 9 locus DNA-microsatellite data seem to offer sufficient accurate stock composition estimates to be useful for fisheries management, i.e. the genetic differentiation among stocks in the Baltic seems sufficient to meet the accuracy and precision needed to distinguish wild and reared salmon and to identify the river of origin for wild salmon. For management, a maximum uncertainty of 10% is recommended, which has been achieved for the wild group by using a mixed sample size of about 300 fish. In addition, the majority of the individual stocks have been identified with high accuracy in the catches.

Currently, baseline samples have been collected for 34 Baltic salmon stocks, representing 97% of the total wild juvenile salmon production. This is presently used to estimate the proportions of various stocks in catches during the spawning run and feeding migration; however, not all catches are covered.

Assessment of Baltic salmon is based on an evaluation of the status of individual rivers and stocks. Data on the proportion of wild salmon in the catches are used to estimate the exploitation rate of wild salmon. The availability of such data reduces the uncertainty in the abundance estimates for wild salmon.

Sampling the catches so that the proportion of the smaller salmon stocks are estimated accurately is costly because the two largest wild salmon rivers in the Baltic Sea currently produce about 70% of all the wild Baltic salmon juveniles.

Conclusions

According to microsatellite-DNA analysis, approximately half of the salmon caught in the Baltic Sea and the Main Basin originate from salmon of wild origin. In the Gulf of Finland the proportion of wild salmon in the catch is very low. This information together with stock proportion data is useful for management purposes. The microsatellite-DNA method is presently one of the most obvious choices and approaches. In addition, because the majority of the individual stocks can be identified with high accuracy in the catches, the microsatellite-DNA method seems to be a useful technique to monitor spatial and temporal variations in stock composition and proportion in mixed-stock fisheries, which is essential for effective fisheries management and conservation.

Because of cost considerations the recommended sampling design does not provide information on individual rivers but only splits the catches into five groups: wild salmon in unit 1, reared salmon in unit 1, wild salmon in unit 2, reared salmon in unit 2, and salmon from other units.

Recommendations on sampling design and sampling protocol

The assessment of Baltic salmon is presently based on an evaluation of the status of individual rivers. In order for the catch data to be useful for the assessment of wild salmon, wild and reared salmon stocks need to be separated in the catch samples. This has been acknowledged by the Data Collection Regulation (DCR) that states that stock compositions of the catches must be estimated with level 1 precision, i.e. with precision of plus or minus 25% for a 95% confidence level. The appropriate sample sizes for genetic analyses have been calculated based on the uncertainty in the stock proportion estimates of stock groups from different units using Bayesian estimation procedures. Because the mean value of the stock-proportion estimates within the catches is larger than 5% only for assessment units 1 and 2, the stock-proportion estimates for wild salmon are calculated separately for these units only. Therefore stock-proportion estimates can be obtained for the following 5 groups: wild salmon in unit 1, reared salmon in unit 1, wild salmon in unit 2, reared salmon in unit 2, and salmon from other units.

The text table below summarizes the number of salmon to be scale-sampled in the Baltic Main Basin. These sample sizes have been calculated based on the catches in 2004. The sample sizes correspond to 1 sample for every 50 tonnes of salmon caught and the sampling of 70 salmon (10 salmon from each size class) within each sample. The current total sample size proposed is sufficient for the genetic analysis to obtain catch-proportion estimates with level 1 precision.

Country	ICES Sub-division	Drift net	Long-line	Total samples	Total number of fish
Denmark	25	1	2	3	210
	26	2		2	140
	28	1		1	70
	Total	**4**	**2**	**6**	**420**
Finland	25	2	1	3	210
	26	1		1	70
	28	1		1	70
	Total	**4**	**1**	**5**	**350**
Sweden	25	2	2	4	280
	26	2		2	140
	28	2		2	140
	Total	**6**	**2**	**8**	**560**
Latvia	28	1		**1**	70
Poland	26	2		**2**	140
Grand total		**17**	**5**	**22**	**1540**

Table 1. Summary of the number of salmon to be scale-sampled in the Baltic Main Basin.

In addition to the Baltic Main Basin area sampling and based on catch-proportion estimates for 2004, a minimum catch sample of 400 salmon is needed from the Åland Island fishery in order to obtain level 1 precision for proportion estimates of wild salmon stocks. For the Gulf of Bothnia, a total Finnish/Swedish sample size of 400 salmon is needed in order to obtain level 1 precision for proportion estimates of wild salmon stocks in units 1 and 2.

From the Baltic Sea Main Basin samples a subsample of 500 salmon will be taken for genetic analysis, and thus the **total number of samples will be 1300 (500 + 400 + 400) salmon.**

It would not be very cost-effective to do genetic material analysis in all nations separately. Thus ICES proposes that international cooperation and coordination continues in baseline sampling, collection, and analysis of genetic material in the framework of the Baltic Salmon and Trout Working Group. This is an ongoing process and WGBAST has been organizing already the coordination and cooperation among countries. Currently all countries with naturally reproducing stocks have contributed to the baseline sample database which currently contains 34 Baltic salmon stocks, representing 97% of the total wild juvenile salmon production.

This database is maintained and updated by FGFRI (Finnish Game and Fisheries Research Institute) and is available to all parties. In addition, preliminary arrangements have been made between countries to aggregate the collected scale samples for genetic analysis and there are preliminary agreements between Swedish and Finnish laboratories for genetic material analysis in their laboratories. Continuation of this process is recommended.

1.3.2.3 Quality assurance of biological and chemical measurement in the Baltic Sea

Request

A HELCOM/ICES Steering Group shall coordinate quality assurance activities on biological and chemical measurements in the Baltic marine area and report routinely on planned and ongoing ICES inter-comparison exercises, and to provide a full report on the results.

ICES coordinates the QA work on behalf of HELCOM and the QA work contributes to the review and revision of the HELCOM monitoring programmes and assessment procedures taking into account the requirements of EU Water Framework Directive. Revised monitoring programmes and assessment procedures shall contribute to improving the scientific understanding of marine ecological processes. The monitoring and assessment programmes shall reflect developments in an ecosystem approach to the management of human activities.

Recommendations and advice

ICES recommends to HELCOM:

- The HELCOM COMBINE Manual should be updated according to specific point in the Annex 4 of the HELCOM/ICES SGQAB report, and the Annex 4 - 6 of the HELCOM/ICES SGQAC report
- To urge the Contracting Parties to secure the participation of national representatives in QA related activities for biological parameters – intercalibrations, ring-tests, taxonomical workshops.
- That the list on planned QA- related activities (ring-tests, intercalibrations, workshops) should be made available on HELCOM web page and have the link easy to find.
- That future work of HELCOM/MON-PRO on new monitoring Manuals, should consider using the standard outline for method description.
- To support the publication in the Baltic Sea Environment Proceedings of the paper created by PEG "Biovolumes and size-classes of phytoplankton in the Baltic Sea".
- To secure the update of phytoplankton counting software 'PhytoWin' once every year according to the new information from PEG.
- To include the bacterioplankton and primary production data in the ICES database.
- To provide a inimum list of mandatory datafields for inclusion in the ICES Biological Community data reporting format 3.2 and have a link to this list on HELCOM web page.
- To revise chapter B.5.5. Routine quality control of the COMBINE Manual including appropriate QC requirements for phytoplankton.
- That the comments to the draft PLC Guidelines (section 1.3.3.6) should be considered by HELCOM in finalizing the PLC Guidelines.
- To apply the data validation procedure in PLC-5 as proposed under paragraph 6.1 of the 2005 SGQAC report.

Summary

More detailed information pertinent to quality assurance can be found in the 2005 report of the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic Sea (SGQAB) and in the 2005 report of the ICES/HELCOM Steering Group on Quality Assurance of Chemical Measurements in the Baltic Sea (SGQAC).

The ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic Sea (SGQAB) and the corresponding ICES/OSPAR Steering Group on Quality Assurance of Biological Measurements in the North East Atlantic (SGQAE) will merged in 2006. The reason for the merger is the similarities in issues dealt with in these groups and in order to strengthen the work on QA issues in relation to biological measurements.

Source of information

The 2005 report of the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic Sea (SGQAB)

The 2005 report of the ICES/HELCOM Steering Group on Quality Assurance of Chemical Measurements in the Baltic Sea (SGQAC).

1.3.2.4 Marine habitat classification and mapping system for the Baltic Sea

Request from HELCOM 2004/6:

"Currently no marine bioregional map exists for the Baltic Sea. However, such a map is a basic information source for several of the tasks of the HELCOM HABITAT group, e.g. the work on building a comprehensive network of protected areas (BSPAs). Also, such a map would also be useful in the work concerning the PSSA status of the Baltic Sea and help contracting parties in their work.

A similar first draft marine bioregional map for the Great Barrier Reef (Australia) was produced by a group of experts applying the "Delphi approach" and a similar approach might in this case be possible to use by ICES. However, the ICES member states participating in the production of such a map would nevertheless make the process easier by bringing in some of the map data on abiotic or biotic data from the Baltic Sea, or parts thereof (salinity data, shoreline data, bathymetric data, species/taxon distribution data etc.)."

Source of information

The 2005 report of the Working Group on Marine Habitat Mapping (WGMHM) (ICES, 2005).

Recommendations and advice

ICES was unable to produce a bioregional map for the Baltic Sea for a number of reasons; this was in particular due to the inability to access relevant datasets and to the limited number of participants from countries surrounding the Baltic at the relevant working group meeting.

ICES recognised that the development of a bioregional map will need to be supported by relevant data sets. Bathymetric and salinity data are essential. Data on oxygen together with salinity in deep basins would be needed, if for example there was a need to map potential reproduction areas of Baltic cod. Data on bottom type (soft sediments and hard bottoms) would be the basic information required to map different benthic communities. Information on wave exposure/fetch would support mapping benthic communities in littoral areas. All these data exist already.

ICES would like to contribute to development of marine habitat maps for the Baltic, but given the slow and disappointing progress made within ICES to date, HELCOM may also benefit from pursuing this request in other fora. One approach could be to establish an international project for marine habitat mapping in the Baltic Sea Region. ICES considers that the BALANCE project provide a good basis for producing a Baltic Sea map, as the project includes relevant aims, provides substantial resources and guarantees the collaborations necessary to pursue this work.

Although ICES could not fulfil this request, ICES may be able to help with future development of a map if the objective of the map can be agreed before development with all interested parties. This definition might be aided by assessing existing marine landscape and broadscale habitat maps produced elsewhere.

Request from HELCOM 2003/5 repeated in HELCOM 2004/6:

"Following the request by the Second Meeting of the Nature Conservation and Coastal Zone Management Group (HELCOM HABITAT 2/2001) with reference to the final Minutes of the Meeting the Habitat Group requested ICES to include the Baltic Sea in its work on a marine classification and mapping system generally accepted and covering the whole Baltic Sea area. The EUNIS classification system should be taken into consideration as well as other ongoing projects in the region such as the CHARM project on "Characterization of the Baltic Sea Ecosystem Dynamics and function of coastal types", which is connected with the EU Water Framework Directive."

Source of information

The 2005 report of the Working Group on Marine Habitat Mapping (WGMHM) (ICES, 2005).

Recommendations and advice

Unfortunately, ICES has not been able to make significant progress with this request and repeats the conclusions from 2003 (ICES, 2003). Overall there is a good correlation between the benthic communities in the Baltic and its salinity regime. Therefore a classification scheme should place a strong emphasis on the salinity regime. Salinity patterns in the Baltic Sea form a dynamic, ever changing environmental gradient. Temporal changes in communities are a dominant force in this system. Sediments are the most conservative classification factor in the Baltic Sea.

Another way to take this work forward would be by a joint international effort. One option is a workshop with invited national marine habitat experts, including geologists, with the particular aim of developing the classification of the Baltic. The workshop could also assess problems and usefulness of the EUNIS system within the Baltic ecosystem. The draft produced by experts could then be considered by HELCOM and other stakeholders for further development.

References

ICES. 2003. Report of the ICES Advisory Committee on Ecosystems, 2001. *ICES Cooperative Research Report* No. 262: 117–120.

ICES. 2005. Report of the Working Group on Marine Habitat Mapping, 5–8 April 2005, Bremerhaven, Germany. ICES CM 2005/E:05. 85 pp.

1.3.2.5 Seal and harbour porpoise populations in the Baltic marine area

HELCOM request:

To evaluate every second year the populations of seals and harbour porpoise in the Baltic marine area, including the size and structure of the populations, distribution, migration pattern, reproductive capacity, effects of contaminants on the health status, and additional mortality owing to interactions with commercial fisheries by sub-region (by-catch, intentional killing).

This request to ICES should address the following fundamentals of a potential conservation plan:

→Possible target and limit reference points for grey seals that would satisfy the provisions of the Habitat Directive, while considering the uncertainty inherent in assessing the population trends, birth rates, and total mortality. Risk levels to explore could be 1, 2.5, and 5%.

→Population growth rates that under different assumption about total mortality would be needed for maintaining *status quo* to with high probability allow the population to continue to increase towards a future target. A growth rate could in itself be an interim target in the conservation plan.

→Information on indicators for health for the population birth rates, contaminants, etc.

→Evaluation of habitat protection and seal sanctuaries in the Baltic and possible need for more use of such.

→Identification of gaps of monitoring of the population and by-catches.

Source of information

Details of the status of marine mammals in the Baltic Sea were provided in the 2003, 2004, and 2005 WGMME reports (ICES CM 2003/ACE:03, ICES CM 2004/ACE:02, ICES CM 2005/ACE:05) as well as the 2005 WGBAST report (ICES CM 2005/ACFM:18).

Advice

1. ICES advises that in the Baltic Sea
   a) a) Defining a lower limit reference point requires an objective. A value where the probability of quasi-extinction is high should be considered as the lower limit reference point. There is still scientific debate as to where this level lies and further analysis would be needed to identify the point which is associated with unacceptable quasi-extinction risk. To achieve this, the by-catch and intentional killing of seals should be scientifically evaluated in terms of numbers-at-age of killed seals in relation to the number of seals in a stable age-structured population, to predict the effects on the population and the corresponding risk of quasi-extinction.b) If the management authorities wish to set target points or upper limits (or upper conservation bounds) for the grey seal population, then relevant objectives and their time frame should be formulated. Once these objectives have been set, the effects of different seal population levels on the human use of the ecosystem could be explored by ICES.

2. ICES advises that a number of candidate indicators of seal population health exist. The information content of these indicators and how they vary with threats to the populations are not well known and ICES cannot, at present, give a prioritised list of relevant indicators of seal population health. Candidate indicators could be evaluated according to criteria previously advised by ICES (2001), with regard to their information content and sensitivity to anthropogenic effects on seal populations. ICES proposes that the workshop on habitat quality and health aspects in marine mammals (planned for the spring 2007) should evaluate the indicators using ICES 2001 criteria.

3. ICES advises that seal habitat protection includes such areas that are essential to undisturbed activities and behaviour during all life stages. No evaluation has been made of existing seal sanctuaries in the Baltic due to lack of information. The benefit of avoiding disturbances at breeding and haul-out sites seems evident but has not been quantified. The large size and variability in the range of foraging habitat makes it difficult to define essential foraging habitat. Specific migration constrictions could be defined as essential habitats, but there is no clear evidence yet that critical migration constrictions exist, or if they do exist, where they are located. For a re-colonisation of the southern Baltic coast by seals it is obvious that undisturbed haul-out sites are essential to provide a year-round basis for pupping, moulting, and resting. Thus protection of such sites from disturbance

could help in re-colonisation. Sites should be selected independent of their current nature conservation status but rather on their suitability.

4. ICES advises that:

b) a)Present monitoring programmes for Baltic seals should be coordinated and cover the entire distribution range of each species. An update of the estimate of present population size using the photo-id method is recommended.

c) b) Human impact on seal behaviour and undisturbed habitat needs to be quantified and mapped. Bycatch and hunting should be monitored and analysed to infer spatial disaggregated vital statistics for population analysis and modelling.

d) c) Spatial disaggregated information concerning distribution and life history data of the Baltic grey seals should be collated.

e) d) Impacts of seals on human use of living resources need to be monitored and integrated with assessments of the fishery resources on a spatial disaggregated scale.

Size and structure of the populations, distribution, migration pattern, reproductive capacity, effects of contaminants on the health status, and additional mortality

Seals

The status of marine seal populations in the Baltic Sea is summarised in Table 1.3.2.5.1 and the status of seals in Lake Saimaa and Lake Ladoga in Table 1.3.2.5.2

Table 1.3.2.5.1 Summary of the status of marine seals in the Baltic Sea.

	Baltic ringed seal (*Phoca hispida botnica*)	**Grey seal** (*Halichoerus grypus*)	**Kalmarsund harbour seal** (*Phoca vitulina*)	**SW Baltic harbour seal** (*Phoca vitulina*)
Distribution	Resident in three main areas: the Bothnian Bay (70%), Gulf of Finland and Archipelago Sea (~5%), and Gulf of Riga (25%)[6]	Northern, central, and southern Baltic Proper	Kalmarsund, resident	West of 13°E
Migration patterns	relatively sedentary	High site fidelity during summer; in southern Baltic Kernel home range 51 221 km² (range: 4160 to 119 583 km²). Most daily distances were less than 10km, however grey seals can make extensive movemenst of up to 850km. Grey seals tracked during winter/early spring ranged over larger areas.	Unknown	Kattegat animals remained within 50 km of tagging site (2000-2002). Kernel home range was 395 km² (range: 237 - 709 km²)
Population size	4748 GoB (2004)[4] 149 GoF (1995) [5], 120-140 AS (2004) [4] 579 GoR (2003) [4]	17,640[4]	555[1]	4923 (2003)[2] 3992 (2004)[3]
Population trend	+5% GoB; low but stable in GoF, unknown in AS and GoR	In Sweden 7.5% increase per year, other areas unknown, local differences.	Not affected by the PDV epizootic in 2002: increase of 9.5% per year	−53% (epizootic loss) in 2002. Is recovering but rate unknown.
Reproductive capacity (pregnancy rate)	Pregnancy rate 0.76 (1996-2004)	Pregnancy rate 0.81 (2004)	No information available.	The low rate of population increase in the Kattegat area, compared to the Skagerrak prior to the last epizootic, may be an indication of reduced reproductive capacity.
Effects of contaminants on health status	Organochlorines had negative effects on the reproductive capacity of all species of seals from the 1960s to the 1980s. The prevalence of intestinal ulcers has increased during last decade. Intestinal ulcers may be fatal if the intestine is perforated, leading to peritonitis. Analyses of more than 1000 lower jaws collected during the seal epizootic in 1988 revealed a high prevalence of alveolar exostosis, not found at all in reference material collected 1850-1930. Similar changes in Baltic grey seals were thought to be indicative of organochlorine pollution. Elevated levels of contaminants imply that ringed seals are ingesting more PCB and DDT than grey seals. The higher levels of DDT in ringed seals compared to the grey seals could be explained by differences in their diets.			
By-catch (per year)	30 SE (2004)	300 SE (2004), 150 EST (2001), 7 POL (2001), other countries unknown	Unknown	380 SE (2004), other countries unknown
Intentional killing	5-10 annually (FIN) for research	81 SE, 135 FI, 152 FA Number of licences: 797 (2004), Number of shot: 371 (2004) in SE, FI and FA; 35 pups poached in EST (2002)	Unknown	4 in Swedish part of Kattegat (2004) to protect coastal fishery; no data available from DK

Key: GoB = Gulf of Bothnia; GoF = Gulf of Finland; GoR = Gulf of Riga; AS = Archipelago Sea; DK = Denmark; EST = Estonia; FIN = Finland; POL = Poland; SE = Sweden; FI = mainland Finland, FA = Finland Åland. [1]Kalmarsund based on 361 counted animals ,[2]Danish Kattegat, Belt Sea, South Baltic, [3]Makläppen, Swedish Kattegat, [4]Numbers shown are actual counts of animals [5]Numbers based on direct counts during strip-transects and estimated for total study area, [6]Estimated percentage to give an approximate guide to the distribution

Table 1.3.2.5.2 Summary of the status of seals in Lake Saimaa and Lake Ladoga.

	Saimaa seal *(Phoca hispida saimensis)*	**Ladoga seal** (*Phoca hispida ladogensis*)
Distribution	Fragmented, 60% of lake area	90% of lake area; new wintering habitat in northern Lake Ladoga found
Migration patterns	High site fidelity; generally movements not longer than 20 km.	Unknown
Population size	ca. 280 (winter 2004/2005)	3000 - 5000 (2004)
Population trend	Population increase p.a.: 2.6%	Unknown.
Reproductive capacity (pregnancy rate)	Pregnancy rate 0.58 to 0.80 (2003)	reproductive capacity not known
Effects of contaminants on health status	Current levels of DDT and PCB concentrations are lower, as compared to previous studies. Levels of organochlorine concentrations in Saimaa seals have never been as high as those in Baltic seals. No updated information on possible effects of environmental contaminants	High mercury concentrations in liver, kidneys and lanugo hair.
By-catch (per year)	Around 8	351 (2003)
Intentional killing	None	Tens poached

Harbour porpoise (*Phocoena phocoena*)

The status of harbour porpoises in the Baltic Sea is summarised in Table 1.3.1.5.3.

Table 1.3.2.5.3 Summary of the status of harbour porpoises in the Baltic Sea.

	Harbour porpoise (western Baltic: ICES Subdivisions 22 to 23, eastern part of IIIa)	**Harbour porpoise (eastern and central Baltic: ICES IIId: Subdivisions 24 to 32)**
Distribution	Harbour porpoises can occur throughout the Baltic Sea and adjacent waters. PODs (acoustic Porpoise Detectors) have been deployed in the German, Polish, and Estonian part of the Baltic Sea, respectively, since 2002 and 2003. The results indicate a decrease in click activity from the western German waters of the Kiel Bight to the eastern Pommeranian Bight. It also gives some indication of seasonal changes in click activity. In Poland and Estonia few detections have been recorded so far.	
Migration patterns	There are indications of seasonal migrations of porpoises between Danish inner waters and the North Sea.	Unknown.
Population size in year 1900	Unknown	Unknown but larger than at present
Current population estimate	<u>SCANS Survey July 1994:</u> Kattegat/Eastern ICES IIIa: 36046 (C.V. 0.34) (0.725 animals/km^2) Belt Seas/Northern ICES 22, 23: 5262 (C.V. 0.25) (0.644 animals/km^2) Kiel Bight/Southern ICES 22: 588 (C.V. 0.48) (0.101 animals/km^2) <u>German surveys July 2004:</u> Kiel Bight/southern ICES 22: 217 (95% C.I. 76-406) (0.046 animals/km^2) Eastern ICES 22/Western ICES 24: 803 (95% C.I. 390-1410) (0.111 animals/km^2)	<u>Swedish survey July 1995:</u> ICES 24+25 without Polish coast: 599 animals (95% C.I. 200-3300) (C.V. 0.57) (0.014 animals/km^2), <u>German surveys July 2004:</u> Southern part of ICES 24: 61 animals (95% C.I. 0-245) (0.006 animals/km^2).
Population trend	Unknown	Unknown
Current reproductive rate	Unknown	Unknown
Health status	No new data presented 2005.	No new data available.
Contaminants	In comparison to butyltin levels in marine mammals from other geographic regions, the samples indicate a high level of tributyltin contamination along the Polish coast of the Baltic Sea. Animals from the Baltic also had 41% to 254% higher mean levels of PCDD/Fs and PCBs than corresponding samples from the Kattegat and Skagerrak.	
By-catch (per year)	According to the Swedish reporting system for bycatch covering 5% of the Swedish Baltic fleet no bycatch has been reported in ICES IIId (Subdivisions 24-32) (Westerberg, pers. comm.). In area of Kattegat and Belt Sea bycatches are in the 100s.	8 by-catches from Poland (2003-2004) (I. Kuklik, pers. comm). 2 by-catches from Latvia (2003-2004) (V. Pilats, pers. comm.).
Intentional killing	None	None

1.3.2.6 Answer to HELCOM on the review of the quality assurance section of the Pollution Load Compilation (PLC) guidelines regarding PLC-5

HELCOM has requested ICES to

To review and revise the quality assurance section of the PLC Guidelines

ICES Comments

The HELCOM/ICES Steering Group on Quality Assurance of Chemical Measurements has reviewed and proposed revision of the quality assurance section of the PLC Guidelines to assure that these are consistent with the quality assurance section of the COMBINE Manual.

Comments on the draft PLC guidelines

The sections, chapters and annexes mentioned to below refer to the PLC guidelines as provided by the HELCOM secretariat.

The chapter 4 "Quality Assurance" is almost identical with the published HELCOM Guidelines "Chemical measurements in the Baltic Sea: Guidelines on quality assurance". Therefore subsections 4.2 to 4.9 and selected annexes should be replaced by appropriate references to the "Chemical measurements in the Baltic Sea: Guidelines on quality assurance" and the HELCOM website. Only subsection 4.1 (general aspects of QA) and annexes containing specific PLC items should be left in the paper. The reason behind it was that there is no need to have two documents nearly identical on the HELCOM website and to avoid discrepancies when only one of them is updated regularly.

Regarding the data validation procedure for PLC (see section draft PLC guidelines section 6.1), ICES recommends that obligations for supplying Quality Assurance (QA) information be defined in accordance with the ICES data reporting format 3.2 as follows:

Accreditation status	R
Measurement uncertainty	R
Limit of detection/quantification	M
Use of reference materials (type, code, values)	M
Use of control charts	R
Participation in laboratory intercomparison tests (provider, round/exercise)	M
Participation code	R

(R = recommended, M = mandatory)

Concerning the use of data in an assessment, a data validation procedure might be established based on the QA information provided by laboratories. ICES considers that missing QA information which is mandatory is a reason to discard such data from the assessment.

Comments on annexes in the draft PLC guidelines:

Annex 5 Reference to ISO 5667 should be left as specific PLC item in the PLC Guide.

Annex 7: The text with respect to marine monitoring should be replaced with a reference to the COMBINE Manual and to ICES report No.35. SGQAC suggestion for a new title: Technical notes on the determination of variables in rivers and waste water.

Annex 8 should be deleted, only the "Reporting of low level data" can be incorporated as a subsection in chapter 2.1.3 of the PLC guidelines.

Annex 10: SGQAC recommend only optional establishment of a reference laboratory. The laboratories should have the choice to participate in national and international laboratory intercomparison tests. Always traceability to international standards should be maintained.

Annex 11: SGQAC suggested changing the title of the Annex to: "Laboratory Intercomparison Tests ", and change the text to the following:

Operation of laboratory intercomparison tests are is outlined in ISO/IEC Guide 43. It is recommended to perform the tests according to this Guide.

In conducting the laboratory intercomparison tests for PLC it is essential, that:

- the test material is identical as much as possible with the matrices (e.g. riverine water and waste water) to be analysed within PLC-Water
- different concentration levels of each analyte in each matrix are included in the test and they are adequate to the concentrations of the samples collected in PLC-Water, in particular adequate to the concentrations of metals and mercury in riverine waters
- the test material is homogenous and stable for the duration of the testing period and homogeneity and stability of the material is tested
- the participating laboratories use the analytical methods, which they intend to apply for PLC-Water.

Additionally it is suggested to supply a list of links to institutes providing laboratory intercomparison tests and to helpful databases (e.g. COMAR).

Annex 12 should be left in the PLC Guidelines.

Source of information: Report of the HELCOM/ICES Steering Group on Quality Assurance of Chemical Measurements in the Baltic Sea,1 February 2005.

PLC-5 Guidelines, HELCOM February 2005

1.3.2.7 Answer to special request from IBSFC on closed areas in the Gotland Basin and Gdansk Deep in 2005

IBSFC has requested ICES to

> *advise, not later than 15.04.2005, on areas within the Gotland Deep and Gdansk Deep where the hydrological condition allow for a successful cod spawning in 2005*

ICES Comments

The hydrographic situation in the central basins of the southern Baltic was monitored during the Polish and Danish BITS surveys in February/March 2005. Also, the Russian BITS survey conducted at the same time in the southern Gotland Basin and the Gdansk Deep provided hydrographic measurements.

From these results it appears unlikely that the hydrographic conditions in 2005 will allow high egg survival in the Gotland Basin and the Gdansk Deep.

Cod egg survival is possible in the deeper part of the Slupsk Furrow, the southern slopes of the Gotland Basin and the northwestern entrance to the Gdansk Deep. In the central Gdansk Deep, a limited "Reproductive Volume" (RV) was found as well, but with a low oxygen concentration, i.e. < 3 ml/l. Although at present areas with potential for successful egg development exist, the hydrographic condition will degrade prior to and during the spawning season to an extent that good egg survival is very unlikely.

The results suggested that, as in previous years, cod egg survival is possible in the Bornholm Basin but the main areas with sufficient oxygen for successful cod egg development are restricted to the southern part of the basin. In general the hydrographic conditions have deteriorated in the Bornholm Basin, the Slupsk Furrow and the Gdansk Deep throughout the last year (Figure 1). While oxygen concentrations are similar in the Gdansk Deep in February 2004 and 2005, in the location of the halocline is now deeper and salinity lower. This is narrowing the water layer available for successful egg development.

Saline, oxygenated water passes through the Bornholm Deep before introduced into the Gdansk and Gotland Deeps and this process normally takes several months. The hydrographic situation in the Bornholm Basin is at present relatively unfavourable and the time lack excludes a possible improvement in the Eastern basins before July-August when the cod eggs should already have hatched.

The areas closed for all fisheries in the Gdansk Deep and the Gotland Basin that were introduced by the EU Council of Ministers (Figure 2) correspond under present conditions largely to the areas with the highest probability for cod egg survival. If and when a major inflow occurs, the extension of the closed areas and seasons should be reconsidered depending on the extent of an inflow.

Conclusion

ICES reiterates its conclusion from 2004: that the basic hydrographic processes affecting the environmental conditions for cod egg survival are understood, but reliable predictions of where and when egg survival and subsequent recruitment will be high are not yet possible. This is not only caused by uncertainties with respect to atmospheric forcing conditions in the months to come and variability in the hydrographic response, but mainly due to the fact that biological processes, such as distribution of spawning effort, egg mortality due to other causes than hydrography, and larval and early juvenile mortality, complicate the recruitment process.

The hydrographic conditions in 2005 will not allow high cod egg survival in the Gotland Basin and the Gdansk Deep. Thus, reproductive success will again depend largely on the Bornholm spawning ground and to a certain degree on the Slupsk Furrow.

Therefore, **ICES considers that there is no basis for additional closed areas in the Gdansk Deep and Gotland Basin to ensure undisturbed spawning activity of cod in 2005.**

References

Background analysis to request by an ICES review group consisting of H-H. Hinrichsen, I. Karpushevskiy, F. W. Köster, G. Kraus, P. Margonski.

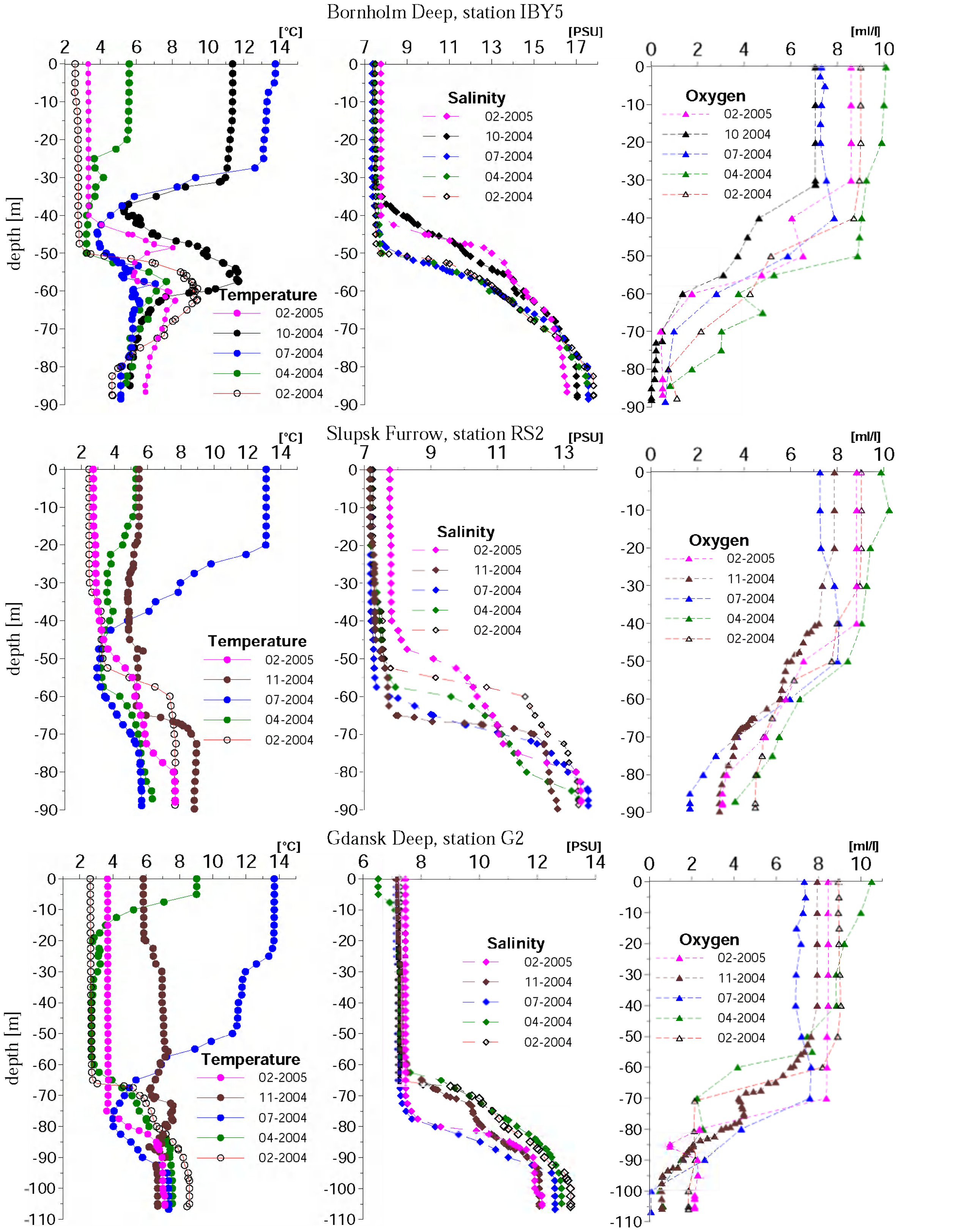


Figure 1 Changes in vertical distribution of temperature, salinity and oxygen concentration at three stations located in the Bornholm Deep, Slupsk Furrow and Gdansk Deep from February 2004 to 2005.

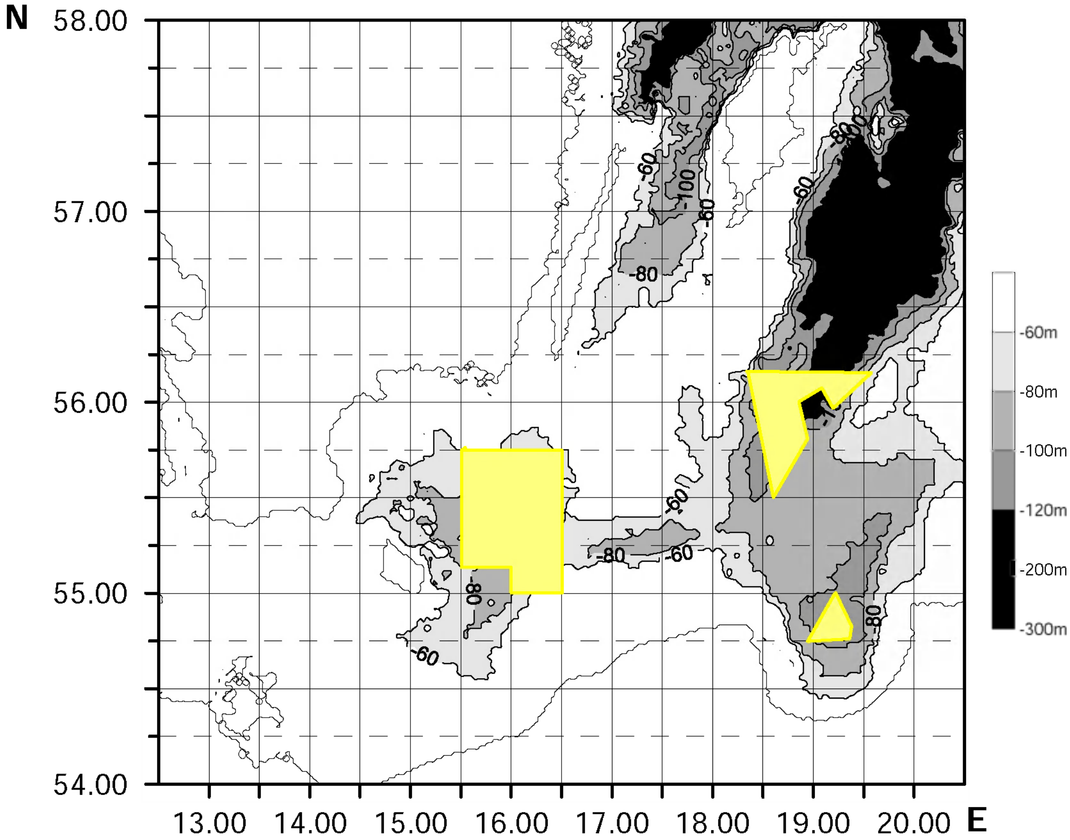


Figure 2 Closed areas for all fisheries in the Central Baltic as introduced by the EU Council of Ministers for 2005.

1.3.2.8 Answer to special request on progress with revising estimates of smolt production potential in wild salmon rivers

IBSFC requested ICES to:

> *Keep IBSFC updated on progress with revising estimates of smolt production potential in wild salmon rivers.*

ICES comments

For the purpose of advising on how well the 50% target in the Salmon Action Plan is reached, ICES maintains the use of the potential smolt capacities that were established 1998–2000. ICES is investigating alternative estimation procedures but has not yet concluded on the best way forward. Indications are that the 1998–2000 estimates are lower than the actual potentials. Below is a description of the revisions under considerations.

A Bayesian network model is used for the construction of the prior distribution for the smolt carrying capacity of each river. The idea was to express the knowledge of salmon scientists about the carrying capacity in the form of probability distribution. In particular, the knowledge about the carrying capacity before obtaining any recent smolt abundance data is intended to be expressed here. Each expert was asked to provide their knowledge about different factors affecting the carrying capacity, like area suitable for production, habitat quality, and mortality of smolts during downstream migration. Prior probability distributions for the carrying capacity are then calculated as the product of all these factors. The final prior distributions are an average over priors of all experts, which means that the diversity of different expert opinions is taken into account.

No measurement data is used directly in this model. Experts were asked not to take into account measurement data that will be used explicitly in the Bayesian stock assessment model. For example, experts are asked to ignore any smolt counts that will be used in the assessment. However, before giving their opinion the experts look at existing additional material from the different rivers that contain information useful for the evaluation of the river areas suitable for production, the habitat quality of each river, and information on mortality of smolts during downstream migration.

Variables affecting the carrying capacity have been assigned to classes, and experts have been asked to provide the probability that the true value of the parameter belongs to each class. Standard probability calculus has then been exploited to obtain the probability distributions for carrying capacity.

The model outputs are discrete prior distributions for the carrying capacity. These will be used in further analysis of data, which will combine this prior information with information in data. If data appears to be informative, the carrying capacities will then be substantially updated. Such an update can be expected each year as new data is incorporated.

The smolt production capacities can be found in Table 1.4.14.2 for the stocks in the Main Basin. Figure 1.3.2.8.1 shows the estimated smolt capacities as probability distributions. The most likely value in these distributions is the peak (mode) of the distribution; therefore mode values are provided in Table 1.4.14.2 of the smolt production capacities by river.

Formulating the Salmon Action Plan recovery objective in probabilistic terms would be: "to ensure that probability that the smolt production is below the target is low". This requires a specification of a low probability (e.g. 10%?) from managers. An element in the revision of the estimation procedures is to consider appropriate values for discussion with the Commission. For each stock, managers should evaluate what risk they are willing to take in order to decide if the probability to reach IBSFC objectives is sufficient for a particular stock.

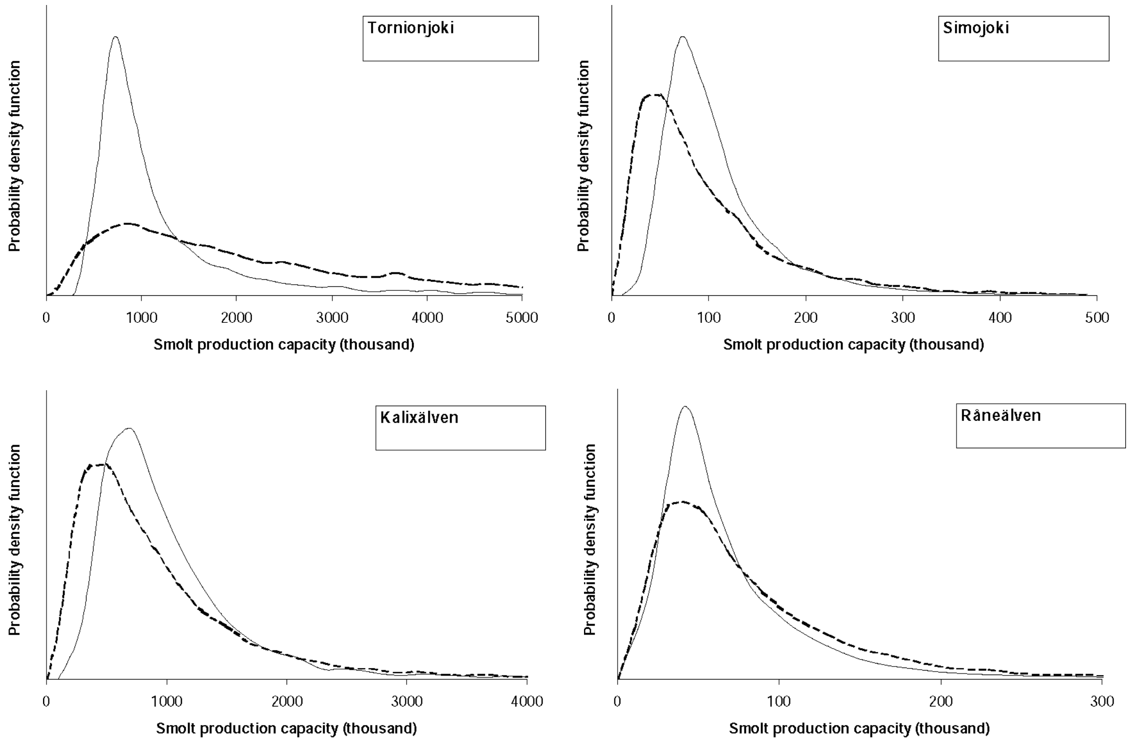


Figure 1.3.2.8.1 Prior (dotted line) and posterior probability distributions of the smolt production capacity for stocks of assessment unit 1. The mode (peak) represents the most likely estimate of the capacities and the range of the distribution indicates the uncertainty of the estimate.

1.3.2.9 Answer to special request on fishing practices for salmon in the Gulf of Finland

IBSFC requested ICES to provide :

Information on the development of fishing practices for salmon in the Gulf of Finland and assessment of the consequences of such development of catches of wild and reared salmon.

<u>ICES comments</u>

The catch distribution between offshore, coastal, and river catches has drastically changed. While overall exploitation decreased it simultaneous moved from the offshore mixed stock fishery to coastal fisheries, focusing on local stocks. By 1987 about 80% of the total catch in the Gulf of Finland was taken offshore; in 1988 and 1989 the offshore fishery share was about 60%, and in 1990–1994 offshore fishery was about 40% of the total catch. Since 1995 the offshore fishery has taken only about 20% or less of the total catch. In 2004 the share of offshore catch was 4% (Figure 1.3.1.9.1). Catches in the coastal fishery have also decreased considerably.

In 2004 the main part (88%) of commercial catch in Gulf of Finland was taken by trap nets. Recreational catches were about 33% of the total catch in the area. However, the estimates of recreational catches contain large uncertainty. In many areas at the Finnish coast the traditional trapnet sites could not be used any more because of large damages caused by seals on salmon in gears. Seals harm the fishery even in the inner archipelago. According to Finnish logbook records, approximately 35% of the commercial salmon catch (3682 fish) was discarded due to seal damages. Also in Estonia the harm caused by seals has increased in coastal fisheries. The total effort and catch in the Finnish longline fishery has strongly decreased in the last few years. Because of low CPUEs together with low prices and seal damages there has been decreased interest in longline fishing. Fishers using trapnets now operate closer to harbours and with fewer trapnets than earlier, as it is necessary to empty the trapnets more frequently to keep seal damages low.

In the Finnish commercial offshore fishery the number of vessels has been reduced significantly (i.e. from 47 in 1999 to 16 in 2004).

Russia reported only minimal coastal and river catches (about 500 salmon) in 2004 from this area and none from the open sea.

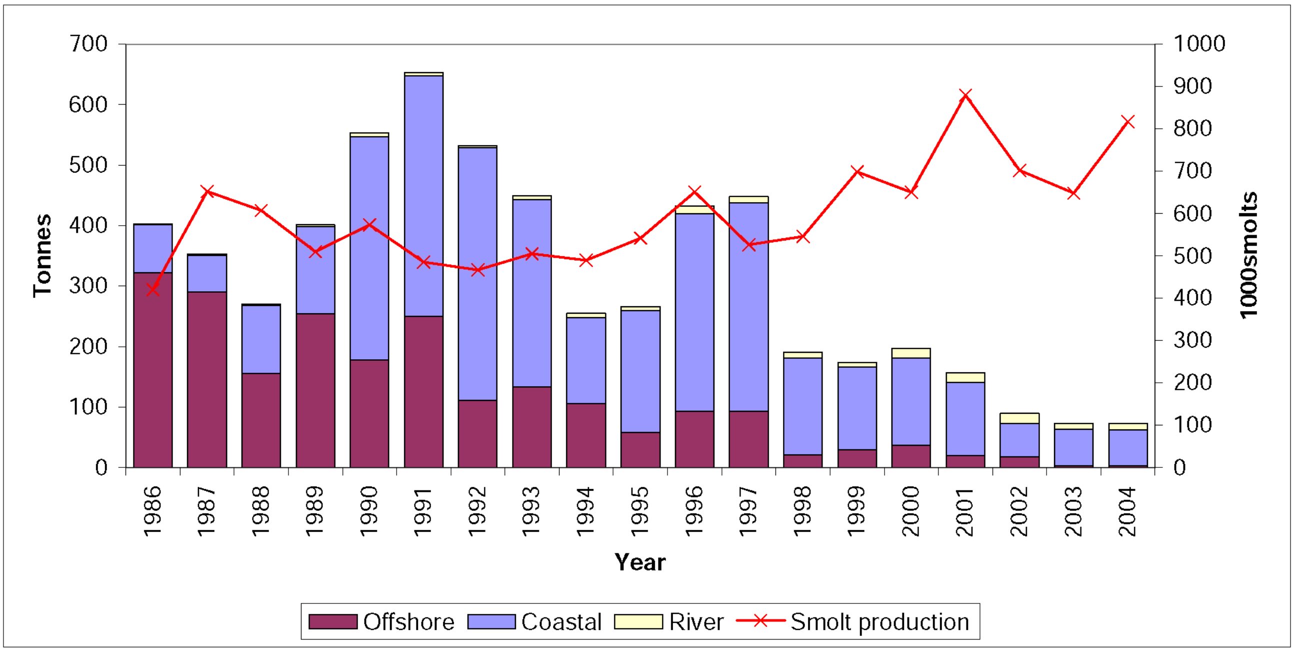


Figure 1.3.2.9.1 Salmon catches and smolt releases in the Gulf of Finland in 1986-2004.

1.4 The Baltic Sea

1.4.1 Cod in Subdivisions 22–24

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
At risk of reduced reproductive capacity	Not available	Overexploited	

Based on the most recent estimates of SSB, ICES classifies the stock as being at risk of reduced reproductive capacity. In the absence of defined fishing mortality reference points, the state of the stock cannot be evaluated with regard to these. An analytical assessment demonstrates that the most recent estimated fishing mortality exceeds the IBSFC fishing mortality reference point (1.0). The current fishing mortality is well above what is likely to be sustainable in the long term. At this high exploitation rate the stock is highly dependent upon the strength of incoming year classes.

Management objectives

IBSFC adopted a long-term management strategy for cod in the Baltic in 2003 (Resolution XX on the Management Plan for the Cod Stocks in the Baltic Sea (adopted by the Extraordinary Session, June 2003)). This management plan includes rules on setting the TAC, and also establishes a number of technical measures. The plan is presented in Section 1.3.2 above.

ICES has evaluated the management plan in 2004 and concluded that it is consistent with the Precautionary Approach, except when SSB is very low, as the management plan does not include a provision for zero catch. It was also noted by ICES that this can only be successful if the implementation of the management plan is effective, i.e. the resulting effects can be measured with sufficient accuracy and the assessments are sufficiently unbiased.

The EC is in the process of presenting new proposals for a long-term management plan for the two cod stocks in the Baltic.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$: not defined.	$\mathbf{B}_{pa}$: 23 000 t.
	$\mathbf{F}_{lim}$: not defined.	$\mathbf{F}_{pa}$: not defined.

Technical basis

$\mathbf{B}_{lim}$: -	$\mathbf{B}_{pa}$: Previous MBAL.

The evaluations of harvest control rules for western Baltic cod have demonstrated that, under the assumption of the current exploitation pattern, target fishing mortalities (including all catches) between 0.3–0.6 (ages 3–6) result in a low risk to reproduction and high long-term yields. There is presently not an estimate of $\mathbf{B}_{lim}$ available for this stock, but this conclusion is robust to assumptions of $\mathbf{B}_{lim}$ up to 30 000 t. A major improvement to the stock development and to the landings is expected if an additional reduction of juvenile mortality could be achieved. If juvenile mortality is halved the upper range of the target fishing mortality could be increased by 0.1.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

Landings of less than 28 400 t in 2006 are in accordance with the agreed management plan, which corresponds to a fishing mortality of less than 1.0.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

ICES has evaluated candidates for management plans, see Section 1.3.3.1

Short-term implications

Outlook for 2006

Basis: F(2005) = $\mathbf{F_{sq}}$ = 1.19; SSB(2006) = 23.8; Landings (2005) = 27.4; Discards= 3.6.
The fishing mortality to be applied in 2006 according to the agreed management plan (F(management plan)) is 0.92.

Rationale	TACs (2006)	F(2006)	Basis	Discards (2006)	SSB(2007)
Zero catch	0	0	F=0	0	59.4
Status quo	33.6	1.19	$\mathbf{F_{sq}}$	3.2	24.6
Agreed management plan	4.3	0.1	F(management plan) * 0.1	0.3	54.8
	9.9	0.25	F(management plan) * 0.25	0.8	48.8
	18.0	0.5	F(management plan) * 0.50	1.5	40.2
	24.5	0.75	F(management plan) * 0.75	2.2	33.6
	27.9	0.9	F(management plan) * 0.90	2.5	30.2
	28.4	0.92	management plan with 15% constraint	2.6	29.7
	30.1	1.0	F(management plan)[1]	2.8	28.0
	32.1	1.1	F(management plan) * 1.1	3.0	26.0
	34.6	1.25	F(management plan) * 1.25	3.3	23.6
Precautionary limits	48.0	2.3	F giving SSB(2007) = $\mathbf{B_{pa}}$*0.50	5.0	11.5
	35.0	1.27	F giving SSB(2007) = $\mathbf{B_{pa}}$	3.3	23.0
	23.0	0.69	F giving SSB(2007) -= $\mathbf{B_{pa}}$*1.5	2.0	34.5

Weights in '000 t.
[1] The management plan gives priority to a limitation of TAC change of 15% between two consecutive years even when $\mathbf{B_{pa}}$ is not reached.
Shaded scenarios are not considered consistent with the Precautionary Approach or the management plan.

Management considerations

The fishery is largely based on recruiting year classes. Discarding, based on estimates since 1996, continues to be substantial. The management plan target F is based on landings, but the assessment is based on total catch. Advice refers only to landings.

Management plan evaluations

As a response to a request from the EC candidates for a cod management plan for eastern Baltic cod have been evaluated, see Section 1.3.1.1 request on Baltic cod HCR. The evaluations of harvest control rules for western Baltic cod have demonstrated that, under the assumption of the current exploitation pattern, target fishing mortalities (including all catches) between 0.3–0.6 (ages 3–6) result in a low risk to reproduction and high long-term yields. There is presently no estimate of $\mathbf{B_{lim}}$ available for this stock, but this conclusion is robust to assumptions of $\mathbf{B_{lim}}$ up to 30 000 t. A major improvement to the stock development and to the landings is expected if an additional reduction of juvenile mortality could be achieved. If juvenile mortality is halved the upper range of the target fishing mortality could be increased by 0.1.

The management plan is only in accordance with the Precautionary Approach if effectively implemented and enforced. The situation in recent years with significant amounts of non-reported cod landings indicates that overall, enforcement has not been effective

The management plan assumes that there are estimates of fishing mortality (F) and spawning stock biomass (SSB) available. Such estimates are derived from time-series of commercial catch data and of stock abundance indices obtained from scientific research cruises, and proper estimates of F and SSB can only be provided if these input data are complete and reliable. The situation in recent years with significant amounts of non-reported cod landings renders scientific estimates close to being useless in the context of a management plan which assumes precise estimates of present stock parameters.

When catch data are unreliable only indices based on abundance survey time-series of stock and mortality trends can be provided. The major survey time-series includes a break in 2000 when gears and design were standardized. There has been significant work done on modelling the bridge before and after 2000, but there are uncertainties related to this break in the time-series that are not, and probably cannot be resolved. Therefore, a consistent time-series is only available for 2000 and onwards.

The simulations have taken neither biological interactions nor density-dependent growth/maturity into account and are thus merely indicative of the direction of outcomes from the management strategies prescribed in the joint request. However, the conclusions regarding the general direction required – significant reductions in fishing mortality to achieve simultaneously a low risk of SSB falling below the conservation limit $\mathbf{B}_{\text{lim}}$ and a high long-term yield – are not sensitive to density-dependent effects.

It is therefore suggested that an implementation of a long-term management plan is based on an adaptive approach whereby the development of the stock is monitored as the effects of the reduced fishing mortality are developing, and the specific numerical values within the management plan may then be modified on the basis of the outcomes of the fishing mortality reductions.

Regulations and their effects

A 'Bacoma' codend with a 120-mm mesh was introduced by IBSFC in 2001 in parallel to an increase in diamond mesh size to 130 mm in traditional codends. The expected effect of introducing the Bacoma 120-mm exit window 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 trawl and the minimum landing size. In October 2003 the regulation was changed to a 110-mm Bacoma window which was expected to enhance the compliance by the fishing industry and to be in better accordance with the minimum landing size, changed to 38 cm in the same year. This appears to have been accepted by the fishing industry, although it has not yet been possible to evaluate its effects.

In addition to this, the fisheries are regulated by a seasonal closure.

Scientific basis

Data and methods

The assessment is based on long-term catch data as well as three commercial CPUE indices and two survey recruitment indices. Discard data are available from 1996 onwards and are included in the assessment.

Uncertainties in assessment and forecast

Neither the XSA diagnostics nor the retrospective analysis indicates severe problems in the estimation of current stock status. In addition, the available survey indices appear to give a consistent picture of stock development. However, in the forecasts it is difficult to account for the impact that the BACOMA window will have on the selectivity, and this may increase uncertainty. The catchability of 1-year-old recruiting fish in the surveys has increased.

Comparison with previous assessment

The current assessment has revised the value of SSB in 2003 upwards by 12%.

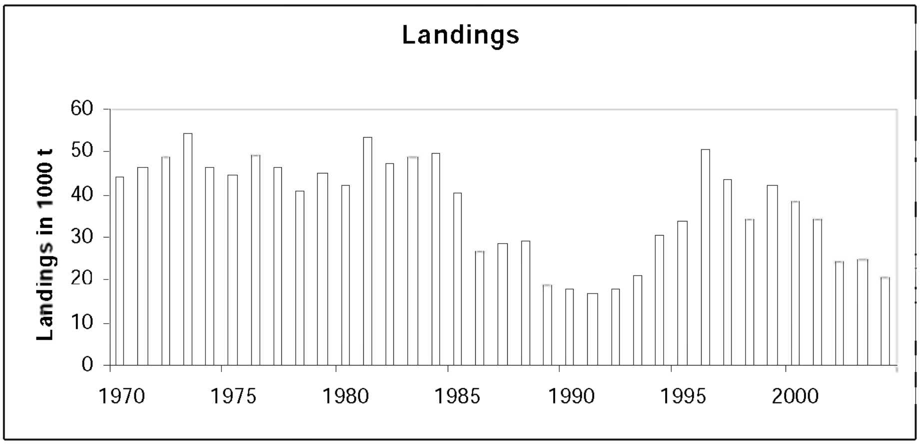
Sources of information

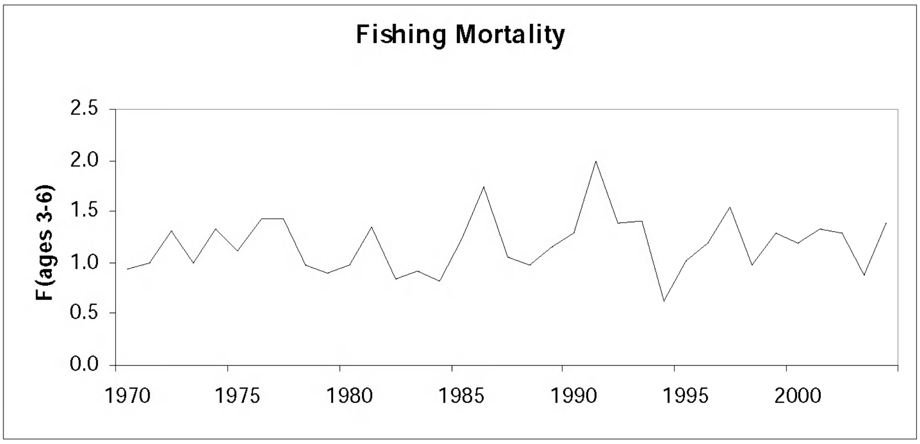
Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005 (ICES CM 2005/ACFM:19) and Technical Minutes of ACFM, May 2005.

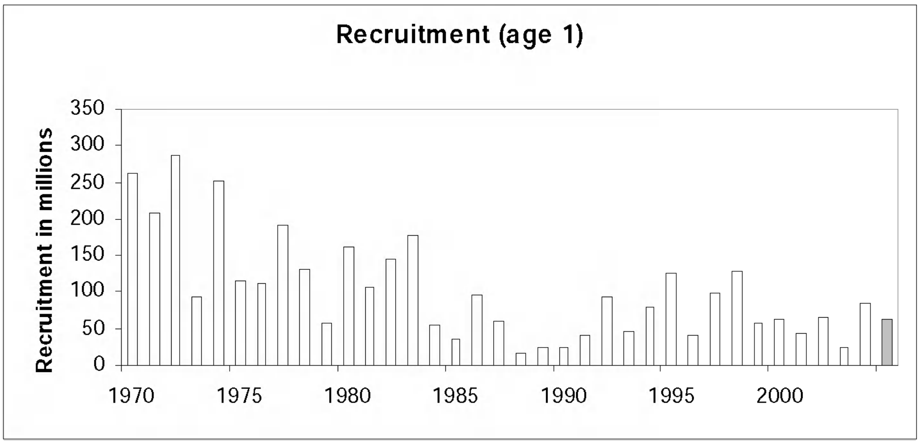
Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1]	ACFM Landings (22–24)	ACFM Landings (22–32)
1987	TAC	9		29	236
1988	TAC	16		29	223
1989	TAC	14	220	19	198
1990	TAC	8	210	18	171
1991	TAC	11	171	17	140
1992	Substantial reduction in F	-	100	18	73[2]
1993	F at lowest possible level	-	40	21	66[2]
1994	TAC	22	60	31	124[2]
1995	30% reduction in fishing effort from 1994 level	-	120	34	142[2]
1996	30% reduction in fishing effort from 1994 level	-	165	51	173
1997	Fishing effort should not be allowed to increase above the level of recent years	-	180	44	132
1998	20% reduction in F from 1996	35	160	34	102
1999	At or below $\mathbf{F}_{sq}$ with 50% probability	38	126	42	115
2000	Reduce F by 20%	44.6	105	38	128
2001	Reduce F by 20%	48.6	105	34	126
2002	Reduce F to below 1.0	36.3	76	24	92
2003	Reduce F to below 1.0	22.6-28.8[3]	75	25	94
2004	Reduce F to below 1.0	< 29.6	29.6	21	
2005	Reduce F to below 0.92	< 23.4	24.7		
2006	Management plan	28.4			

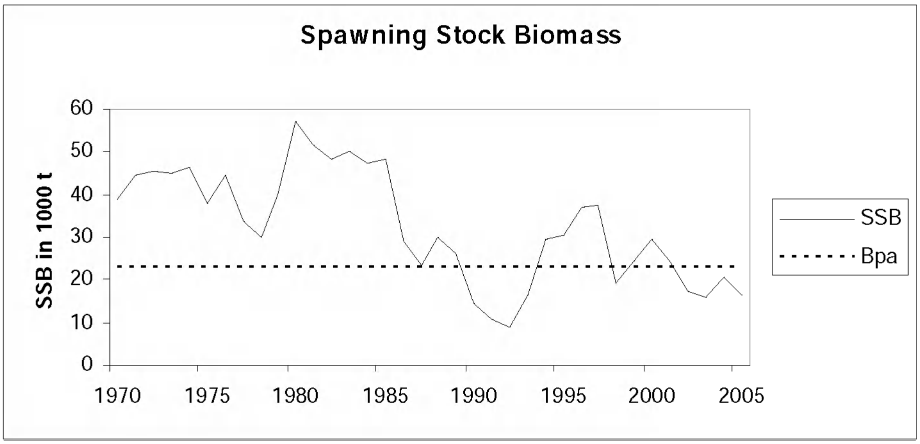
Weights in '000 t.

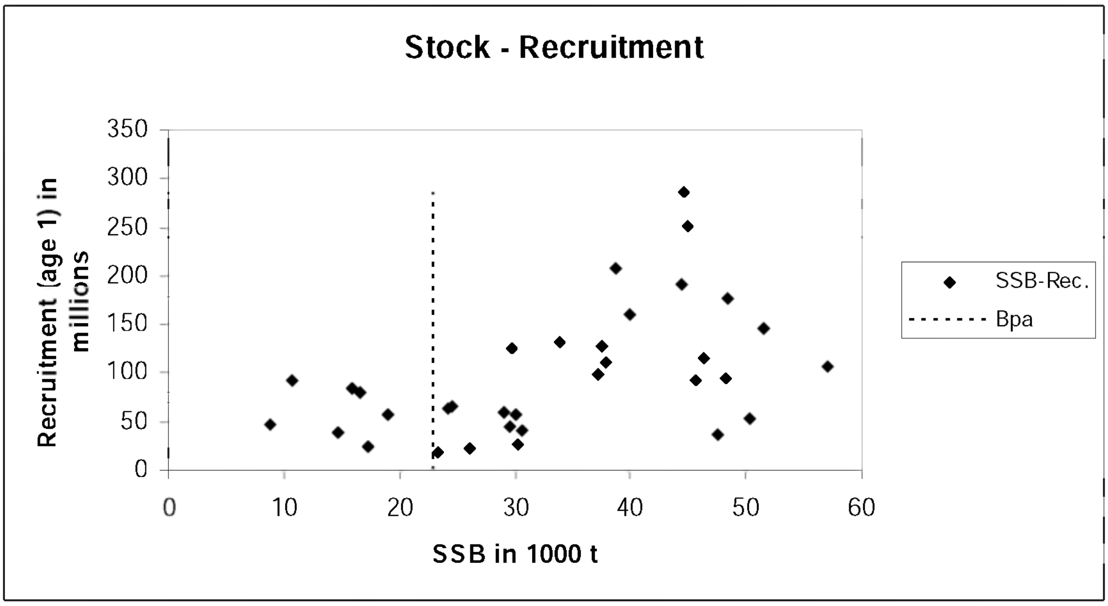
[1] Included in TAC for total Baltic, until and including 2003. [2] The reported landings in 1992–1995 are known to be incorrect due to incomplete reporting. [3] Two options based on implementation of the adopted mesh regulation.

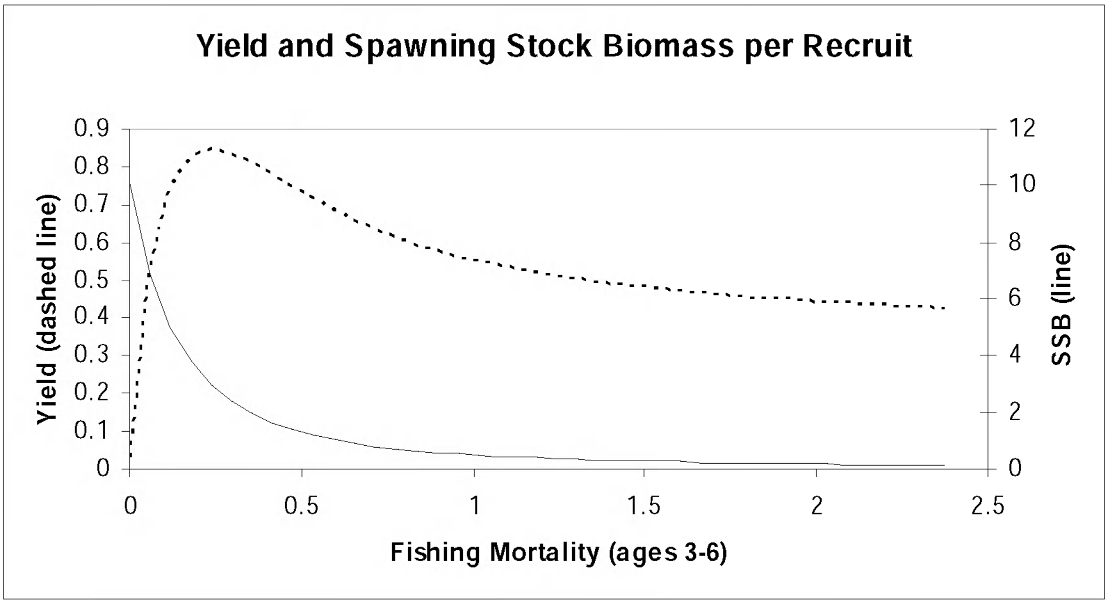

Landings
Landings in 1000 t
60
50
40
30
20
10
0
1970
1975
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 3-6)
2.5
2.0
1.5
1.0
0.5
0.0
1970
1975
1980
1985
1990
1995
2000


Recruitment (age 1)
Recruitment in millions
350
300
250
200
150
100
50
0
1970
1975
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
60
50
40
30
20
10
0
1970
1975
1980
1985
1990
1995
2000
2005
SSB
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
SSB in 1000 t
SSB-Rec.
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12
10
8
6
4
2
0
SSB (line)
0
0.5
1
1.5
2
2.5
Fishing Mortality (ages 3-6)

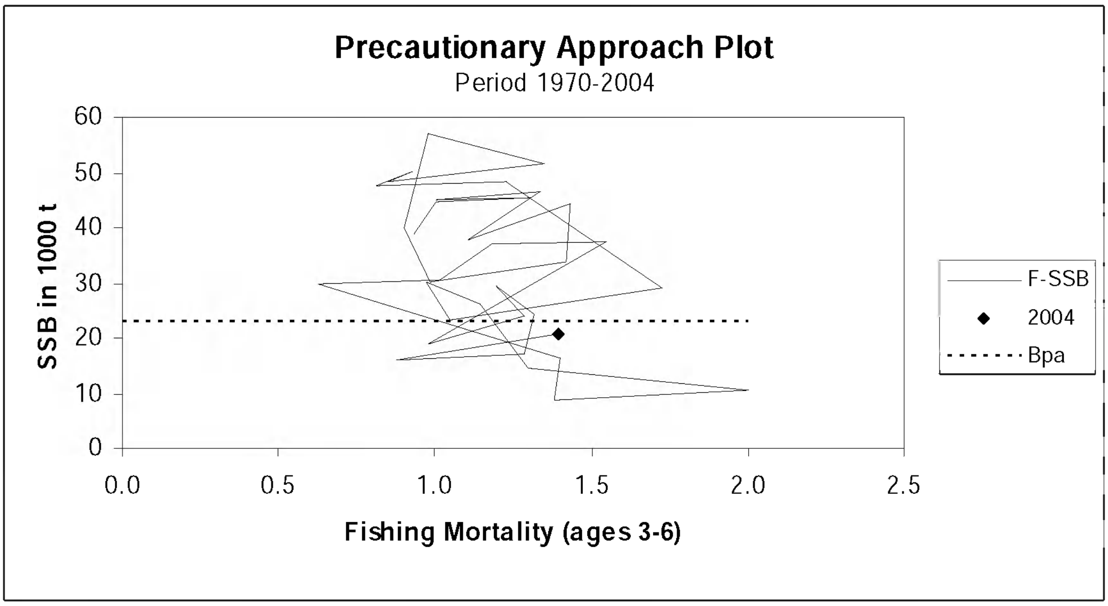

Precautionary Approach Plot
Period 1970-2004
SSB in 1000 t
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
Fishing Mortality (ages 3-6)
F-SSB
2004
Bpa

Table 1.4.1.1 Cod in Subdivisions 22-24. Total Landings (tons) of COD in the ICES Subdivisions 22,23,24

Year	Denmark		Finland	German Dem.Rep.[2]	Germany, FRG	Estonia	Latvia	Poland	Sweden		Total						
	23	22+24	24	22+24	22+24	24	24	24	23	24	22	23	24	Unalloc.	22+24	22+24 + Unalloc.	22-24+ Unalloc.
1965		19,457		9,705	13,350					2,182	27,867		17,007		44,874	44,874	44,874
1966		20,500		8,393	11,448					2,110	27,864		14,587		42,451	42,451	42,451
1967		19,181		10,007	12,884					1,996	28,875		15,193		44,068	44,068	44,068
1968		22,593		12,360	14,815					2,113	32,911		18,970		51,881	51,881	51,881
1969		20,602		7,519	12,717					1,413	29,082		13,169		42,251	42,251	42,251
1970		20,085		7,996	14,589					1,289	31,363		12,596		43,959	43,959	43,959
1971		23,715		8,007	13,482					1,419	32,119		14,504		46,623	46,623	46,623
1972		25,645		9,665	12,313					1,277	32,808		16,092		48,900	48,900	48,900
1973		30,595		8,374	13,733					1,655	38,237		16,120		54,357	54,357	54,357
1974		25,782		8,459	10,393					1,937	31,326		15,245		46,571	46,571	46,571
1975		23,481		6,042	12,912					1,932	31,867		12,500		44,367	44,367	44,367
1976	712	29,446		4,582	12,893					1,800	33,368	712	15,353		48,721	48,721	49,433
1977	1,166	27,939		3,448	11,686				550	1,516	29,510	1,716	15,079		44,589	44,589	46,305
1978	1,177	19,168		7,085	10,852				600	1,730	24,232	1,777	14,603		38,835	38,835	40,612
1979	2,029	23,325		7,594	9,598				700	1,800	26,027	2,729	16,290		42,317	42,317	45,046
1980	2,425	23,400		5,580	6,657				1,300	2,610	22,881	3,725	15,366		38,247	38,247	41,972
1981	1,473	22,654		11,659	11,260				900	5,700	26,340	2,373	24,933		51,273	51,273	53,646
1982	1,638	19,138		10,615	8,060				140	7,933	20,971	1,778	24,775		45,746	45,746	47,524
1983	1,257	21,961		9,097	9,260				120	6,910	24,478	1,377	22,750		47,228	47,228	48,605
1984	1,703	21,909		8,093	11,548				228	6,014	27,058	1,931	20,506		47,564	47,564	49,495
1985	1,076	23,024		5,378	5,523				263	4,895	22,063	1,339	16,757		38,820	38,820	40,159
1986	748	16,195		2,998	2,902				227	3,622	11,975	975	13,742		25,717	25,717	26,692
1987	1,503	13,460		4,896	4,256				137	4,314	12,105	1,640	14,821		26,926	26,926	28,566
1988	1,121	13,185		4,632	4,217				155	5,849	9,680	1,276	18,203		27,883	27,883	29,159
1989	636	8,059		2,144	2,498				192	4,987	5,738	828	11,950		17,688	17,688	18,516
1990	722	8,584		1,629	3,054				120	3,671	5,361	842	11,577		16,938	16,938	17,780
1991	1,431	9,383			2,879				232	2,768	7,184	1,663	7,846		15,030	15,030	16,693
1992	2,449	9,946			3,656				290	1,655	9,887	2,739	5,370		15,257	15,257	17,996
1993	1,001	8,666			4,084				274	1,675	7,296	1,275	7,129	5,528	14,425	19,953	21,228
1994	1,073	13,831			4,023				555	3,711	8,229	1,628	13,336	7,502	21,565	29,067	30,695
1995	2,547	18,762	132		9,196		15		611	2,632	16,936	3,158	13,801		30,737	30,737	33,895
1996	2,999	27,946	50		12,018	50	32		1,032	4,418	21,417	4,031	23,097	2,300	44,514	46,814	50,845
1997	1,886	28,887	11		9,269	6		263	777	2,525	21,966	2,663	18,995		40,961	40,961	43,624
1998	2,467	19,192	13		9,722	8	13	623	607	1,571	15,093	3,074	16,049		31,142	31,142	34,216
1999	2,839	23,074	116		13,224	10	25	660	682	1,525	20,409	3,521	18,225		38,634	38,634	42,155
2000	2,451	19,876	171		11,572	5	84	926	698	2,564	18,934	3,149	16,264		35,198	35,198	38,347
2001	2,124	17,446	191		10,579	40	46	646	693	2,479	14,976	2,817	16,451		31,427	31,427	34,244
2002	2,055	11,657	191		7,322		71	782	354	1,727	11,968	2,409	9,781		21,749	21,749	24,158
2003	1,373	13,275	59		6,775		124	568	551	1,899	9,573	1,925	13,127		22,700	22,700	24,624
2004 [1]	1,927	11,386			4,651		221	538	393	1,727	9,091	2,320	9,430	13	18,521	18,534	20,854

[1]Provisional data. [2]Includes landings from Oct.-Dec. 1990 of Fed.Rep.Germany.

Table 1.4.1.2 Cod in Subdivisions 22 to 24.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1970	262766	38733	43959	0.9361
1971	206955	44628	46623	1.0051
1972	286485	45598	48900	1.3048
1973	92894	44959	54357	1.0010
1974	251576	46426	46571	1.3358
1975	114316	37852	44367	1.1052
1976	110990	44479	49433	1.4296
1977	191230	33905	46305	1.4164
1978	131992	30128	40612	0.9830
1979	57848	39887	45046	0.9014
1980	161437	57101	41972	0.9752
1981	106623	51534	53646	1.3522
1982	146231	48391	47524	0.8493
1983	176774	50332	48605	0.9261
1984	53624	47486	49495	0.8135
1985	36204	48257	40159	1.2250
1986	95635	29059	26692	1.7287
1987	59112	23287	28566	1.0510
1988	17602	30183	29159	0.9724
1989	25862	26124	18516	1.1445
1990	23557	14696	17780	1.2953
1991	39977	10675	16693	2.0002
1992	92821	8869	17996	1.3839
1993	46869	16519	21228	1.3975
1994	80316	29747	30695	0.6274
1995	126155	30589	33895	1.0162
1996	41610	37227	50845	1.1833
1997	97797	37472	43621	1.5466
1998	127727	19037	34208	0.9774
1999	57781	24177	42149	1.2871
2000	63355	29585	38357	1.1968
2001	44657	24543	34199	1.3186
2002	66358	17205	24158	1.2864
2003	25198	15992	24686	0.8741
2004	83559	20657	20854	1.3942
2005	62565*	16440		
Average	102238	32549	37196	1.1783

*Output from RCT3 analysis

1.4.2 Cod in Subdivisions 25–32

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Reduced reproductive capacity	Harvested unsustainably	Overexploited	Not applicable	

The stock is at historical low levels and there is no indication of increase in the spawning stock biomass. Based on estimates of SSB and fishing mortality ICES classifies the stock as suffering reduced reproductive capacity and being harvested unsustainably. Indications by surveys are that the 2003 recruiting year class is expected to be high compared to the last 15 years.

Management objectives

IBSFC adopted a long-term management strategy for cod in the Baltic in 2003 (Resolution XX on the Management Plan for the Cod Stocks in the Baltic Sea (adopted by the Extraordinary Session, June 2003)). This management plan includes rules on setting the TAC, and also establishes a number of technical measures. The plan is given in Section 1.3.1.1 above.

In 2004 ICES concluded that the IBSFC management plan formally is in accordance with the Precautionary Approach. In addition, the envisaged time frame to bring the eastern cod stock above $\mathbf{B}_{pa}$ within 5 years is in accordance with the Precautionary Approach. It was also noted by ICES that this can only be successful if the implementation of the management plan is effective, i.e. the resulting effects can be measured with sufficient accuracy and the assessments are sufficiently unbiased. However, in the light of the significant IUU (Illegal Unreported Unregulated) fisheries in the past years, this is unlikely to be the case.

The EC is in the process of presenting new proposals for a long-term management plan for the two cod stocks in the Baltic.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 160 000 t	$\mathbf{B}_{pa}$ be set at 240 000 t
	$\mathbf{F}_{lim}$ is 0.96	$\mathbf{F}_{pa}$ be set at 0.6
Target reference points		**N/A**

Technical basis:

$\mathbf{B}_{lim}$: SSB below which recruitment is impaired.	$\mathbf{B}_{pa}$: MBAL.
$\mathbf{F}_{lim}$: $\mathbf{F}_{med}$ (estimated in 1998).	$\mathbf{F}_{pa}$: 5 percentile of $\mathbf{F}_{med}$.

The evaluations of harvest control rules for eastern Baltic cod have demonstrated that, under the assumption of the current exploitation pattern, target fishing mortalities (including all catches) close to 0.3 (ages 4–7) result in a low risk to reproduction and high long-term yields.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The agreed management plan states that if the stock is below 160 000 t then a TAC should be fixed to return SSB to above this level by the end of the year of application of the TAC, and to provide at least 30% increase in SSB. As the stock is currently below 160 000 t, this implies total landings of less than 14 900 t in 2006 (including possible misreporting) which is expected to lead to an SSB of 160 000 t in 2007.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

ICES has evaluated candidates for management plans, see Section 1.3.3.1.

Short-term implications

Outlook for 2006

Basis: F(2005) =0.95;SSB(2006) = 86 000 t; Landings (2005) = 66 000 t.

Rationale	TAC (2006)[1]	Basis	Total F (2006)	Landings F (2006)[1]	Disc F (2006)	landings ('000t)[1]	Discards ('000t)	SSB (2007)	%SSB change[2)]	% TAC change
Zero catch	0	F=0	0	0	0	0	0	177	105	-100
Status quo	72.4	F_{sq}	0.95	0.95	0.003	72	3	101	17	+59
Agreed Management Plan	14.9	Man. Plan	.15	.15	.001	14.9	0.5	160	85	-65
Precautionary limits	6.2	F_{pa} * 0.1	.06	.06	0	6.2	0.2	170	97	-85
	14.9	F_{pa} * 0.25	0.15	0.15	0.001	14.9	0.5	160	85	-65
	28.2	F_{pa} * 0.5	0.30	0.30	0.001	28.2	1	142	64	-34
	40.4	F_{pa} * 0.75	0.45	0.45	0.002	40.4	1.4	135	42	-6
	47.0	F_{pa} * 0.90	0.54	0.54	0.002	47.0	1.7	122	27	10
	51.3	F_{pa} (=F_{sq} *0.63)	0.60	0.60	0.002	51.3	1.9	120	17	20
	55.5	F_{pa} *1.1	0.66	0.66	0.003	55.5	2	118	7	30
	61.0	F_{pa} *1.25	0.75	0.75	0.003	61.0	2.3	111	-8	43

Shaded scenarios are not considered consistent with the Precautionary Approach or the management plan.
[1)] Including possible misreporting.
[2)] SSB(2007) relative to SSB(2006).
[3)] Calculated landings (2006) relative to TAC 2005 (=42 800 t).

Management considerations

The 2000 year class has not shown up strong in the fishery although it was originally estimated as being relatively strong. There are indications that the 2003 year class may be strong, but its precise strength is not yet clear.

The state of the stock has not improved, the fishing mortality has remained high and SSB low.

Management plan evaluations

As a response to a request from the EC candidates for a cod management plan for eastern Baltic cod have been evaluated, see Section 1.3.1.1 request on Baltic cod HCR. These evaluations are based on computer simulations and have demonstrated that under the current exploitation pattern target fishing mortalities (all catches) close to 0.3 (ages 4–7) result in a low risk to reproduction and high long-term yields.

The management plan is only in accordance with the Precautionary Approach if effectively implemented and enforced. The situation in recent years with significant amounts of non-reported cod landings indicates that overall, enforcement has not been effective

The management plan assumes that there are estimates of fishing mortality (F) and spawning stock biomass (SSB) available. Such estimates are derived from time-series of commercial catch data and of stock abundance indices obtained from scientific research cruises, and proper estimates of F and SSB can only be provided if these input data are complete and reliable. The situation in recent years with significant amounts of non-reported cod landings renders scientific estimates close to being useless in the context of a management plan which assumes precise estimates of present stock parameters.

When catch data are unreliable only indices based on abundance survey time-series of stock and mortality trends can be provided. The major survey time-series includes a break in 2000 when gears and design were standardized. There has been significant work done on modelling the bridge before and after 2000, but there are uncertainties related to this break in the time-series that are not, and probably cannot be resolved. Therefore, a consistent time-series is only available for 2000 and onwards.

The simulations have taken neither biological interactions nor density-dependent growth/maturity into account and are thus merely indicative of the direction of outcomes from the management strategies prescribed in the joint request. However, the conclusions regarding the general direction required – significant reductions in fishing mortality to achieve simultaneously a low risk of SSB falling below the conservation limit $\mathbf{B}_{lim}$ and a high long-term yield – are not sensitive to density-dependent effects.

It is therefore suggested that an implementation of a long-term management plan is based on an adaptive approach whereby the development of the stock is monitored as the effects of the reduced fishing mortality are developing, and the specific numerical values within the management plan may then be modified on the basis of the outcomes of the fishing mortality reductions.

Ecosystem considerations

Cod is a major predator on herring and sprat, and stock size of cod determines the natural mortality on these populations.

Factors affecting the fisheries and the stock

Regulations and their effects

The primary regulation is annual TACs. There has been extensive misreporting of catches.

A 'Bacoma' codend with a 120-mm mesh was introduced by IBSFC in 2001 in parallel to an increase in diamond mesh size to 130 mm in traditional codends. The expected effect of introducing the Bacoma 120-mm exit window 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 trawl and the minimum landing size. In October 2003 the regulation was changed to a 110-mm Bacoma window which was expected to enhance the compliance by the fishing industry and to be in better accordance with the minimum landing size, changed to 38 cm in the same year. This appears to have been accepted by the fishing industry, although it has not yet been possible to evaluate its effects.

In order to enable undisturbed spawning a closure of a central part of the main spawning area in the Bornholm deep has been implemented and enforced during the main spawning seasons since the mid-1990s for all fisheries. This area was extended in 2004 but ICES evaluated the effects as being limited, as the extension covered an area which under normal circumstances has neither especially favourable hydrographical conditions nor an extremely high egg production. Additionally, since the mid-1990s a seasonal closure was enforced for cod-directed fisheries in the entire Baltic. This closure covered the main spawning season of the eastern Baltic cod stock.

The following closures were adopted for 2005:

- Seasonal closure from May 1 to September 15 for all cod-directed fishery
- Year-round area closures for all fisheries in the Bornholm deep, the Gotland basin, and the Gdansk deep to reduce fishing mortality

Changes in fishing technology and fishing patterns

Cod in the Eastern Baltic are taken primarily by trawlers and gillnetters. Historically, the proportion taken by gillnetters has expanded during periods of high abundance in response to the higher proportion of large fish in the stock. There is an increase of cod taken by longline in the Swedish fishery in the past 2 years.

The environment

Spawning is confined to the deep basins where there is water of sufficiently high oxygen content and salinity for eggs to survive, and the amount of water with these characteristics is dependent on inflows of high salinity water from the North Sea. The high recruitment from the mid-1970s reflected a relatively high frequency of major inflows of high salinity water from the North Sea, leading to high oxygen concentrations in the cod spawning areas and hence to high egg survival and good recruitment. Since the mid-1980s there were no major inflows from the North Sea, leading to poor conditions for egg survival, and much reduced recruitment. The reduced salinity also led to reduced abundance of the main larval food, *Pseudocalanus elongatus*. An inflow in 1993 led to some improvement in egg survival, but this did not result in improved recruitment as larval survival was limited by food supply at this time. A major inflow in early 2003 led to a substantial increase in the volume of water suitable for cod egg survival.

A minor inflow of high salinity water was noted at the start of 2005, but it is not anticipated that this will have a significant impact on the hydrographic conditions in the spawning basins during the cod spawning season. Overall conditions for egg survival are expected to be rather poor and reproductive success will again depend largely on spawning in the Bornholm Deep and to a lesser extent the Slupsk Furrow.

Scientific basis

Data and methods

The assessment is based on long-term catch data and a survey index. Three indices of commercial catch per unit effort were used in the 2005 assessment. The survey design was changed completely in 2001, and despite extensive sea trials and statistical analyses to estimate correction factors, there still appear to be indications of an increase in catchability corresponding to the change in survey design. However, the introduction of commercial CPUE data has made the assessment much less dependent upon the survey indices. The change in the survey design and the resulting change in catchability in the time-series mean that any stock assessment relies largely on information from the fishing industry.

There is information on substantial mis-reporting in 1993–1996, and this has also been the case since 2000. It is not possible to provide reliable stock estimates based on fishery-independent information alone. The alternatives available are therefore i) stock assessments based on catch information, including information on mis- and non-reporting or ii) very poor or very heavily biased assessments. In this situation ICES has chosen to include mis- and non-reportings in the assessment.

Estimates are available for misreporting from a range of industry and enforcement sources. These indicate that recent catches have been around 35–45% higher than the reported figures. These estimates have been incorporated in the assessment. By nature this information is highly uncertain, and also incomplete, with no information available for some of the nations where misreporting is suspected to occur. This means that the corrected landings values derived by the WG can at best be considered to be approximate minimum values.

Discard data are available since 1996 and are applied in the assessment as yearly proportions per age-group discarded. Before 1996, an average proportion discarded per age-group estimated for 1996–2003 is applied. The season and area coverage of discard sampling requires improvement. A relationship between year-class strength and discard rates cannot be estimated from the available data. Due to recent changes in technical regulations, e.g. increase of minimum landing size, introduction of BACOMA 110 and varying closures, discard rates may have additionally varied.
There are large inconsistencies in age determination for this stock as a result of the lack of clear growth rings in the otoliths. This results in poor quality catch-at-age and survey data. An ICES study group has recently been established to develop new approaches to age determination for this stock.

Information from the fishing industry

Some of the information on misreporting came from industry sources.

The 110-mm 'BACOMA' codend has been much more widely accepted than its 120-mm predecessor.

Uncertainties in assessment and forecast

See data and methods, above.

An additional year with a large proportion of the catch being non-reported means that all year classes that now occur in this stock are subject to large uncertainties.

There are some indications that the 2003 year class may be larger than any other year class in the past 10 years, but problems with the catch and survey data make it difficult to determine how strong this year class is. This year class should make a major contribution to the catch and spawning stock during the forecast period, so estimates of these quantities are highly sensitive to the estimated strength of this year class.

Environment conditions

The procedures for conducting the survey take into account the distribution of cod in relation to the oxygen content of the water.

Comparison with previous assessment and advice

The current assessment is consistent with the previous assessment in concluding that the stock is well below $\mathbf{B_{lim}}$. Most of the problems associated with the current assessment were also noted in the previous assessment. The inclusion of commercial CPUE data has added some stability to the assessment, making it possible to provide short-term forecasts.

Source of information

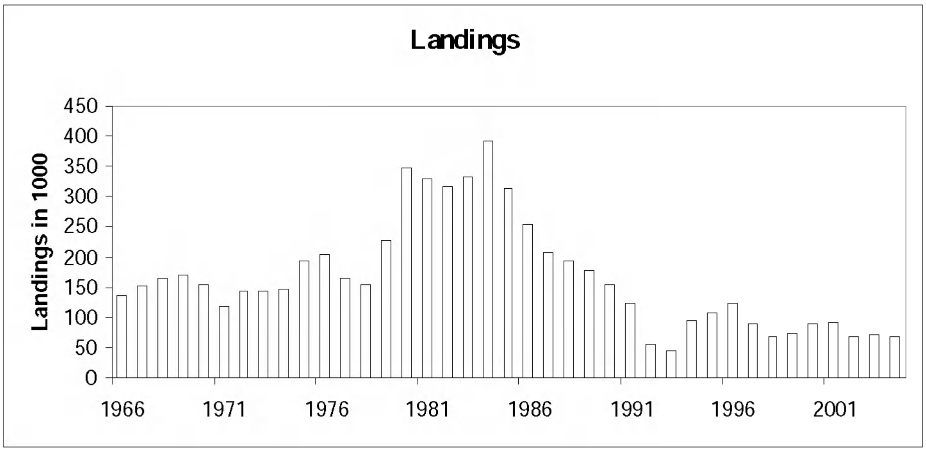
Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

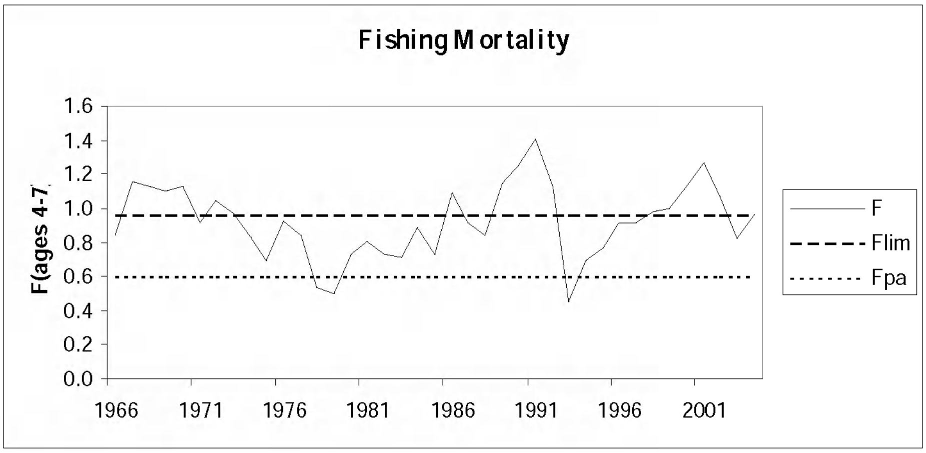
Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1]	ACFM landings (25–32)	ACFM landings (22–32)
1987	Reduce towards $\mathbf{F}_{max}$	245		207	236
1988	TAC	150		194	223
1989	TAC	179	220	179	198
1990	TAC	129	210	153	171
1991	TAC	122	171	123	140
1992	Lowest possible level	-	100	55[2]	73[2]
1993	No fishing	0	40	45[2]	66[2]
1994	TAC	25	60	93[2]	124[2]
1995	30% reduction in fishing effort from 1994	-	120	108[2]	142[2]
1996	30% reduction in fishing effort from 1994	-	165	122	173
1997	20% reduction in fishing mortality from 1995	130	180	89	132
1998	40% reduction in fishing mortality from 1996	60	140	67	102
1999	Proposed $\mathbf{F}_{pa}$ (= 0.6)	88	126	73	115
2000	40% reduction in F from 96–98 level	60	105	89	128
2001	Fishing mortality of 0.30	39	105	91	126
2002	No fishing	0	76	68	92
2003	70% reduction in F	See option table	75	69	94
2004	90% reduction in F	<13.0	45.4	68	89
2005	No fishing	0	42.8		
2006	Management plan	14.9			

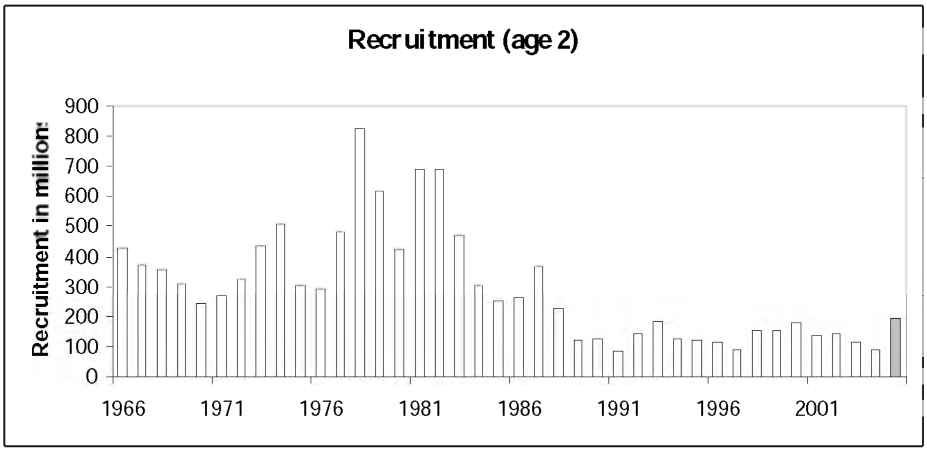
Weights in '000 t.

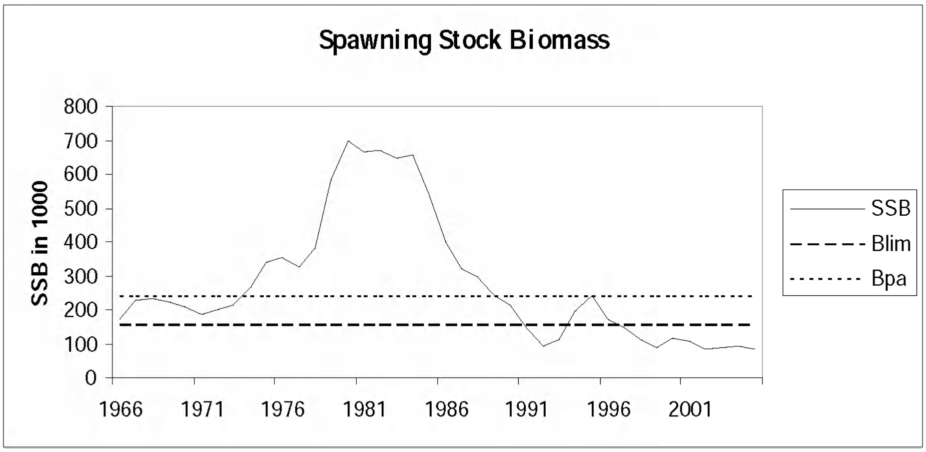
[1] For total Baltic until and including 2003.

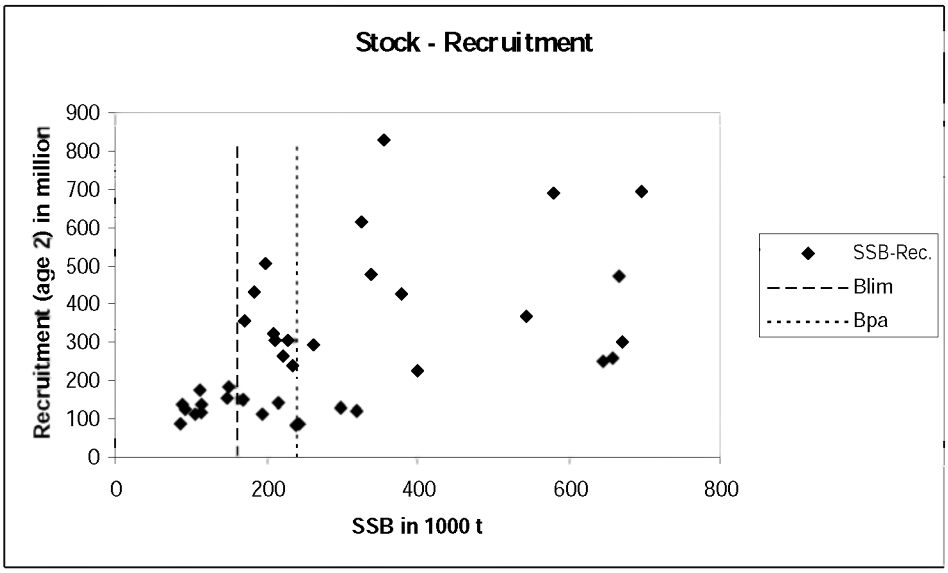
[2] The reported landings in 1992–1995 are known to be incorrect due to incomplete reporting.

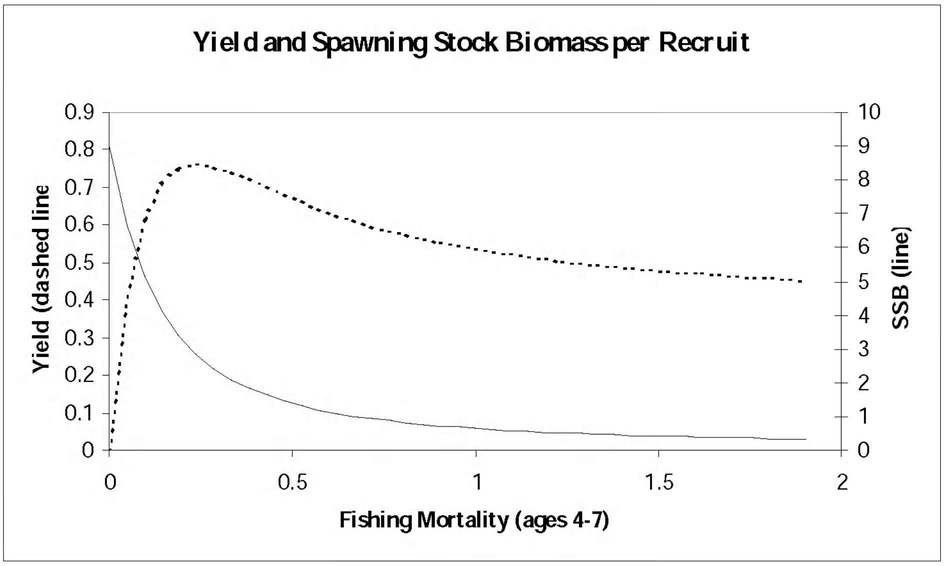

Landings
Landings in 1000
450
400
350
300
250
200
150
100
50
0
1966
1971
1976
1981
1986
1991
1996
2001


Fishing Mortality
F(ages 4-7)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1966
1971
1976
1981
1986
1991
1996
2001
F
Flim
Fpa


Recruitment (age 2)
Recruitment in millions
900
800
700
600
500
400
300
200
100
0
1966
1971
1976
1981
1986
1991
1996
2001


Spawning Stock Biomass
SSB in 1000
800
700
600
500
400
300
200
100
0
1966
1971
1976
1981
1986
1991
1996
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 2) in million
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
100
200
300
400
500
600
700
800
900
0
200
400
600
800


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line
SSB (line)
Fishing Mortality (ages 4-7)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2

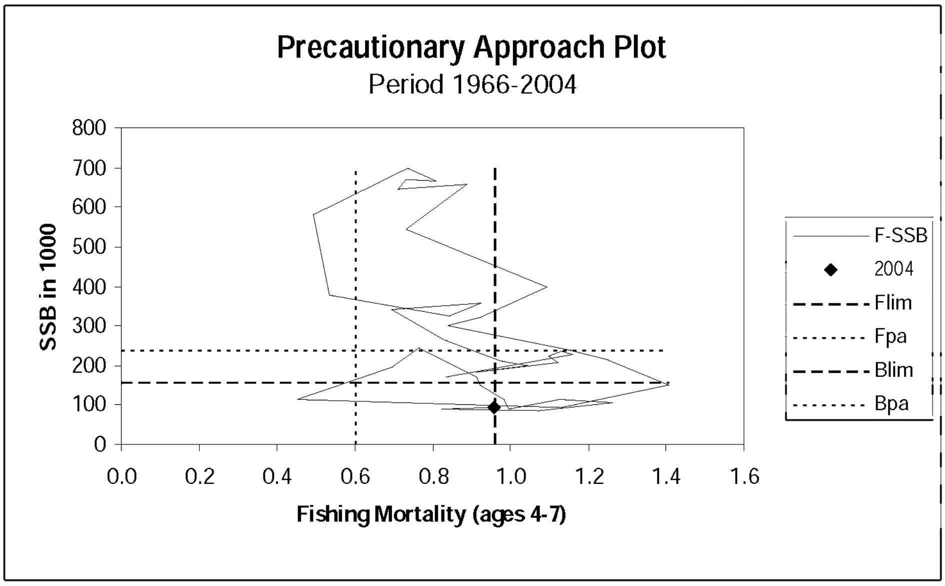

Precautionary Approach Plot
Period 1966-2004
SSB in 1000
Fishing Mortality (ages 4-7)
F-SSB
2004
Flim
Fpa
Blim
Bpa
0
100
200
300
400
500
600
700
800
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6

Table 1.4.2.1 Total landings (tonnes) of COD in the ICES Subdivisions 25-32 by country.

Year	Denmark	Estonia	Finland	German Dem.Rep. [2]	Germany, Fed. Rep.	Latvia	Lithuania	Poland	Russia	Sweden	USSR	Faroe Islands[4]	Norway	Unallo-cated[3]	Total
1965	15,856		23	975	2,183			41,498		19,523	22,420				102,478
1966	16,570		26	2,196	1,383			56,007		20,415	38,270				134,867
1967	19,924		27	11,020	1,057			56,003		21,367	42,980				152,378
1968	21,516		70	12,118	2,018			63,245		21,895	43,610				164,472
1969	23,459		58	18,460	4,715			60,749		20,888	41,580				169,909
1970	22,307		70	10,103	4,855			68,440		16,467	32,250				154,492
1971	23,116		53	2,970	2,766			54,151		14,251	20,910				118,217
1972	34,072		76	4,055	3,203			57,093		15,194	30,140				143,833
1973	35,455		95	6,034	14,973			49,790		16,734	20,083				143,164
1974	32,028		160	2,517	11,831			48,650		14,498	38,131				147,815
1975	39,043		298	8,700	11,968			69,318		16,033	49,289				194,649
1976	47,412		287	3,970	13,733			70,466		18,388	49,047				203,303
1977	44,400		310	7,519	19,120			47,702		16,061	29,680				164,792
1978	30,266		1,437	2,260	4,270			64,113		14,463	37,200				154,009
1979	34,350		2,938	1,403	9,777			79,754		20,593	75,034	3,850			227,699
1980	49,704		5,962	1,826	11,750			123,486		29,291	124,350	1,250			347,619
1981	68,521		5,681	1,277	7,021			120,001		37,730	87,746	2,765			330,742
1982	71,151		8,126	753	13,800			92,541		38,475	86,906	4,300			316,052
1983	84,406		8,927	1,424	15,894			76,474		46,710	92,248	6,065			332,148
1984	90,089		9,358	1,793	30,483			93,429		59,685	100,761	6,354			391,952
1985	83,527		7,224	1,215	26,275			63,260		49,565	78,127	5,890			315,083
1986	81,521		5,633	181	19,520			43,236		45,723	52,148	4,596			252,558
1987	68,881		3,007	218	14,560			32,667		42,978	39,203	5,567			207,081
1988	60,436		2,904	2	14,078			33,351		48,964	28,137	6,915			194,787
1989	57,240		2,254	3	12,844			36,855		50,740	14,722	4,520			179,178
1990	47,394		1,731		4,691			32,028		50,683	13,461	3,558			153,546
1991	39,792	1,810	1,711		6,564	2,627	1,865	25,748	3,299	36,490		2,611			122,517
1992	18,025	1,368	485		2,793	1,250	1,266	13,314	1,793	13,995		593			54,882
1993	8,000	70	225		1,042	1,333	605	8,909	892	10,099		558		13,450	45,183
1994	9,901	952	594		3,056	2,831	1,887	14,335	1,257	21,264		779		36,498	93,354
1995	16,895	1,049	1,729		5,496	6,638	4,513	25,000	1,612	24,723		777	293	18,993	107,718
1996	17,549	1,338	3,089		7,340	8,709	5,524	34,855	3,306	30,669		706	289	8,515	121,889
1997	9,776	1,414	1,536		5,215	6,187	4,601	31,396	2,803	25,072		600			88,600
1998	7,818	1,188	1,026		1,270	7,765	4,176	25,155	4,599	14,431					67,428
1999	12,170	1,052	1,456		2,215	6,889	4,371	25,920	5,202	13,720					72,995
2000	9,715	604	1,648		1,508	6,196	5,165	21,194	4,231	15,910				23,118	89,289
2001	9,580	765	1,526		2,159	6,252	3,137	21,346	5,032	17,854				23,677	91,328
2002	7,831	37	1,526		1,445	4,796	3,137	15,106	3,793	12,507				17562	67,740
2003[1]	7,693	591	1,108		1,363	4,510	2,767	15,374	3,707	12,135				19,686	68,934
2004	6,623	1,193	861		2,659	4,806	2,041	14,582	3,410	12,043				19,550	67,768

[1]Provisional data. [2]Includes landings from Oct.-Dec. 1990 of Fed.Rep.Germany. [3]Working group estimates. No information available for years prior to 1993. [4] For 1997 landings not officially reported, estimated by the WG.

Table 1.4.2.2 Cod in Subdivisions 25 to 32.

Year	Recruitment Age 2 thousands	SSB tonnes	Landings (incl. Misrep.) tonnes	Mean F Ages 4-7
1966	430020	171994	134867	0.837
1967	370654	228646	152378	1.1587
1968	353832	233928	164472	1.1303
1969	306471	222631	169909	1.0962
1970	239840	208818	154492	1.1241
1971	264630	184163	118217	0.9132
1972	322053	198974	143833	1.0433
1973	431919	211970	143164	0.9731
1974	506674	262925	147815	0.831
1975	303519	339510	194649	0.6955
1976	293317	355540	203303	0.926
1977	478908	326898	164792	0.8439
1978	829060	379176	154009	0.5357
1979	614995	579627	227699	0.4952
1980	425726	696697	347619	0.7342
1981	689596	666100	330742	0.8091
1982	693291	670901	316052	0.7301
1983	472096	645211	332148	0.7124
1984	302749	657621	391952	0.8895
1985	252862	544873	315083	0.7333
1986	260080	399341	252558	1.0936
1987	367738	320421	207081	0.9196
1988	224075	299193	194787	0.8401
1989	122056	240157	179178	1.1485
1990	128152	215711	153546	1.2457
1991	83238	151092	122517	1.4076
1992	140890	92641	54882	1.13
1993	182984	113930	45183	0.4519
1994	127058	194596	93354	0.6967
1995	119215	243718	107718	0.7636
1996	115107	169895	121889	0.9143
1997	87868	148574	88600	0.9201
1998	149556	112125	67429	0.9816
1999	153325	89696	72989	0.9964
2000	177707	115279	89168	1.1252
2001	138626	105055	91325	1.2645
2002	139730	85775	67740	1.0734
2003	113055	87427	71386	0.8207
2004	89517	93584	67768	0.9584
2005	195425*	84389		
Average	294928	278720	165546	0.9222

*GM for the period 1989–2003 with multiplier 1.5.

1.4.3 Herring in Subdivisions 22–24 and Division IIIa (spring spawners)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Reference points not defined	Reference points not defined	unknown	unknown	

In the absence of defined reference points, the state of the stock cannot be evaluated with regard to these. An analytical assessment demonstrates that SSB has been slightly increasing over a number of years. The fishing mortality estimates for 2004 are 0.36 for adults and 0.11 for the juveniles (0- and 1-ringers). The age structure in the catch over the last three years consistently reflects that the large 1999 year class is now part of the spawning stock. The 2003 year class seems to be above average.

Management objectives

There are no explicit management objectives for this stock.

Reference points

There are no reference points for this stock.

Yield and spawning biomass per Recruit
F-reference points

	Fish Mort Ages 3-6	Yield/R	SSB/R
Average last 3 years	0.413	0.025	0.051
$\mathbf{F}_{0.1}$	0.212	0.023	0.099
$\mathbf{F}_{med}$	0.529	0.025	0.037

If target reference points are to be established, $\mathbf{F}_{0.1}$ would be associated with high long-term yields and low risk of reduced reproductive capacity.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

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 95 000 t in 2006.

Short-term implications

Outlook for 2006

Basis: F(2005) = $\mathbf{F}_{sq}$ = 0.358; SSB(2005) =194; catch (2005) =92.
Landings are for Division IIIa (spring-spawning herring and western Baltic (Subdivisions 22–24) combined), see further in Section 1.4.18.

Rationale	Catches (2006)	Basis	F(2006)	SSB(2007)
Zero catch	0	**F**=0	0	325
Proportion F	78	$\mathbf{F}_{sq}$ *0.8	0.286	249
Proportion F	87	$\mathbf{F}_{sq}$ *0.9	0.322	240
Status quo	95	$\mathbf{F}_{sq}$	0.358	233
Proportion F	104	$\mathbf{F}_{sq}$ *1.1	0.393	225
Proportion F	111	$\mathbf{F}_{sq}$ *1.2	0.429	218
Proportion F	119	$\mathbf{F}_{sq}$ *1.3	0.465	211
$\mathbf{F}_{0.1}$	60	$\mathbf{F}_{0.1}$	0.212	266

Weights in '000 t.

Management considerations

North Sea Autumn-Spawning and the Western Baltic Spring-Spawning herring stocks are exploited and managed simultaneously in Division IIIa. Hence, the management of the herring fisheries in Division IIIa influences both stocks. The advisory emphasis on one or the other stock will vary between periods and depends on their relative status.

In the second half of the 1990s and the beginning of the 2000s the North Sea Autumn-Spawning stock was depleted and advice on management of herring fisheries in Division IIIa focused on rebuilding the North Sea herring. The herring fishery in Division IIIa was then managed in a manner consistent with the management of the North Sea Autumn-Spawning herring. With the rebuilding of the North Sea stock, concerns for the North Sea Autumn-Spawning herring are less and advice on management of the herring fisheries in Division IIIa is now more focused on the Western Baltic stock.

Catch options for the whole stock of Western Baltic Spring-Spawning herring can be partitioned into catches by area. Likewise, the catches of WBSS in Division IIIa also imply catches of North Sea Autumn-Spawning herring which constitute part of the total catch in that area. The basis for the split of the Western Baltic Spring-Spawning herring catch by area and of the catch in Division IIIa by stock was the ratios between the catches in 2004. The current relevant fleet definitions are:

Division IIIa
Fleet C: Directed herring fisheries with purse seiners and trawlers
Fleet D: Bycatches of herring caught in the small-mesh fisheries

Subdivision 22-24
The WBSS are exploited by other fleets as well, in Subdivisions 22–24.

The text table below shows the 2004 share of the total catch in tonnes of Western Baltic Spring-Spawning herring by fleet:

WBSS	Fleet C (IIIa)	Fleet D (IIIa)	SD 22-24 + Fleet A (IV)	Total
2004	16 825 (22%)	11 175 (15%)	48 815 (64%)	76 815

The text table below shows the proportion of Western Baltic Spring-Spawning herring in the catches by fleet in Division IIIa, as well as for the fleets in SD 2224.

WBSS	Fleet C	Fleet D	SD22-24 + *Fleet A (IV)**
2004	0.56	0.51	1

* Only WBSS caught in Subarea IV are accounted for in the calculations

The text table below shows the expected catches for each stock and in each area corresponding to a range of total catch options for the Western Baltic Spring-Spawning herring stock:

Management considerations for Division IIIa based on short-term predictions (2006)						
Western Baltic Spring-Spawners			North Sea Autumn-Spawners		Both Stocks together	
All fleets total catches	Fleet C (22% of TAC)	Fleet D (15% of TAC)	Fleet C (WBSS/56%)	Fleet D (WBSS/51%)	Fleet C	Fleet D
60,000	13,100	8,700	10,500	8,400	23,600	17,100
65,000	14,200	9,500	11,400	9,100	25,600	18,600
70,000	15,300	10,200	12,200	9,800	27,500	20,000
75,000	16,400	10,900	13,100	10,500	29,500	21,400
80,000	17,500	11,600	14,000	11,200	31,500	22,800
85,000	18,600	12,400	14,900	11,900	33,500	24,300
90,000	19,700	13,100	15,700	12,600	35,400	25,700
95,000	20,800	13,800	16,600	13,300	37,400	27,100
100,000	21,900	14,500	17,500	14,000	39,400	28,500

A TAC of up to 37 400 t for the C-fleet is in accordance with the largest advised total catch of 95 000 t Western Baltic Spring-Spawning herring, under assumptions of retained catch share among areas and retained proportions among stocks. The corresponding number for the D fleet is 27 100 t.

Low recruitment of the three most recent NSAS year classes together with an increase in the WBSS stock is expected to lead to changes in stock composition as well as area distribution and thereby affect near future catch options. Especially consequences for the D-fleet catch options should be closely followed.

Factors affecting the fisheries and the stock

Regulations and their effects

ICES considered the effects on the WBSS of the present EU-Norway agreement in 2005 on quota transfer in Division IIIa. The agreement sets 12 800 tonnes for Norway of which 50% can be taken in the North Sea. A bycatch TAC for Division IIIa herring in the small-meshed fishery (fleet-D) is set at 24 150 tonnes, none of which is taken by Norway and thus no transfer in this fleet category is possible.

The effect of a transfer of 50% of Norwegian catches amount to 6400 t and will at the most equal a reduction in outtake of 3600 t in the exploitation of WBSS, since part of the catches will anyway be taken in the transfer area where WBSS are taken. The changes in F and SSB for WBSS will thus be marginal.

Changes in fishing technology and fishing patterns

Since 2001 the fishery behavior has changed in the German fleet. In former years the dominant part of herring was caught in the passive gears, bottom-set gillnets and trapnets. The proportion of herring, which was caught by trawlers in the area off the Rügen Island coast up to the Arcona Sea (Subdivision 24), increased from 26% in 2001 to 52% in 2004. This change was caused by new requirements from a new fish factory on the Rügen Island.

The environment

Herring in Division IIIa and Subdivisions 22–24 make age- and stage-specific migrations. There are feeding migrations from the Western Baltic into more saline waters of Division IIIa and the eastern parts of Division IVa.

Scientific basis

Data and methods

The otolith microstructure method to calculate the proportion of spring and autumn spawners caught in these areas has been used for all catch and IBTS data for the period 1991–2004. Analytical assessment is based on catch data and acoustic and trawl survey results.

In order to continue to improve the assessment, an acoustic survey covering the whole stock is needed. Development of stock identification methods using combinations of genetics and otolith analyses continues. Results from such methods allow exploration of the importance of stock migrations and local stock components in the area.

Uncertainties in assessment and forecast

There is a tendency to overestimate the fishing mortality in the five-year retrospective analysis.

The historical bias in the assessment is small, except in the recruitment. Apparently, the strength of a year class is not firmly estimated before the year class has been followed for 2–3 years.

Comparison with previous assessment and advice

The current procedure for assessing the stock has given consistent results with respect to fishing mortality and spawning biomass for several years. Compared to last year's assessment, the change in the estimate is +1% for the fishing mortality in 2003 and -2% for the SSB in 2003.

The assessment carried out in 2004 is in line with the 2003 assessment.

Information from the fishing industry

The fishing industry suggests that substantial area misreporting occurs from the North Sea to Kattegat.

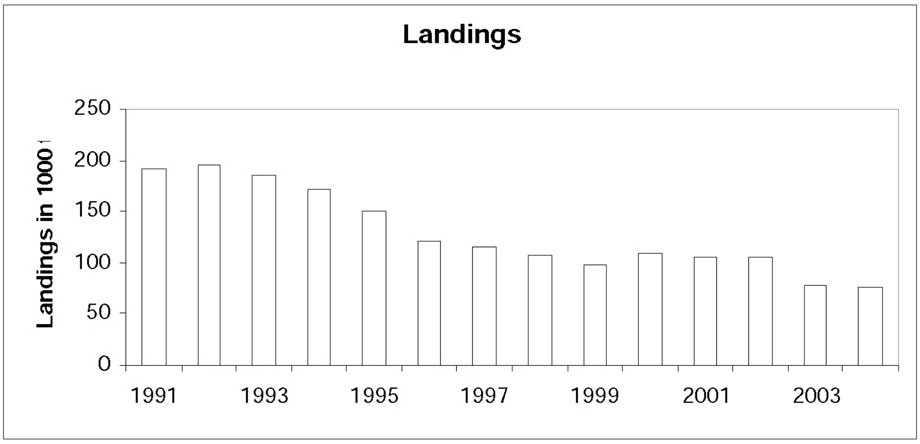
Source of information

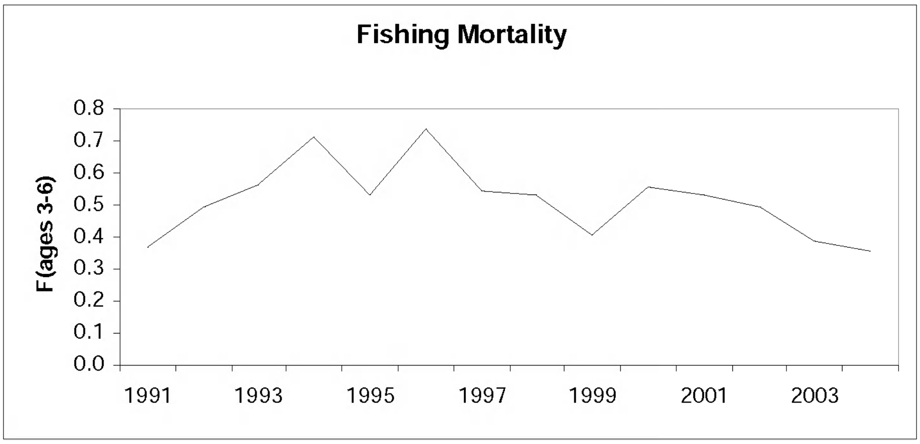
Report of the Baltic Fisheries Assessment Working Group Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

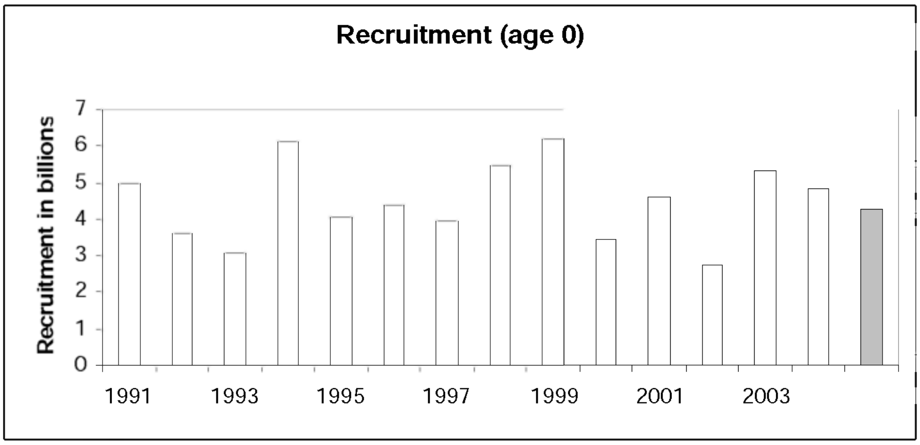
Report of the Herring Assessment Working Group for the Area South of 62°N, 8–17 March 2005 (ICES CM 2005/ACFM:16).

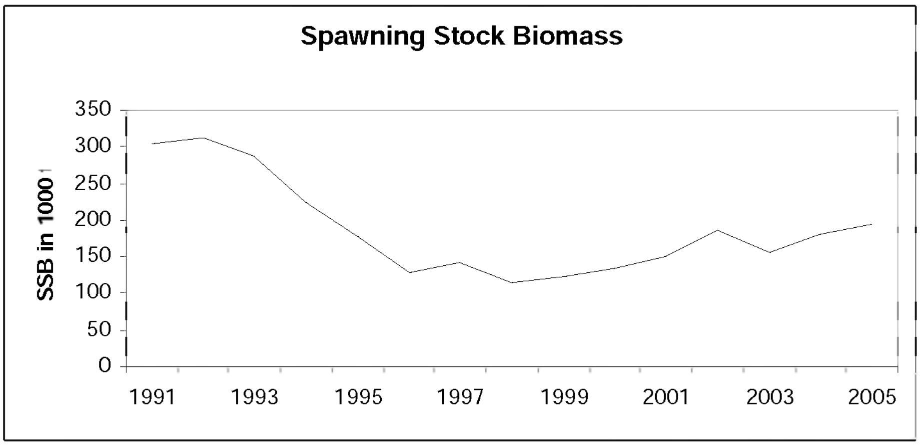
Year	ICES Advice	Pred. Catch Corresp. to advice	Agreed TAC IIIa[2]	ACFM catch of Stock			
				22–24	IIIa	IV	Total
1987	Reduction in F	224	218	102	59	14	175
1988	No increase in F	196	218	99	129	23	251
1989	TAC	174	218	95	71	20	186
1990	TAC	131	185	78	118	8	204
1991	TAC	180	155	70	112	10	192
1992	TAC	180	174	85	101	9	195
1993	Increased yield from reduction in F; reduction in juvenile catches	188	210	81	95	10	186
1994	TAC	130–180	191	66	92	14	172
1995	If required, TAC not exceeding recent catches	168–192	183	74	80	10	164
1996	If required, TAC not exceeding recent catches	164–171	163	58	71	1	130
1997	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	66–85[1]	100	68	55	1	124
1998	Should be managed in accordance with North Sea autumn spawners	-	97	51	53	8	112
1999	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-	99	50	43	5	98
2000	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~60 for Sub-divs. 22–24	101	54	57	7	118
2001	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Sub-divs. 22–24	101	64	42	6	112
2002	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Sub-divs. 22–24	101	53	47	7	107
2003	Reduce F	<80	101	40	36	2	78
2004	Separate management regime for this stock Reduce F	<92	91	42	24	7	77
2005	Separate management regime for this stock *Status quo* F	95	120				
2006	Separate management regime for this stock *Status quo* F	95					

Weights in '000 t.
[1]Catch in Subdivisions 22–24. [2]Including mixed clupeoid TAC and bycatch ceiling in small-mesh fishery.

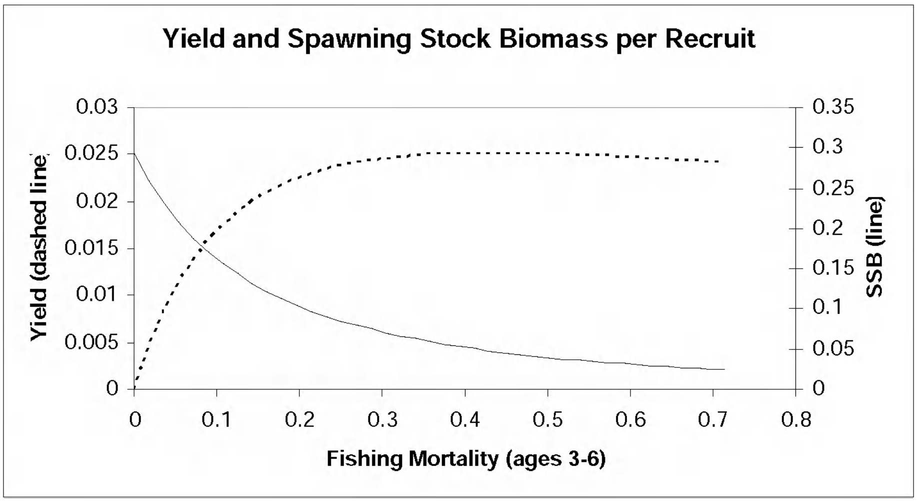

Landings
Landings in 1000 t
250
200
150
100
50
0
1991
1993
1995
1997
1999
2001
2003


Fishing Mortality
F(ages 3-6)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1991
1993
1995
1997
1999
2001
2003


Recruitment (age 0)
Recruitment in billions
7
6
5
4
3
2
1
0
1991
1993
1995
1997
1999
2001
2003


Spawning Stock Biomass
SSB in 1000 t
350
300
250
200
150
100
50
0
1991
1993
1995
1997
1999
2001
2003
2005


Stock - Recruitment
Recruitment (age 0) in billion
7
6
5
4
3
2
1
0
0
50
100
150
200
250
300
350
SSB in 1000 t


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.03
0.025
0.02
0.015
0.01
0.005
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 3-6)

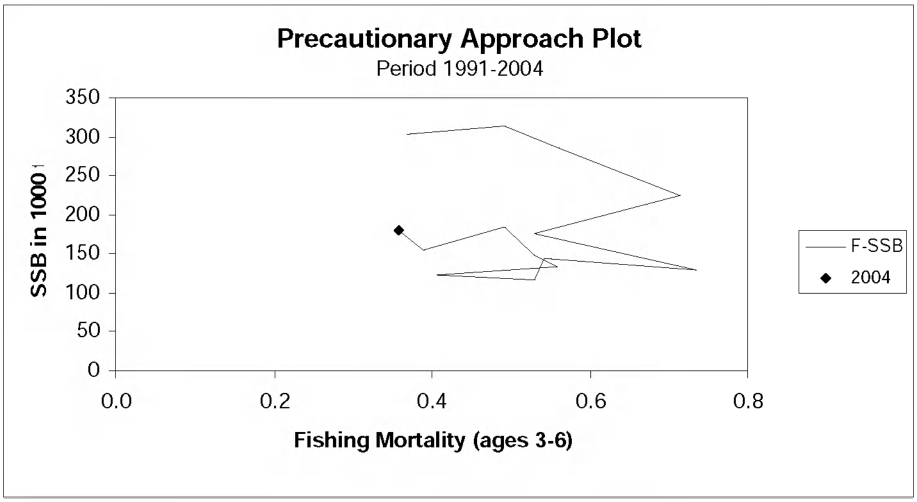

Precautionary Approach Plot
Period 1991-2004
SSB in 1000 t
350
300
250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
Fishing Mortality (ages 3-6)
F-SSB
2004

Table 1.4.3.1 HERRING in Division IIIa and Subdivisions 22-24, 1985-2004.
Landings in thousands of tonnes.

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Skagerrak										
Denmark	88.2	94.0	105.0	144.4	47.4	62.3	58.7	64.7	87.8	44.9
Faroe Islands	0.5	0.5								
Norway	4.5	1.6	1.2	5.7	1.6	5.6	8.1	13.9	24.2	17.7
Sweden	40.3	43.0	51.2	57.2	47.9	56.5	54.7	88.0	56.4	66.4
Total	133.5	139.1	157.4	207.3	96.9	124.4	121.5	166.6	168.4	129.0
Kattegat										
Denmark	69.2	37.4	46.6	76.2	57.1	32.2	29.7	33.5	28.7	23.6
Sweden	39.8	35.9	29.8	49.7	37.9	45.2	36.7	26.4	16.7	15.4
Total	109.0	73.3	76.4	125.9	95.0	77.4	66.4	59.9	45.4	39.0
Sub. Div. 22+24										
Denmark	15.9	14.0	32.5	33.1	21.7	13.6	25.2	26.9	38.0	39.5
Germany	54.6	60.0	53.1	54.7	56.4	45.5	15.8	15.6	11.1	11.4
Poland	16.7	12.3	8.0	6.6	8.5	9.7	5.6	15.5	11.8	6.3
Sweden	11.4	5.9	7.8	4.6	6.3	8.1	19.3	22.3	16.2	7.4
Total	98.6	92.2	101.4	99.0	92.9	76.9	65.9	80.3	77.1	64.6
Sub. Div. 23										
Denmark	6.8	1.5	0.8	0.1	1.5	1.1	1.7	2.9	3.3	1.5
Sweden	1.1	1.4	0.2	0.1	0.1	0.1	2.3	1.7	0.7	0.3
Total	7.9	2.9	1.0	0.2	1.6	1.2	4.0	4.6	4.0	1.8
Grand Total	349.0	307.5	336.2	432.4	286.4	279.9	257.8	311.4	294.9	234.4

Year	1995	1996	1997	1998 [2]	1999 [2]	2000	2001 [3]	2002	2003	2004 [1]
Skagerrak										
Denmark	43.7	28.7	14.3	10.3	10.1	16.0	16.2	26.0	15.5	8.0
Faroe Islands										
Germany									0.7	0.5
Norway										1.4
Sweden	48.5	32.7	32.9	46.9	36.4	45.8	30.8	26.4	25.8	21.8
Misreporting										
Total	95.2	64.4	50.2	60.2	46.5	61.8	47.0	43.4	43.9	31.7
Kattegat										
Denmark	16.9	17.2	8.8	23.7	17.9	18.9	18.8	22.5	14.0	10.9
Sweden	30.8	27.0	18.0	29.9	14.6	17.3	16.2	7.2	10.2	9.6
Total	47.7	44.2	26.8	53.6	32.5	36.2	35.0	29.7	24.2	20.5
Sub. Div. 22+24										
Denmark	36.8	34.4	30.5	30.1	32.5	32.6	28.3	11.0	6.1	7.1
Germany	13.4	7.3	12.8	9.0	9.8	9.3	11.4	22.4	18.8	18.0
Poland	7.3	6.0	6.9	6.5	5.3	6.6	9.3	7.0	4.4	5.5
Sweden	15.8	9.0	14.5	4.3	2.6	4.8	13.9	10.7	9.6	9.9
Total	73.3	56.7	64.7	49.9	50.2	53.3	62.9	51.1	38.9	40.5
Sub. Div. 23										
Denmark	0.9	0.7	2.2	0.4	0.5	0.9	0.6	0.4	2.3	1.2
Sweden	0.2	0.3	0.1	0.3	0.1	0.1	0.2	1.0	0.2	0.3
Total	1.1	1.0	2.3	0.7	0.6	1.0	0.8	1.4	2.6	1.5
Grand Total	217.3	166.3	144.0	164.4	129.8	152.3	145.7	125.6	109.6	94.2

[1] Preliminary data.

[2] Data for 1998 and 1999 revised in 2003

[3] German data revised in 2004

Table 1.4.3.2 Herring in Subdivisions 22-24 and Division IIIa (spring spawners).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1991	4979060	302863	191573	0.3689
1992	3631200	313084	194411	0.4924
1993	3057310	287160	185010	0.5602
1994	6141020	224788	172438	0.7135
1995	4036680	177088	150831	0.5307
1996	4380020	129220	121266	0.7344
1997	3964840	143328	115588	0.5417
1998	5479590	115933	107032	0.5301
1999	6192940	121986	97240	0.4058
2000	3460880	133636	109914	0.5592
2001	4607080	149508	105803	0.5299
2002	2736450	185430	106191	0.4928
2003	5311160	154966	78309	0.3894
2004	4808130	180386	76815	0.3575
2005	*4255743	193981		
Average	4469474	187557	129459	0.5148

* Geometric mean for the years 1993–2002.

1.4.4 Herring in Subdivisions 25–29 and 32 (excluding Gulf of Riga herring)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	At risk of being harvested unsustainably	Unknown	

In the absence of biomass reference points, the state of the stock cannot be evaluated with regard to these. The SSB has decreased steadily since the mid-1970s. Since 1999 it has stabilised at a low level, and may currently be increasing. Based on the most recent estimates of fishing mortality, ICES classifies the stock to be at risk of being harvested unsustainably.

Management objectives

There are no explicit management objectives for this stock.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$: not defined	$\mathbf{B}_{pa}$: not defined
	$\mathbf{F}_{lim}$: not defined	$\mathbf{F}_{pa}$: 0.19
Target reference points		$\mathbf{F}_{y}$: not defined

Yield and spawning biomass per Recruit
F-reference points

	Fish Mort Ages 3-6	Yield/R	SSB/R
Average last 3 years	0. 263	0.012	0.042
$\mathbf{F}_{0.1}$	0.231	0.011	0.049
$\mathbf{F}_{med}$	0.227	0.011	0.049

$\mathbf{F}_{0.1}$ is not a suitable candidate for high long-term yield, because it is higher than $\mathbf{F}_{pa}$.

Technical basis

$\mathbf{F}_{lim}$: not defined	$\mathbf{F}_{pa}$: = $\mathbf{F}_{med}$ (assessment 2000)

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

Target reference points have not been agreed for this stock. All the candidate yield- and spawning biomass-per-recruit F-reference points are above $\mathbf{F}_{pa}$ and are therefore not relevant as target reference point candidates.

Exploitation boundaries in relation to precautionary limits

Fishing in 2006 below $\mathbf{F}_{pa}$ = 0.19 corresponds to landings less than 120 000 t.

Short-term implications

Outlook for 2006

Basis: F(2005) = $\mathbf{F_{sq}}$ = 0.204; SSB(2005) = 617 ; catch (2005) = 118.

Rationale	TAC (2006)	F(2006)	Basis	SSB(2006)	SSB(2007)
Zero catch	0	0	F=0	702	854
Status quo	128	0.204	$\mathbf{F_{sq}}$	659	683
High long-term yield	Not defined	Not defined	F(long-term yield)		Not defined
Precautionary limits	12	0.019	$\mathbf{F_{pa}}$ * 0.1	698	833
	30	0.048	$\mathbf{F_{pa}}$ * 0.25	692	810
	60	0.095	$\mathbf{F_{pa}}$ * 0.5	682	771
	90	0.143	$\mathbf{F_{pa}}$ * 0.75	672	732
	108	0.171	$\mathbf{F_{pa}}$ * 0.90	666	709
	120	0.190	$\mathbf{F_{pa}}$	661	693
	132	0.209	$\mathbf{F_{pa}}$ * 1.1	657	677
	150	0.238	$\mathbf{F_{pa}}$ * 1.25	651	651

Weights in '000 t
Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

Most pelagic fisheries in the Baltic take a mixture of herring and sprat and this contributes to uncertainties in the actual catch levels. In 1992–2002 a substantial discrepancy existed between the agreed TAC for herring and the reported landings. In recent years when the herring TAC has become restrictive, there has been an incentive to misreport herring as sprat. The extent to which such misreporting has occurred is not known precisely, but it is likely that it is important for the quality of the catch data and consequently the outcome of the assessment.

Regulations and their effects

From 2005 EC vessels operating in the sprat and herring fishery are no longer allowed to land unsorted catches, unless there is a proper sampling scheme to monitor species composition.

The IBSFC Contracting Parties agreed to implement four management areas for Herring (Resolution XXI on management areas for Herring (adopted by the 29th Session, September 2003)): Northern Area (Subdivisions 30 and 31), Central Area (Subdivisions 25–29+32, excluding Gulf of Riga), Gulf of Riga, and Western Area (Subdivisions 22–24). These changes made the management units for herring coincide with the stock definition used for assessments except for the western Baltic stock which also occurs outside the Baltic in Kattegat-Skagerrak.

Scientific basis

Data and methods

The assessment is based on catch data and an international acoustic survey.

Data have in the past reflected insufficient sampling schemes to determine the catch composition in unsorted pelagic landings, but from 2005 a regulation requires a proper sampling to be in place based on the management initiatives.

The IBSFC Contracting Parties recognized the conservation problems for the Central Baltic Herring stocks in Sub-divisions 25–29 and 32 (excluding Gulf of Riga) arising from the bycatches of herring (up to 35%) in mixed pelagic fisheries targeting sprat.

The Contracting Parties agreed to implement measures to ensure that the species composition in mixed pelagic fisheries is sampled and that the species caught in these fisheries are accounted against the appropriate quotas (Resolution XXII on mixed pelagic fisheries (adopted by the 29th Session, September 2003)).

Uncertainties in assessment and forecast

The assessment is uncertain because of the complexity of the stock structure and the uncertain catch data due to inaccurate catch composition data. This problem relates to poor sampling which gives imprecise estimates of catch composition from vessels landing sprat and herring. Due to the restrictions on the herring TAC this problem may be further exacerbated by species misreporting.

The short-term forecast uses 3-year average for the mean weight of recruits. However, a decrease in the mean weights of recruits has been observed over this period. If this decrease is strong the weights for the recruits may be overestimated in the projection.

Comparison with previous assessment

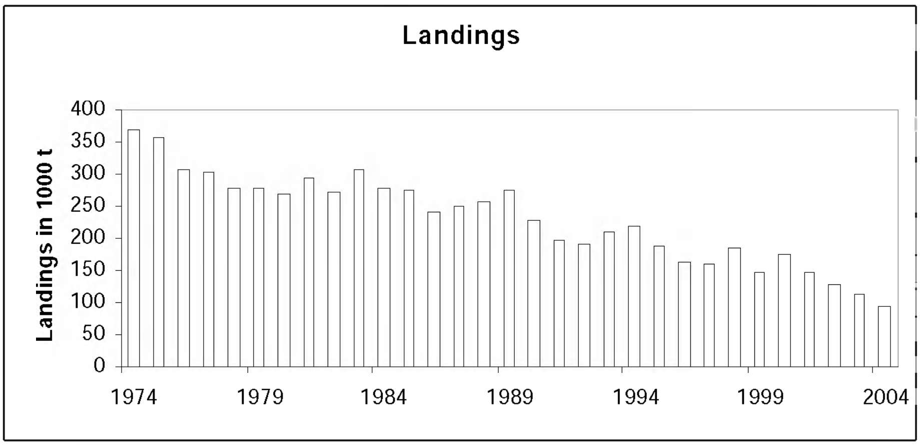
The current assessment has revised the value of SSB in 2003 downwards by 14%. The estimate of F in 2003 has been revised upwards by 17%.

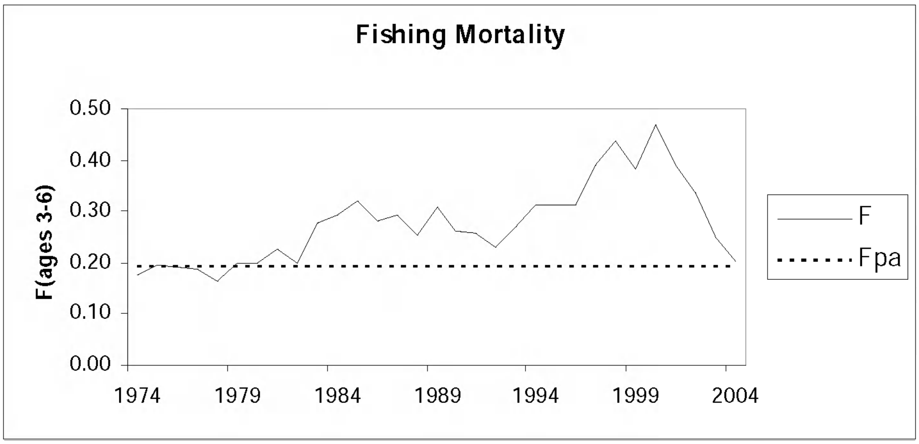
Source of information

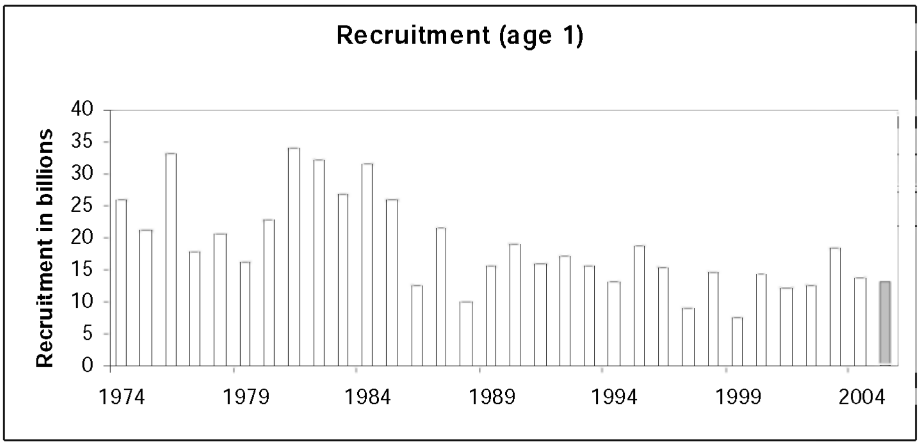
Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

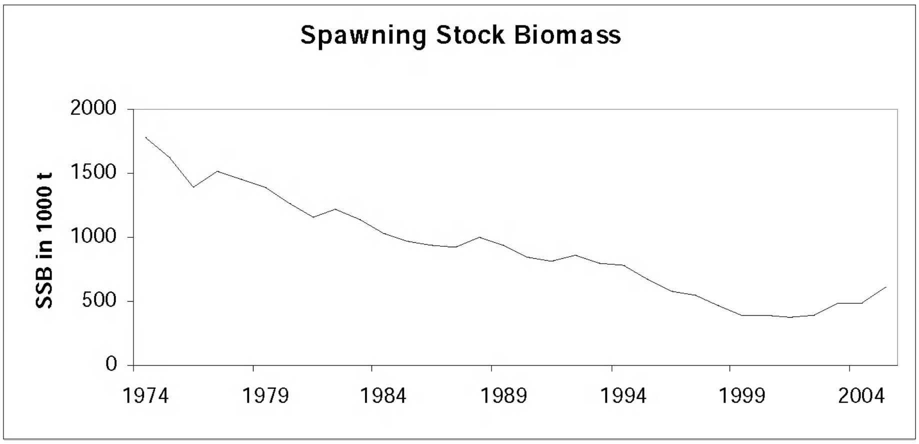
Year	ICES Advice 1987–2002 incl. Gulf of Riga herring	Single-stock exploitation boundaries	Predicted catch Corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC[1]	ACFM Catch		
						22–24	25–29+32	Total
1987			200		399	102	252	354
1988			204		399	99	286	385
1989			176		399	95	290	385
1990			112		399	78	244	322
1991	TAC for entire area		293		402	70	213	283
1992	F near present level		343		402	85	210	295
1993	Increase in yield at higher F		371		560	81	231	312
1994	Increase in yield at higher F		317–463		560	66	242	308
1995	TAC		394		560	74	221	295
1996	TAC		394		560	58	195	253
1997	No advice		-		560	67	208	276
1998	No advice		-		560	51	212	263
1999	Proposed $\mathbf{F}_{pa=}$ (0.17)		117		476	50	178	228
2000	Proposed $\mathbf{F}_{pa=}$ (0.17)		95		405	54	208	262
2001	Proposed $\mathbf{F}_{pa=}$ (0.17)		60		300	64	188	252
2002	< $\mathbf{F}_{pa}$		73		Not agreed	53	168	221
2003	< $\mathbf{F}_{pa}$		72		143	41	154	195
2004	< $\mathbf{F}_{pa}$		80		171.35	42	93*	135
2005	< $\mathbf{F}_{pa}$	< $\mathbf{F}_{pa}$	130	130	130[2]			
2006	< $\mathbf{F}_{pa}$	< $\mathbf{F}_{pa}$	120	120				

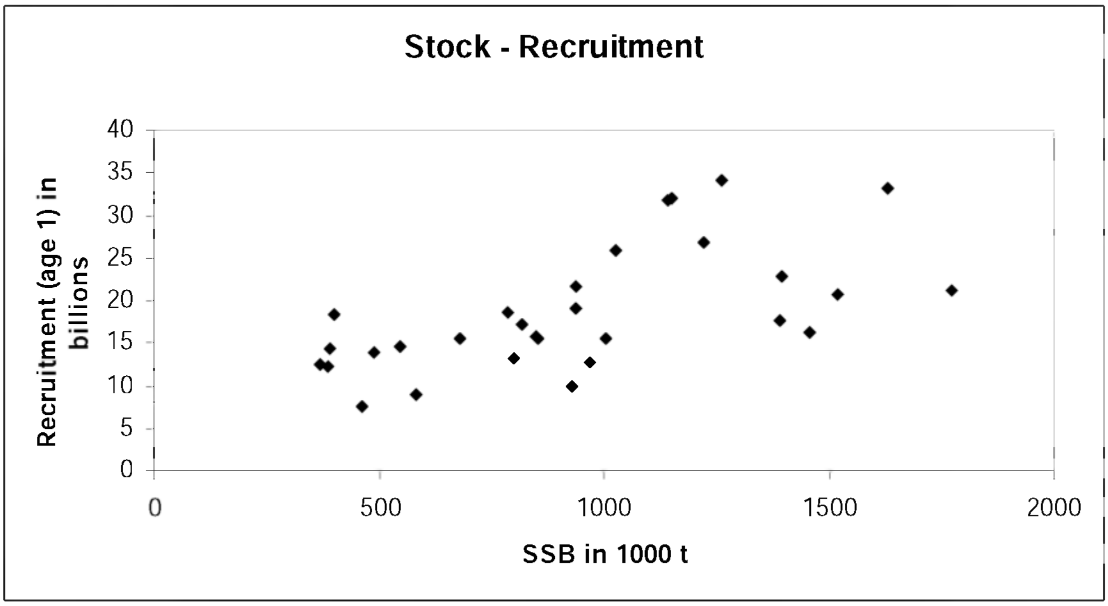
Weights in '000 t.
[1] TAC is for Subdivisions 22–29S, 32.
[2] This is the EU TAC for Subdivisions 25–28(1), 29, and 32.
* excl. GOR (28.2).

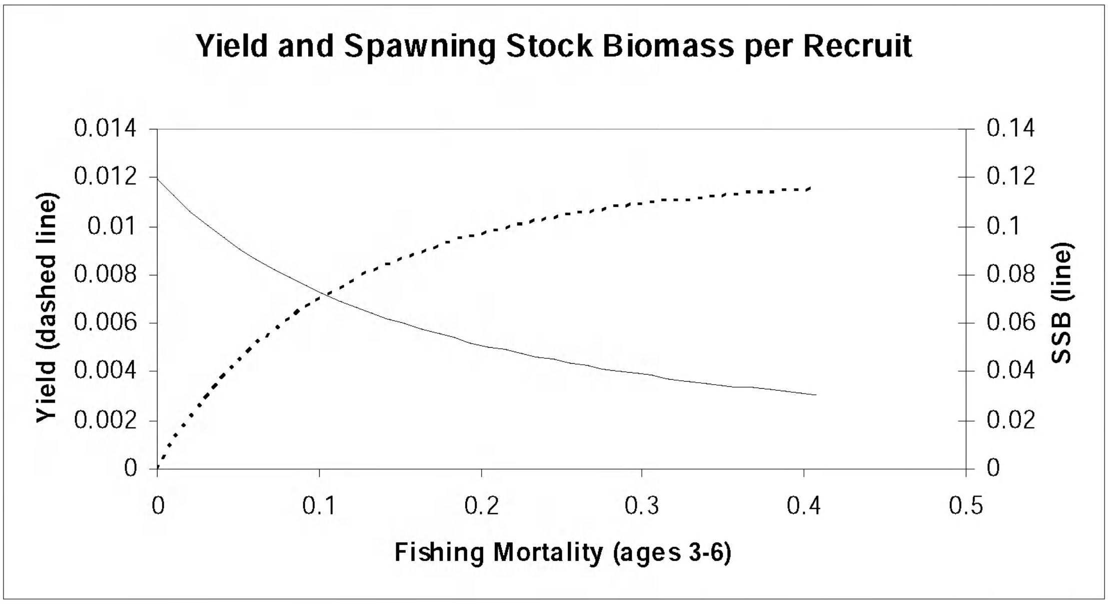

Landings
Landings in 1000 t
0
50
100
150
200
250
300
350
400
1974
1979
1984
1989
1994
1999
2004


Fishing Mortality
F(ages 3-6)
0.00
0.10
0.20
0.30
0.40
0.50
1974
1979
1984
1989
1994
1999
2004
F
Fpa


Recruitment (age 1)
Recruitment in billions
0
5
10
15
20
25
30
35
40
1974
1979
1984
1989
1994
1999
2004


Spawning Stock Biomass
SSB in 1000 t
0
500
1000
1500
2000
1974
1979
1984
1989
1994
1999
2004


Stock - Recruitment
Recruitment (age 1) in billions
40
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
SSB in 1000 t


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
SSB (line)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 3-6)

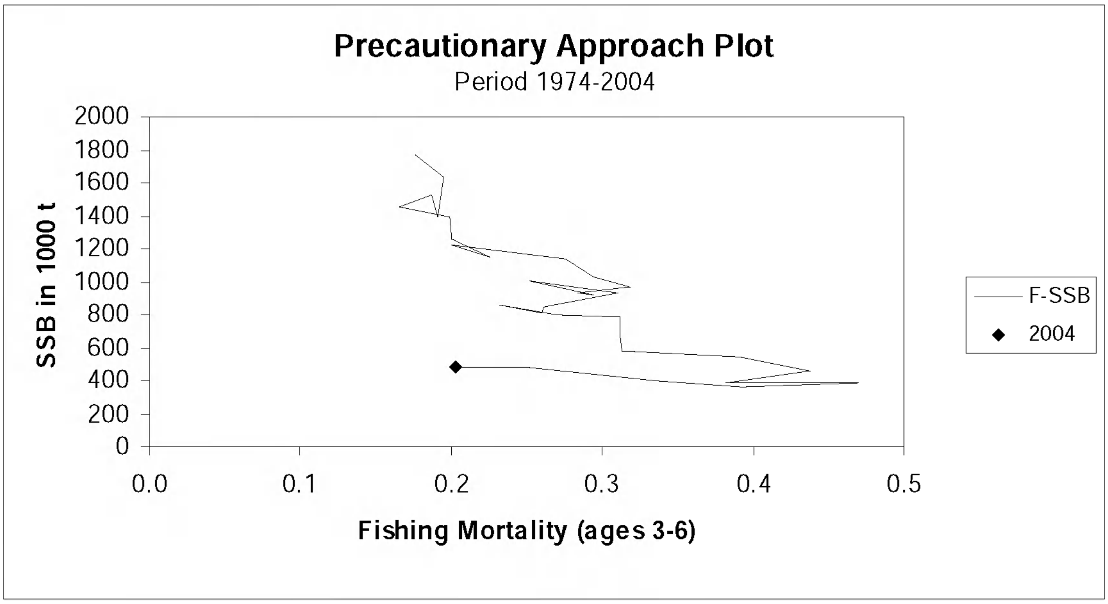

Precautionary Approach Plot
Period 1974-2004
SSB in 1000 t
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 3-6)
F-SSB
2004

Table 1.4.4.1 Herring catches in Sub-divisions 25-29, 32 (thousand tonnes).

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia**	Sweden	Total
1977	11.9		33.7	0.0			57.2	112.8	48.7	264.3
1978	13.9		38.3	0.1			61.3	113.9	55.4	282.9
1979	19.4		40.4	0.0			70.4	101.0	71.3	302.5
1980	10.6		44.0	0.0			58.3	103.0	72.5	288.4
1981	14.1		42.5	1.0			51.2	93.4	72.9	275.1
1982	15.3		47.5	1.3			63.0	86.4	83.8	297.3
1983	10.5		59.1	1.0			67.1	69.1	78.6	285.4
1984	6.5		54.1	0.0			65.8	89.8	56.9	273.1
1985	7.6		54.2	0.0			72.8	95.2	42.5	272.3
1986	3.9		49.4	0.0			67.8	98.8	29.7	249.6
1987	4.2		50.4	0.0			55.5	100.9	25.4	236.4
1988	10.8		58.1	0.0			57.2	106.0	33.4	265.5
1989	7.3		50.0	0.0			51.8	105.0	55.4	269.5
1990	4.6		26.9	0.0			52.3	101.3	44.2	229.3
1991	6.8	27.0	18.1	0.0	20.7	6.5	47.1	31.9	36.5	194.6
1992	8.1	22.3	30.0	0.0	12.5	4.6	39.2	29.5	43.0	189.2
1993	8.9	25.4	32.3	0.0	9.6	3.0	41.1	21.6	66.4	208.3
1994	11.3	26.3	38.2	3.7	9.8	4.9	46.1	16.7	61.6	218.6
1995	11.4	30.7	31.4	0.0	9.3	3.6	38.7	17.0	47.2	189.3
1996	12.1	35.9	31.5	0.0	11.6	4.2	30.7	14.6	25.9	166.7
1997	9.4	42.6	23.7	0.0	10.1	3.3	26.2	12.5	44.1	172.0
1998	13.9	34.0	24.8	0.0	10.0	2.4	19.3	10.5	71.0	185.9
1999	6.2	35.4	17.9	0.0	8.3	1.3	18.1	12.7	48.9	148.7
2000	15.8	30.1	23.3	0.0	6.7	1.1	23.1	14.8	60.2	175.1
2001	15.8	27.4	26.1	0.0	5.2	1.6	28.4	15.8	29.8	150.2
2002	4.6	21.0	25.7	0.3	3.9	1.5	28.5	14.2	29.4	129.1
2003	5.3	13.3	14.7	3.9	3.1	2.1	26.3	13.4	31.8	113.8
2004*	0.2	10.9	14.5	4.3	2.7	1.8	22.8	6.5	29.3	93.0

* preliminary

** in 1977-1990 sum of catches for Estonia, Latvia, Lithuania and Russia.

Table 1.4.4.2 Herring in Subdivisions 25 to 29 and 32 excl. Gulf of Riga.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1974	25871194	1773912	368652	0.1764
1975	21265790	1631766	354851	0.1952
1976	33096886	1392841	305420	0.1912
1977	17710332	1521289	301952	0.1868
1978	20754142	1458758	278966	0.1654
1979	16250850	1395617	278182	0.1983
1980	22715178	1262479	270282	0.2003
1981	34110660	1149306	293615	0.2254
1982	32035514	1222929	273134	0.2008
1983	26731800	1140007	307601	0.2756
1984	31666110	1028099	277926	0.2938
1985	25815594	969434	275760	0.3188
1986	12625182	936989	240516	0.2832
1987	21683000	927067	248653	0.2942
1988	9973722	1002903	255734	0.2521
1989	15473083	935620	275501	0.3105
1990	19029214	851065	228572	0.2619
1991	15839065	815699	197676	0.2596
1992	17286222	854909	189781	0.2316
1993	15580974	800814	209094	0.2705
1994	13143152	788444	218260	0.3119
1995	18641766	678237	188181	0.3114
1996	15442807	581415	162578	0.3130
1997	8962099	544478	160002	0.3913
1998	14590964	463749	185780	0.4378
1999	7625732	390100	145922	0.3824
2000	14336629	385697	175646	0.4699
2001	12194824	368455	148404	0.3922
2002	12493580	398221	129222	0.3374
2003	18397866	490591	113584	0.2481
2004	13865957	483978	93006	0.2035
2005	13174000*	617184**		
Average	18699497	914439	230724	0.2771

* Output from RCT3 analysis.
** predicted.

1.4.5 Gulf of Riga Herring

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	Harvested sustainably	Unknown	

Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and as being harvested sustainably. SSBs have been high since 1990, based on high recruitment. The two year classes 1996 and 2003 were weaker.

Management objectives

There are no explicit management objectives for this stock.

Reference points

	ICES considers that:	**ICES proposes that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$: 36 500 t.	$\mathbf{B}_{pa}$: 50 000 t.
	$\mathbf{F}_{lim}$: not defined.	$\mathbf{F}_{pa}$: 0.4.

Yield and spawning biomass per Recruit
F-reference points

	Fish Mort Ages 3-7,	Yield/R	SSB/R
Average last 3 years	0.361	0.010	0.028
$\mathbf{F}_{0.1}$	0.268	0.009	0.037
$\mathbf{F}_{med}$	0.29	0.010	0.034

Technical basis

$\mathbf{B}_{lim}$: $\mathbf{B}_{pa}$/exp (1.65*0.2).	$\mathbf{B}_{pa}$: = MBAL = 50 000 t.
$\mathbf{F}_{lim}$: not defined.	$\mathbf{F}_{pa}$: from medium-term projections.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Fishing in 2006 below $\mathbf{F}_{pa}$ (= 0.4) corresponds to landings less than 39 900 t in 2006.

Short-term implications

Outlook for 2006

Basis: F(2005) = $\mathbf{F}_{sq}$ = 0.361; Landings(2005) =40.1; SSB(2005) =119.
The maximum fishing mortality which could be in accordance with precautionary limits ($\mathbf{F}_{pa}$) is 0.40.

Rationale	TAC (2006)	F (2006)	Basis	SSB (2006)	SSB (2007)
Zero catch	0	F=0	F=0	118	143
Status quo	36.8	0.36	$\mathbf{F}_{sq}$	110	100
Precautionary limits	4.2	0.04	$\mathbf{F}_{pa}$* 0.1	117	138
	12.3	0.12	$\mathbf{F}_{pa}$* 0.3	115	128
	23.5	0.20	$\mathbf{F}_{pa}$* 0.5	113	115
	30.4	0.28	$\mathbf{F}_{pa}$* 0.7	111	107
	36.8	0.36	$\mathbf{F}_{pa}$* 0.9	100	100
	39.9	0.40	$\mathbf{F}_{pa}$	109	96
	42.8	0.44	$\mathbf{F}_{pa}$* 1.1	108	93
	49.0	0.52	$\mathbf{F}_{pa}$* 1.3	107	85

Weights in '000 t.
Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

The assessment is based upon landings of the Gulf of Riga herring taken both in and outside the gulf. The TAC is applied only to herring caught in the Gulf of Riga, which includes some small percentage of open-sea herring, but not Gulf of Riga herring taken outside the Gulf of Riga.

Fishing at $\mathbf{F}_{pa}$ (0.4) is expected to reduce the SSB slightly in the short term. However, SSB will remain well above $\mathbf{B}_{pa}$.

Factors affecting the fisheries and the stock

Gulf of Riga is a separate semi-enclosed ecosystem of the Baltic Sea characterised by low salinity that restricts the occurrence of marine species. Therefore, herring is the dominant species in the Gulf, unlike the Baltic Proper. There is currently no bycatch of sprat in this fishery. However, bycatch of sprat occurs occasionally when the sprat stock is at a high level. There is also a lack of abundant predators in the Gulf since cod is found in the Gulf of Riga only in the periods when the cod stock is very high (last time in the early 1980s).

Changes in fishing technology and fishing patterns

The fishing pattern has been stable in the period for which assessments are available (1977–2004).

Scientific basis

Data and methods

The assessment is based on catch data, a commercial CPUE index, and an acoustic index. Recruitment predictions are based on two environmental indices.

Environment

The year-class strength of Gulf of Riga herring depends strongly on the severity of the winter. The relationships between average water temperature in April, when the spawning starts and the abundance of zooplankton in May, when the hatching of larvae begins are used for the prediction of recruitment. The period since the end of the 1980s, when the majority of winters were mild has been favourable for the reproduction of Gulf of Riga herring.

Comparison with previous assessment

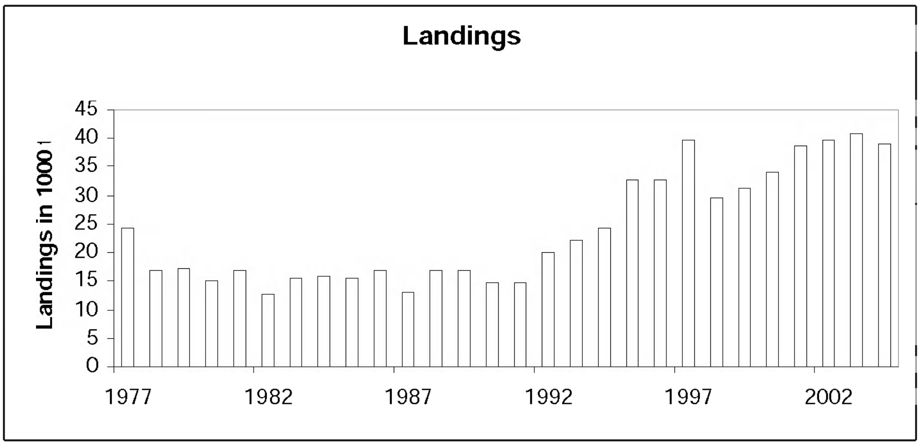
The current assessment has revised the value of SSB in 2003 upwards by about 5% and fishing mortality upwards by 2%.

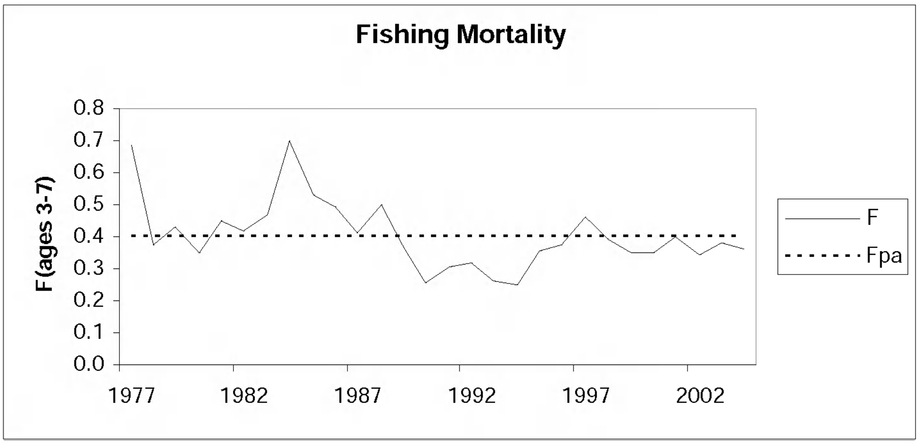
Source of information

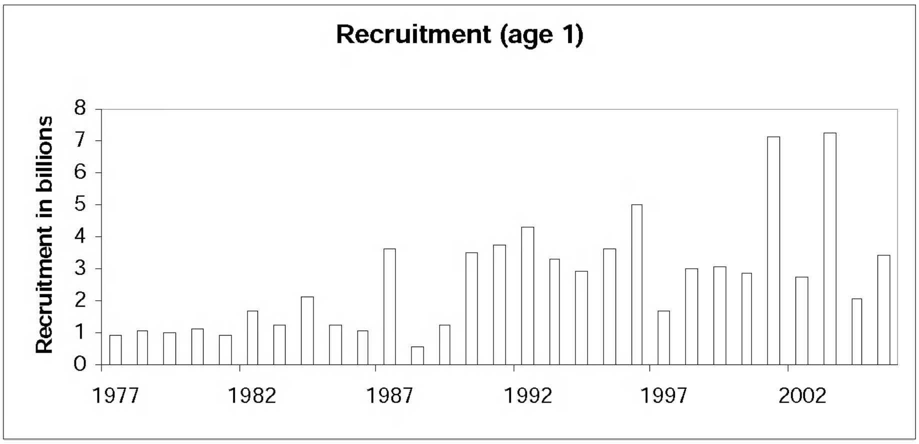
Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12 21 April 2005, ICES CM 2005/ACFM:19.

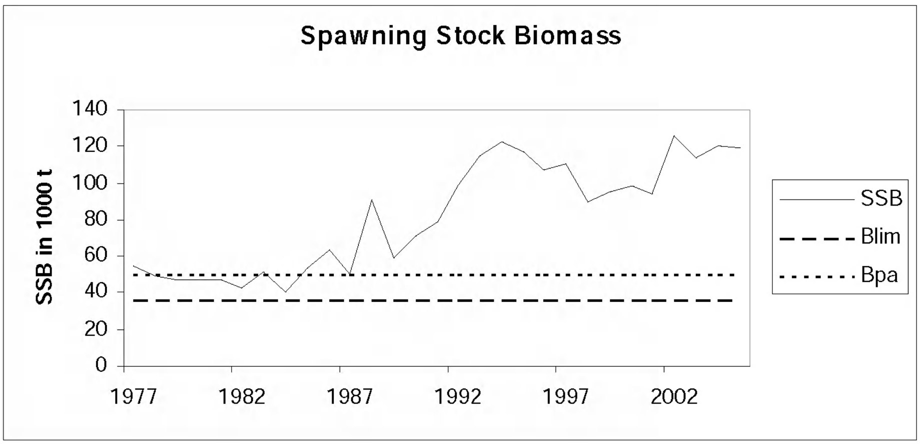
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	Reduce F towards $\mathbf{F}_{0.1}$	8	-	13
1988	Reduce F towards $\mathbf{F}_{0.1}$	6	-	17
1989	F should not exceed present level	20	-	17
1990	F should not exceed present level	20	-	15
1991	No separate advice for this stock	-	-	15
1992	No separate advice for this stock	-	-	20
1993	No separate advice for this stock	-	-	22
1994	No separate advice for this stock	-	-	24
1995	No separate advice for this stock	-	-	33
1996	No separate advice for this stock	-	-	33
1997	Current exploitation rate within safe biological limits	35	-	40
1998	Current exploitation rate within safe biological limits	35	-	29
1999	Current exploitation rate within safe biological limits	34	-	31
2000	Current exploitation rate within safe biological limits	37	-	34
2001	Current exploitation rate within safe biological limits	34.1	-	39
2002	Current exploitation rate within safe biological limits	33.2	-	40
2003	F below $\mathbf{F}_{pa}$	<41	41	40.8
2004	$F=\mathbf{F}_{sq}$	39	39.3	39.1
2005	$F=\mathbf{F}_{sq}$	35.3	38.0	
2006	$F=\mathbf{F}_{pa}$	39.9		

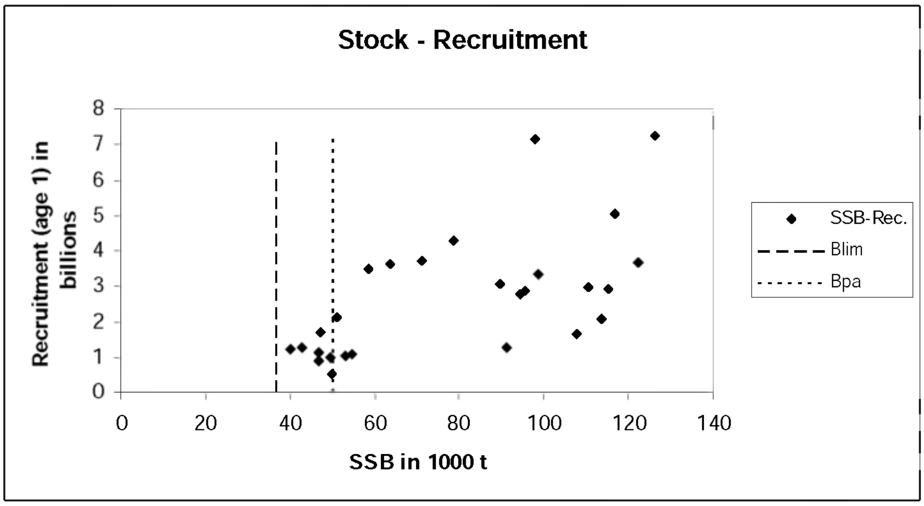
Weights in '000 t.

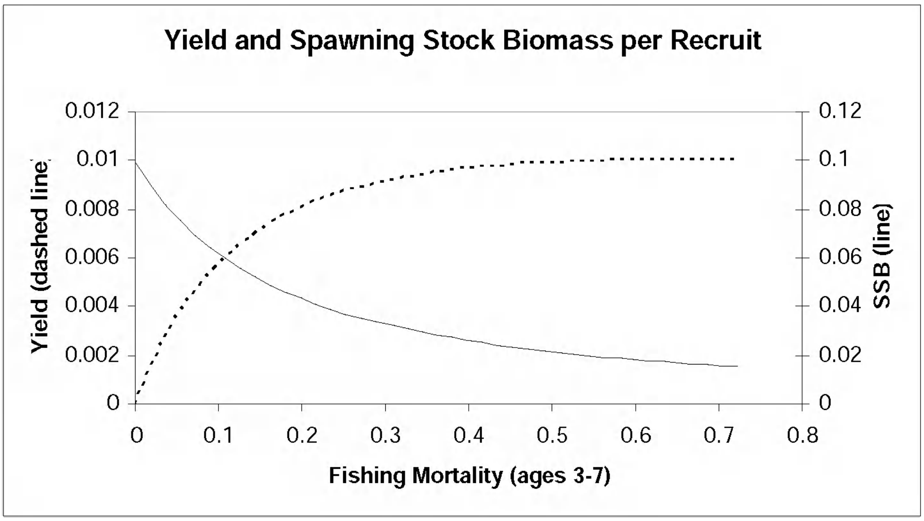

Landings
Landings in 1000 t
45
40
35
30
25
20
15
10
5
0
1977
1982
1987
1992
1997
2002


Fishing Mortality
F(ages 3-7)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1977
1982
1987
1992
1997
2002
F
Fpa


Recruitment (age 1)
Recruitment in billions
8
7
6
5
4
3
2
1
0
1977
1982
1987
1992
1997
2002


Spawning Stock Biomass
SSB in 1000 t
140
120
100
80
60
40
20
0
1977
1982
1987
1992
1997
2002
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
SSB in 1000 t
0
1
2
3
4
5
6
7
8
0
20
40
60
80
100
120
140
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)
0
0.002
0.004
0.006
0.008
0.01
0.012
0
0.02
0.04
0.06
0.08
0.1
0.12
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

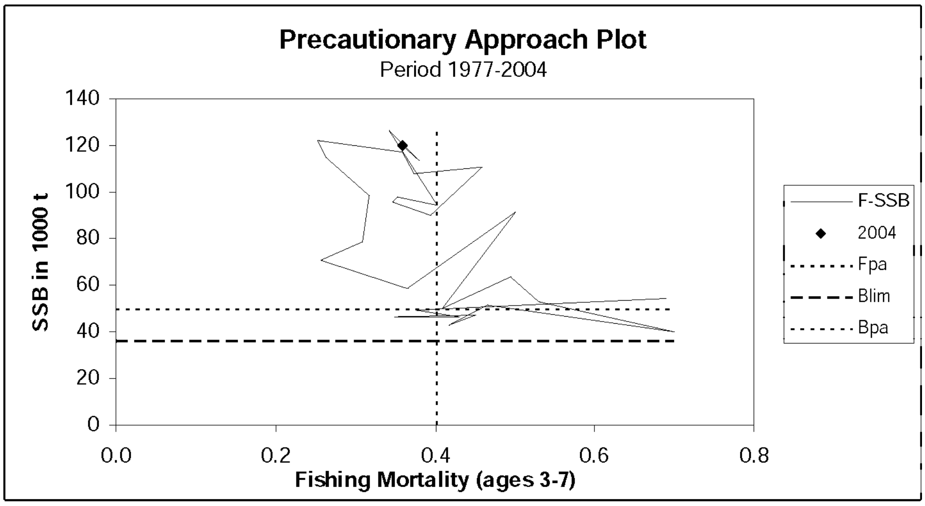

Precautionary Approach Plot
Period 1977-2004
SSB in 1000 t
Fishing Mortality (ages 3-7)
0
20
40
60
80
100
120
140
0.0
0.2
0.4
0.6
0.8
F-SSB
2004
Fpa
Blim
Bpa

Table 1.4.5.1 Herring catches in the Gulf of Riga.

Category	Catch in ' 000 t								
	1976	1977	1978	1979	1980	1981	1982	1983	1984
Total catch	31.9	26.6	23.0	21.8	20.7	22.7	17.5	20.3	19.6
Gulf of Riga herring	27.4	24.2	16.7	17.1	15.0	16.8	12.8	15.5	15.8
Open-sea herring	4.5	2.4	6.3	4.7	5.7	5.9	4.7	4.8	3.8
Category	Catch in ' 000 t								
	1985	1986	1987	1988	1989	1990	1991	1992	1993
Total catch	20.2	18.2	17.7	19.8	22.7	20.8	20.8	25.2	26.5
Gulf of Riga herring	15.6	16.9	12.9	16.8	16.8	14.8	14.7	20.4	21.5
Open-sea herring	4.6	1.3	4.8	3.0	5.9	6.0	6.1	3.5	4.3
Gulf of Riga herring taken outside gulf*								1.3	0.7
Category	Catch in ' 000 t								
	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total catch	29.3	38.8	37.0	44.1	33.5	35.7	38.6	41.7	43.6
Gulf of Riga herring	22.2	30.3	28.3	36.9	26.6	29.5	32.2	37.6	39.7
Open-sea herring	5.0	6.1	4.4	4.3	4.1	4.3	4.5	2.9	3.5
Gulf of Riga herring taken outside gulf	2.1	2.4	4.3	2.9	2.8	1.9	1.9	1.2	0.4
Category	Catch in ' 000 t								
	2003	2004							
Total catch	45.1	42.4							
Gulf of Riga herring	40.4	38.9							
Open-sea herring	4.3	3.3							
Gulf of Riga herring taken outside gulf	0.4	0.2							

* negligible and not estimated before 1992.

1.4.5.2 Total catches of herring in the Gulf of Riga by nation (official landings), t

Year	Estonia	Latvia	Total
1991	7420	13481	20901
1992	9742	14204	23946
1993	9537	13554	23091
1994	9636	14050	23686
1995	16008	17016	33024
1996	11788	17362	29150
1997	15819	21116	36935
1998	11313	16125	27438
1999	10245	20511	30756
2000	12514	21624	34138
2001	14311	22775	37086
2002	16962	22441	39403
2003	19647	21780	41427
2004	18218	20903	39121

Table 1.4.5.3 Gulf of Riga herring.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1977	943846	54533	24186	0.6901
1978	1077181	49375	16728	0.3750
1979	978112	46768	17142	0.4307
1980	1111981	46761	14998	0.3495
1981	910995	47295	16769	0.4518
1982	1705524	43007	12777	0.4187
1983	1260089	51174	15541	0.4658
1984	2095173	40261	15843	0.7004
1985	1238620	53152	15575	0.5296
1986	1045741	63677	16927	0.4949
1987	3631090	49888	12884	0.4095
1988	535271	91182	16791	0.5014
1989	1251944	58614	16783	0.3665
1990	3473835	71057	14931	0.2576
1991	3719060	78587	14791	0.3084
1992	4301668	98774	20000	0.3172
1993	3323880	115148	22200	0.2632
1994	2937156	122317	24300	0.2517
1995	3649703	116827	32656	0.3588
1996	5019975	107644	32584	0.3733
1997	1656654	110484	39843	0.4603
1998	2969889	89651	29443	0.3952
1999	3073028	95490	31403	0.3477
2000	2867650	98049	34069	0.3522
2001	7149835	94259	38785	0.4022
2002	2761527	126156	39701	0.3428
2003	7229050	113567	40803	0.3812
2004	2090937	120186	39115	0.3598
2005	3466294*	119205**		
Average	2555157	81301	22445	0.3850

*Based on RCT3 estimates.
** Predicted.

1.4.6 Herring in Subdivision 30, Bothnian Sea

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	Harvested sustainably	Unknown	

Based on the most recent estimates of SSB, ICES classifies the stock as having full reproductive capacity. The spawning stock biomass has been high since the late 1980s, and seems to have increased in recent years. It is presently well above $\mathbf{B}_{pa}$.

Based on the most recent estimates of fishing mortality, ICES classifies the stock to be harvested sustainably. The fishing mortality has decreased since 2000 and has been below $\mathbf{F}_{pa}$ since 1998.

Recruitment has been high since 1989 and the 2002 year class appears exceptional.

Management objectives

There are no explicit management objectives for this stock. Herring management is for Subdivisions 30 and 31 combined.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$: 145 000 t.	$\mathbf{B}_{pa}$: 200 000 t.
	$\mathbf{F}_{lim}$: 0.30.	$\mathbf{F}_{pa}$: 0.21.
Target reference points	$\mathbf{F}_{y}$: Not defined	

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3-7	Yield/R	SSB/R
Average last 3 years	0.144	0.010	0.068
$\mathbf{F}_{0.1}$	0.168	0.010	0.062
$\mathbf{F}_{med}$	0.146	0.010	0.067

Technical basis

$\mathbf{B}_{lim}$: spawning stock biomass, where probability of lower recruitment increases.	$\mathbf{B}_{pa}$: $\mathbf{B}_{lim}$ *exp(1.645*0.2).
$\mathbf{F}_{lim}$: $\mathbf{F}_{loss}$.	$\mathbf{F}_{pa}$: $\mathbf{F}_{med}$(in 2000)

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Assuming a fishery in 2005 at *status quo* $\mathbf{F}_{sq}$ = 0.14 fishing below $\mathbf{F}_{pa}$ in 2006 corresponds to landings of less than 93 400 t (see section on Short-Term Implications *Outlook for 2006* below, first table).

Assuming a fishing mortality of $\mathbf{F}_{pa}$ in 2005, which has been the management approach in recent years, fishing at F below $\mathbf{F}_{pa}$ in 2006 corresponds to landings of less than 88 100 t (see section on Short-Term Implications *Outlook for 2006* below, second table).

Short-term implications

Two short-term forecasts are presented with different assumptions of catch in 2005. The agreed TAC for 2005 is 64 000 t for management areas 30 and 31. Fishing at $\mathbf{F}_{pa}$ =0.21 in 2005 is expected to yield catches of up to 93 000 t.

Outlook for 2006, assuming that F= $\mathbf{F}_{sq}$ will be realized in 2005. This option corresponds closely to fishing at the TAC level.

Basis: F(2005) = $\mathbf{F}_{sq}$ **= 0.14** ; Landings(2005) = 64.4; SSB(2005) = 503.

Rationale	TAC (2006)	F(2006)	Basis	SSB(2006)	SSB(2007)
Zero catch	0	0	F=0	503	551
Status quo	65 400	0.14	$\mathbf{F}_{sq}$	493	477
High long-term yield	Not defined	Not defined	F(long-term yield)		Not defined
Precautionary limits	9 300	0.02	$\mathbf{F}_{pa}$ * 0.1	502	537
	23 400	0.05	$\mathbf{F}_{pa}$ * 0.25	499	522
	46 700	0.11	$\mathbf{F}_{pa}$ * 0.5	496	497
	70 100	0.16	$\mathbf{F}_{pa}$ * 0.75	492	471
	84 100	0.19	$\mathbf{F}_{pa}$ * 0.90	490	456
	93 400	0.21	$\mathbf{F}_{pa}$	488	446
	102 800	0.23	$\mathbf{F}_{pa}$ * 1.1	487	436
	116 800	0.26	$\mathbf{F}_{pa}$ * 1.25	484	420

Outlook for 2006, assuming that F= $\mathbf{F}_{pa}$ will be realized in 2005

Basis: F(2005) = $\mathbf{F}_{pa}$ **= 0.21** ; Landings(2005) = 93.0; SSB(2005) = 474.

Rationale	TAC (2006)	F(2006)	Basis	SSB(2006)	SSB(2007)
Zero catch	0	0	F=0	452	501
Status quo	61 500	0.14	$\mathbf{F}_{sq}$	443	432
High long-term yield	Not defined	Not defined	F(long-term yield)		Not defined
Precautionary limits	9 600	0.02	$\mathbf{F}_{pa}$ * 0.1	451	490
	23 800	0.05	$\mathbf{F}_{pa}$ * 0.25	449	474
	46 300	0.11	$\mathbf{F}_{pa}$ * 0.5	445	449
	67 800	0.16	$\mathbf{F}_{pa}$ * 0.75	442	425
	80 100	0.19	$\mathbf{F}_{pa}$ * 0.90	440	412
	88 100	0.21	$\mathbf{F}_{pa}$	439	403
	96 000	0.23	$\mathbf{F}_{pa}$ * 1.1	437	394
	107 500	0.26	$\mathbf{F}_{pa}$ * 1.25	435	382

Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

This stock is the dominating part of the TAC set for IBSFC Management Areas 30 and 31. This Management Unit includes ICES Subdivisions 30 and 31.

Most herring is taken in herring trawl fisheries. The mixed herring and sprat catches are low in Management Areas 30 and 31.

SSB is presently at a very high level due to recent strong year classes. Fishing at $\mathbf{F}_{pa}$ in the short term is not expected to reduce SSB close to $\mathbf{B}_{pa}$.

Ecosystem considerations

Stock trends in Bothnian Sea herring have been driven since the 1990s mainly by good recruitment and lower fishing mortality in the most recent years. In addition to higher recruitment, an important ecosystem-related aspect of Baltic herring in the Bothnian Sea is the decrease in growth during the 1990s. This is related to the decrease in the abundance of the copepod *Pseudocalanus* sp., one of the most important food items of Baltic herring, and a concurrent increase of herring density.

With the present exploitation level it is expected that the dioxin concentration in the fish will increase, because there will be more old fish in the catch and in the stock.

Factors affecting the fisheries and the stock

Most of Baltic herring in the Bothnian Sea is taken in a targeted herring fishery. During autumn and early winter there are mixed catches of Bothnian Sea herring and sprat, but these are minimal. This means that the fishing options for Bothnian Sea herring do not have to take into account the state of the sprat stock in overlapping distribution and fishing areas.

To the end of the year 2006, the EU has given Finland and Sweden a dispensation to utilize fish with higher contents of dioxin than the limit, 4 pg/g, for human consumption (EU 2001). No new decision has been made by EU in respect to this issue after 2006. During the 1990s, no decrease has been observed in the dioxin contents in Baltic herring from the Bothnian Sea. With the present low exploitation rate, high recruitment and stock increase, the amount of older herring in the stock will increase and thus also the dioxin content of herring.

Regulations and their effects

The exploitation of the stock has been higher in the mid-1990s than at present, but due to the restrictive TACs in recent years, a strong Finnish national effort regulation of the fisheries has been introduced. This regulation resulted in a decrease of the total Finnish catches in Subdivision 30 from 53 000 t in 2001 to 46 000 t in 2002 and 2003. In 2004, the restrictions were not as stringent (the TAC increased) and the catches increased to 50 000 t.

Changes in fishing technology and fishing patterns

On average 90% of the total catch is taken by the trawl fishery. The trapnet fishery is of minor importance. In the trawl fishery, more effective and larger trawls have been introduced in the 1990s. In the past, reported fishing effort data (trawling hours) may not have correctly indicated fishing mortalities generated by reported total fishing effort. A correction coefficient for trawl fishing effort data in 1980–2004 has been applied.

The environment

Herring growth in the Bothnian Sea may have been food limited. When herring grows well, the large-sized *Pseudocalanus minutus elongatus* is the dominating species both in the zooplankton and in the herring diet. In contrast, during the period of slow growth, the proportions of *Acartia* spp., *E. affinis*, and *B. longispina* have been greater.

Scientific basis

Data and methods

The assessment is based on catch data and three commercial CPUE indices.

Uncertainties in assessment and forecast

There are high uncertainties in the estimates of SSB and F in recent years. Because the stock is increasing F may be overestimated and SSB underestimated.

No fishery-independent information is available, causing underestimation of the uncertainty in the estimates of SSB and F. Variation in environmental conditions affects growth rate and natural mortality, but such variation cannot be quantified and all calculations are therefore based on a constant natural mortality (0.2) for all periods and age groups. Increased predation due to increased numbers of grey seal has not been accounted for in the assessment.

If the stock status should become less favourable, the lack of fishery-independent information can become critical to the ability to give proper advice.

Comparison with previous assessment and advice

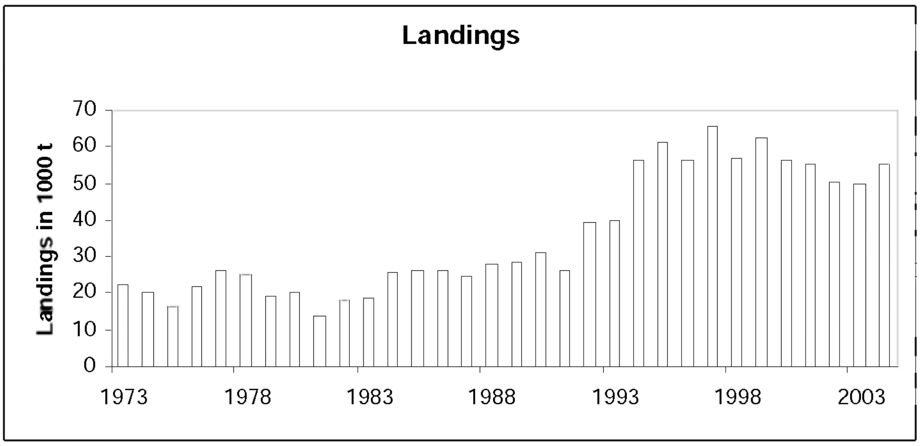
The current assessment has revised the estimated SSB in 2003 upwards by about 18%. The estimate of F has similarly been revised downwards by about 20%. This is caused by the addition of an extra year's worth of data.

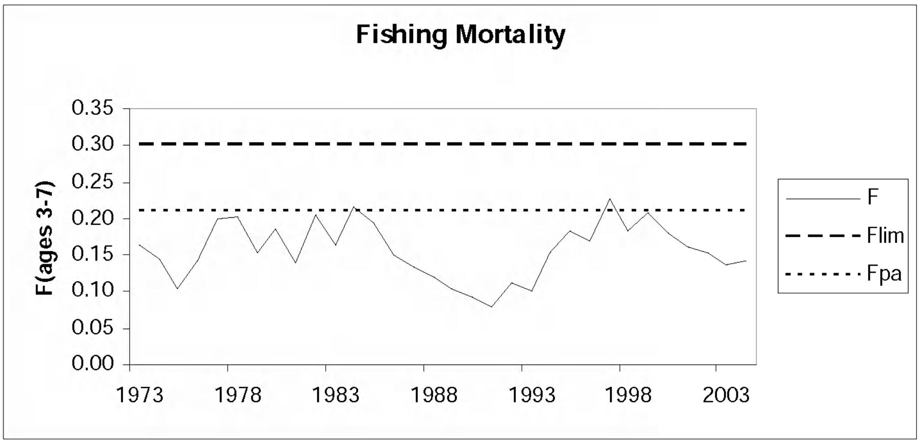
Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

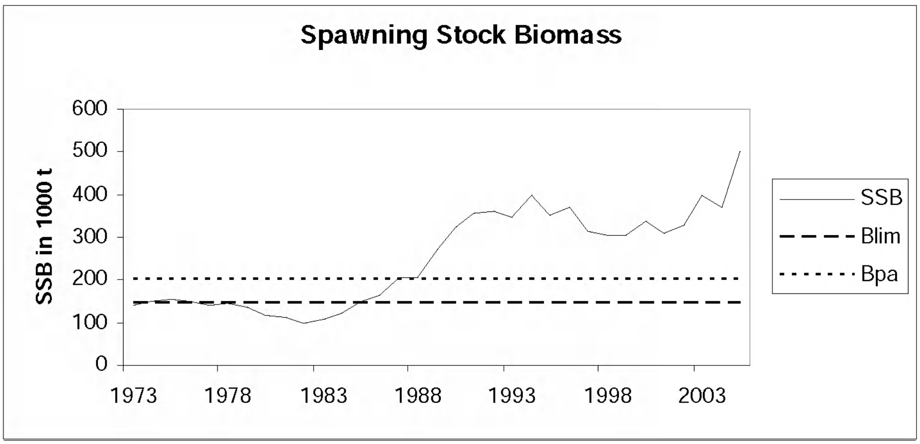
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[2]	ACFM Catch
1987				25
1988				28
1989				29
1990				31
1991	TAC for eastern part of SD, allowance for western part	32+	84	26
1992	*Status quo* F	39	84	39
1993	*Status quo* F	39	90	40
1994	No specific advice	41[1]	90	56
1995	TAC	73	110	61
1996	TAC	73	110	56
1997	F(97) = 1.4 * F(95)	78	110	66
1998	*Status quo* F	50	110	57
1999	Reduce catches	-	94	62
2000	Reduce catches	-	85	56
2001	$\mathbf{F}_{pa}$ = 0.21	36	72	55
2002	F below $\mathbf{F}_{pa}$	53	64	50
2003	F below $\mathbf{F}_{pa}$	50	60	50
2004	F below $\mathbf{F}_{pa}$	50	61.2	55
2005	F below $\mathbf{F}_{pa}$	60.2	64	
2006	F below $\mathbf{F}_{pa}$	88/93		

Weights in '000 t.
[1]Catch at $\mathbf{F}_{01}$. [2]TAC for the areas 29N, 30, 31 and from 2005 on areas 30 and 31 (IBSFC Management Unit 3).

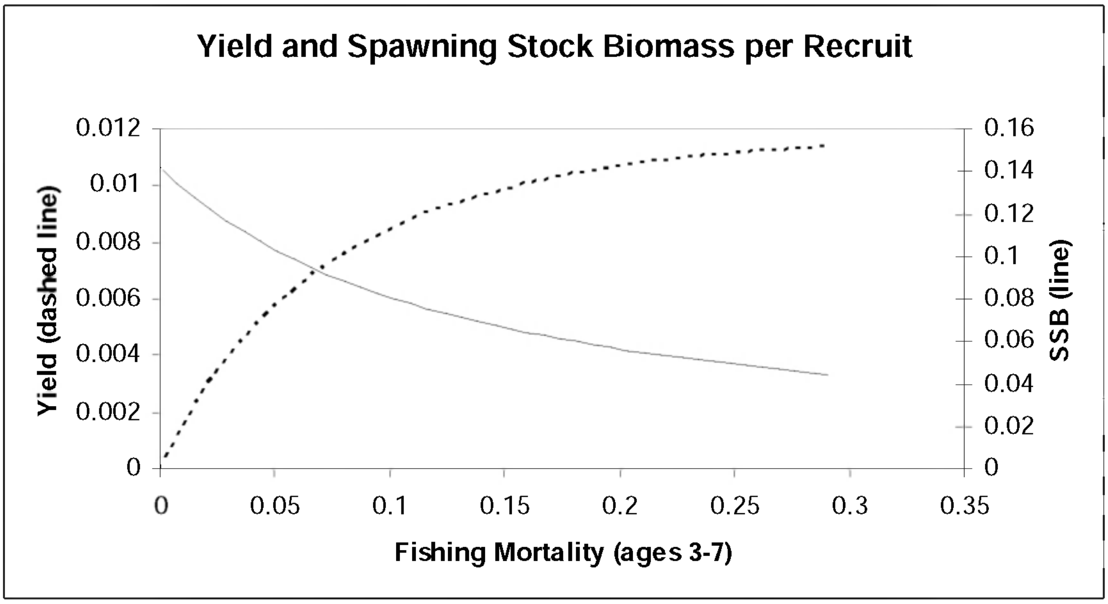

Landings
Landings in 1000 t
70
60
50
40
30
20
10
0
1973
1978
1983
1988
1993
1998
2003


Fishing Mortality
F(ages 3-7)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1973
1978
1983
1988
1993
1998
2003
F
Flim
Fpa

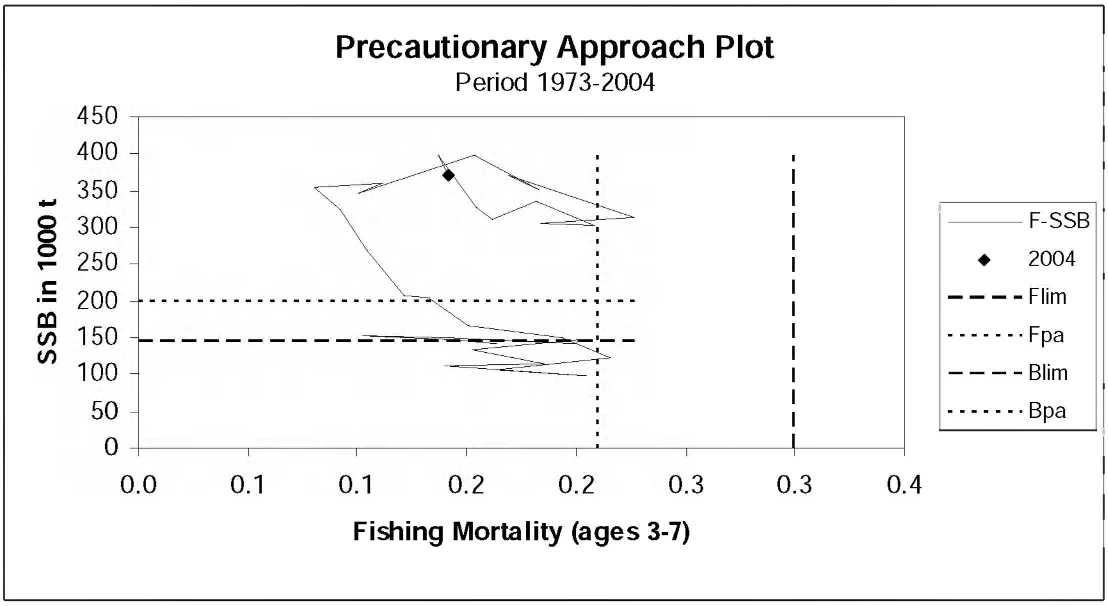

Recruitment (age 1)
Recruitment in billions
20
15
10
5
0
1973
1978
1983
1988
1993
1998
2003


Spawning Stock Biomass
SSB in 1000 t
600
500
400
300
200
100
0
1973
1978
1983
1988
1993
1998
2003
SSB
Blim
Bpa

Stock - Recruitment
Recruitment (age 1) in billions
20
18
16
14
12
10
8
6
4
2
0
0
100
200
300
400
500
SSB in 1000 t
SSB-Rec.
Blim
Bpa



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.012
0.01
0.008
0.006
0.004
0.002
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Fishing Mortality (ages 3-7)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
SSB (line)



Precautionary Approach Plot
Period 1973-2004
SSB in 1000 t
450
400
350
300
250
200
150
100
50
0
0.0
0.1
0.1
0.2
0.2
0.3
0.3
0.4
Fishing Mortality (ages 3-7)
F-SSB
2004
Flim
Fpa
Blim
Bpa

Table 1.4.6.1 Herring in SD 30. Catches in Subdivision 30 (tonnes).

Year	Finland	Sweden	Total
1971	24284	5100	29384
1972	24027	5700	29727
1973	20027	6944	26971
1974	17597	6321	23918
1975	13567	6000	19567
1976	19315	4455	23770
1977	22694	3610	26304
1978	22215	2890	25105
1979	17459	1590	19049
1980	18758	1392	20150
1981	12410	1290	13700
1982	16117	1730	17847
1983	16104	2397	18501
1984	23228	2401	25629
1985	24235	1885	26120
1986	23988	2501	26489
1987	22615	1905	24520
1988	24478	3172	27650
1989	25453	3205	28658
1990	28815	2467	31282
1991	23219	3000	26219
1992	35610	3700	39310
1993	36600	3579	40179
1994	53860	2520	56380
1995	58806	2280	61086
1996	54372	1737	56109
1997	63532	1995	65527
1998	54115	2777	56892
1999	60483	1862	62345
2000	54886	1374	56261
2001	52987	1997	54984
2002	46315	3903	50218
2003	45932	3707	49638
2004*	50236	5214	55450

* preliminary.

Table 1.4.6.2 Herring in Subdivision 30, Bothnian Sea.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1973	2057952	140619	22531	0.1633
1974	2545522	148173	20294	0.1440
1975	1830520	152999	16264	0.1028
1976	4022943	150828	22012	0.1418
1977	1438927	140574	26304	0.2001
1978	764813	146551	25105	0.2012
1979	496362	134253	19049	0.1526
1980	1470352	115367	20150	0.1853
1981	1392136	111140	13700	0.1401
1982	2362235	97725	17847	0.2049
1983	3283164	106402	18501	0.1640
1984	4477316	123558	25629	0.2157
1985	3932432	148745	26120	0.1935
1986	2241119	165815	26489	0.1508
1987	3391207	205319	24520	0.1327
1988	1699901	208069	27650	0.1212
1989	6630686	270764	28658	0.1040
1990	6935713	324418	31282	0.0921
1991	4221892	355529	26219	0.0803
1992	5173273	361232	39310	0.1119
1993	6015209	345296	40179	0.1006
1994	4511652	398632	56380	0.1539
1995	5908458	352594	61086	0.1830
1996	4521176	371090	56109	0.1692
1997	4353103	312294	65527	0.2269
1998	7201451	305601	56892	0.1839
1999	3864405	302675	62345	0.2081
2000	5457855	335934	56261	0.1814
2001	4908977	309738	54984	0.1616
2002	8072953	326220	50218	0.1542
2003	17743224	397118	49638	0.1369
2004	3632389	371375	55450	0.1419
2005	5741127*	503143**		
Average	4312135	249691	35709	0.1564

* GM recruitment 1991–2003.
** Predicted.

1.4.7 Herring in SD 31, Bothnian Bay

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Unknown	Unknown	

In the absence of defined reference points, the state of the stock cannot be evaluated with regard to these.

A tentative analytical assessment indicates that SSB has been high in the 1980s and has declined considerably in the mid-1990s to a low level. Since then SSB has increased and is now near the long-term average due to large year classes in 1999 and 2001. The year class 2002 is perceived as a record high.

Management objectives

There are no explicit management objectives for this stock. Management is for Subdivisions 30 and 31 combined.

Reference points

Precautionary Approach reference points are not defined.

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3-7	Yield/R	SSB/R
Average last 3 years	0.271	0.013	0.054
$\mathbf{F}_{0.1}$	0.178	0.012	0.073
$\mathbf{F}_{med}$	0.135	0.011	0.087

Short-term implications

Catches at recent average levels (2002–2004) 4500 t are below the long-term average catches for this stock and should not be exceeded.

Management considerations

This stock is part of the resource basis for the herring TAC set for IBSFC Management Area including Subdivisions 30 and 31.

Factors affecting the fisheries and the stock

Regulations and their effects

Due to the restrictive TACs in the recent years, Finnish national effort regulations in the form of weekly bans and total bans have been applied separately for the fodder and consumption fisheries in the Bothnian Bay.

The environment

The main part of the total catch is taken by trawl fishery. Fluctuations in total trawl catches and the length of fishing seasons depend upon the onset of winter and ice cover in the autumn. Normally, the trawl fishing season starts in late April and stops for the spawning season in late May to July. The trawl fishery starts again in August/September. The ice cover usually appears in early November. Recruitment is influenced not only by the size of the spawning stock, but to a large extent by the environmental conditions.

Scientific basis

Data and methods

The tentative assessment is based on catch data and on three commercial CPUE indices.

Uncertainties in assessment and forecast

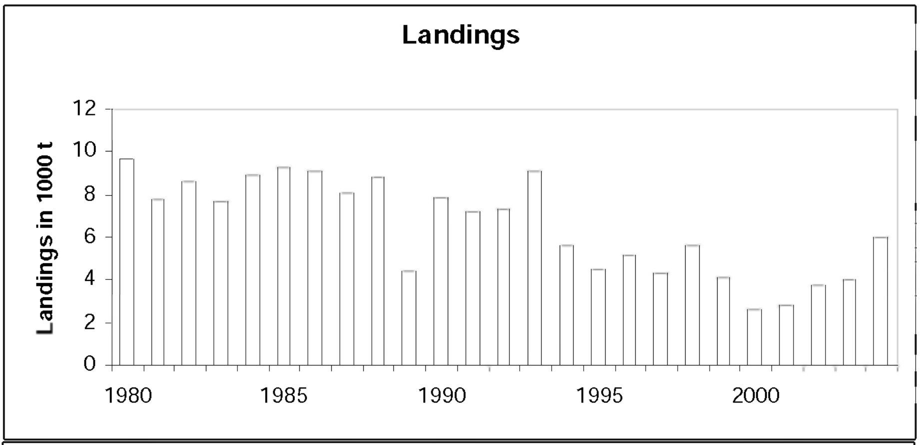
The tentative assessment was not used as a basis for the short-term forecast, due to inconsistent trends between the tuning indices and the estimated SSB over time.

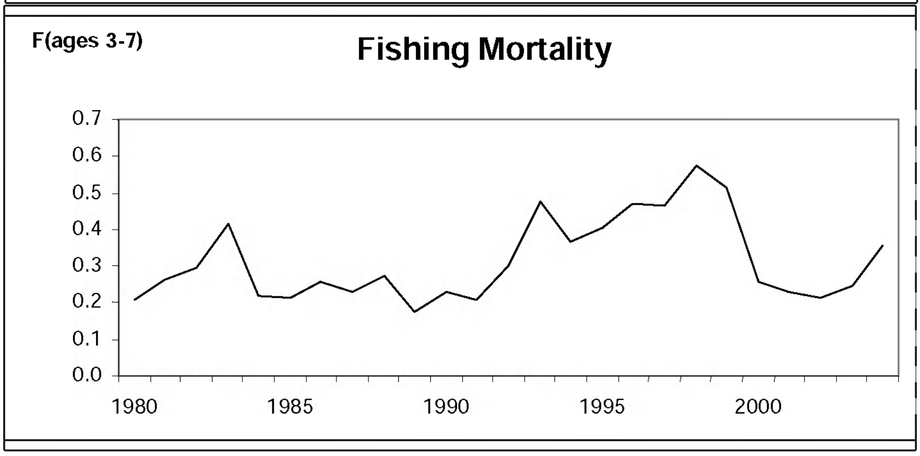
Source of information

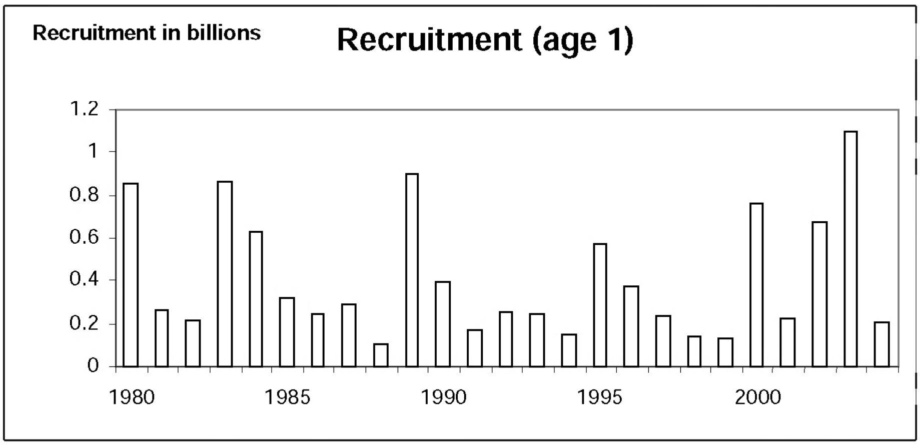
Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

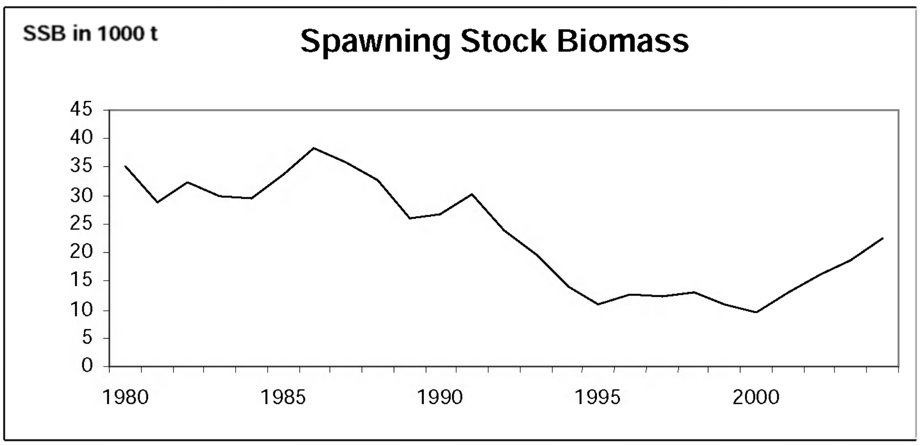
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Catch
1987		9		8.1
1988		13		8.8
1989		7		4.4
1990		9		7.8
1991	TAC for eastern part of SD, allowance for western part	9+	84	6.8
1992	*Status quo* F	8	84	6.5
1993	Increase in yield by increasing F	-	90	9.2
1994	Increase in yield by increasing F	-	90	5.8
1995	Increase in yield by increasing F	18.4	110	4.7
1996	Increase in yield by increasing F	18.4	110	5.2
1997	Increase in yield by increasing F	-	110	4.3
1998	Increase in yield by increasing F	-	110	5.6
1999	Increase in yield by increasing F	-	94	4.2
2000	Increase in yield by increasing F	-	85	2.5
2001	Exploitation rate should not be increased.	-	72	2.8
2002	Exploitation rate should be decreased	-	64	3.8
2003	No increase in catches	3	60	4.0
2004	No increase in catches	3	61.2	6.0
2005	No increase in catches	3.5	64	
2006	Less than average catches (2002–2004)	4.6		

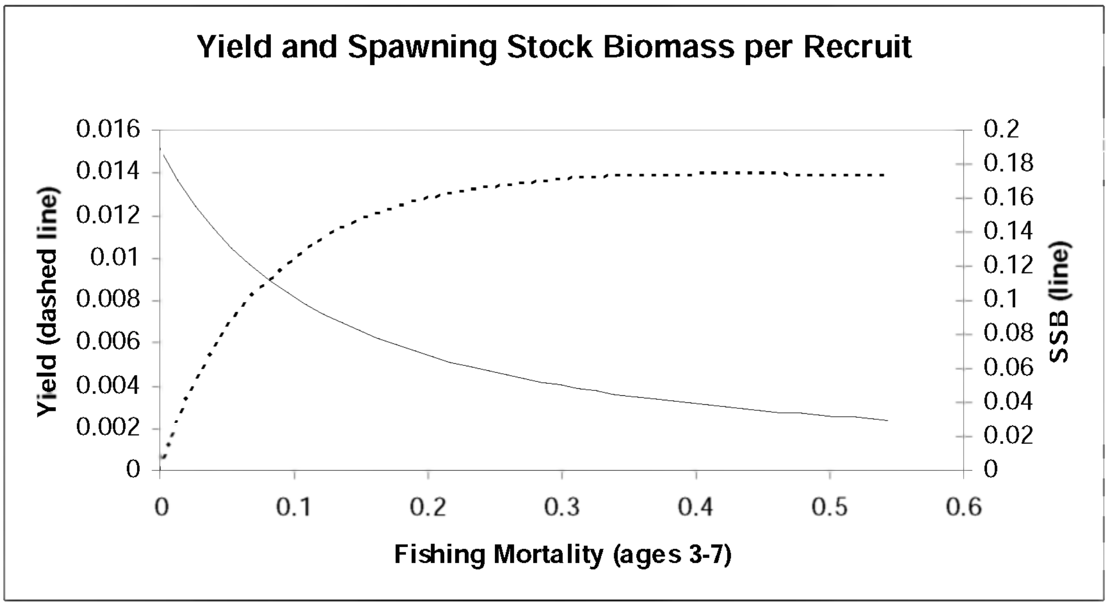
Weights in '000 t.
[1]TAC for the areas 29N, 30, 31 (IBSFC Management Unit 3).


Landings
Landings in 1000 t
12
10
8
6
4
2
0
1980
1985
1990
1995
2000


F(ages 3-7)
Fishing Mortality
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1980
1985
1990
1995
2000


Recruitment in billions
Recruitment (age 1)
1.2
1
0.8
0.6
0.4
0.2
0
1980
1985
1990
1995
2000


SSB in 1000 t
Spawning Stock Biomass
45
40
35
30
25
20
15
10
5
0
1980
1985
1990
1995
2000



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.1
0.2
0.3
0.4
0.5
0.6

Table 1.4.7.1. Herring catches in Subdivision 31 (tonnes).

Year	Finland	Sweden	Total
1971	6,143	820	6,963
1972	3,550	770	4,320
1973	3,152	727	3,976
1974	5,737	665	6,482
1975	4,802	800	5,547
1976	7,763	750	8,508
1977	6,580	750	7,330
1978	9,068	700	9,768
1979	6,275	785	7,060
1980	8,899	760	9,659
1981	7,206	620	7,826
1982	7,982	670	8,652
1983	7,011	696	7,707
1984	8,322	594	8,916
1985	8,595	717	9,312
1986	8,754	336	9,090
1987	7,788	320	8,108
1988	8,501	267	8,768
1989	4,005	423	4,428
1990	7,603	295	7,898
1991	6,800	400	7,200
1992	6,900	400	7,300
1993	8,752	383	9,135
1994	5,195	411	5,606
1995	3,898	563	4,461
1996	5,080	114	5,149
1997	4,195	86	4,281
1998	5,358	224	5,582
1999	3,909	248	4,157
2000	2,479	113	2,592
2001	2,755	67	2,822
2002	3,532	219	3,750
2003	3,855	150	4,004
2004*	5,831	142	5,973

*Preliminary

1.4.8 Sprat in Subdivisions 22–32

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	Harvested sustainably	unknown	

Based on the most recent estimates of SSB and F, ICES classifies the stock as having full reproductive capacity and harvested sustainably.

Management objectives

In Resolution XIII, September 2000, the IBSFC agreed to implement a long-term management plan for sprat in the Baltic:

"The IBSFC agreed to implement a long-term management plan for the sprat stock which is consistent with a precautionary approach and designed to ensure a rational exploitation pattern and provide for stable and high yields. This plan shall consist of the following elements:

1. *Every effort shall be made to maintain a level of spawning stock biomass (SSB) greater than 200 000 t.*
2. *A long-term management plan, by which annual quotas shall be set for the fishery, reflecting a fishing mortality rate of 0.4 for relevant age groups as defined by ICES shall be implemented.*
3. *Should the SSB fall below a reference point of 275 000 t, the fishing mortality rate referred to under paragraph 2 will be adapted in the light of scientific estimates of the conditions then prevailing, to ensure safe and rapid recovery of the spawning stock biomass to levels in excess of 275 000 t.*
4. *The IBSFC shall, as appropriate, adjust management measures and elements of the plan on the basis of any new advice provided by ICES.*

ICES considers the agreed long-term plan to be consistent with the Precautionary Approach.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$: 200 000 t	$\mathbf{B}_{pa}$: 275 000 t
	$\mathbf{F}_{lim}$ not defined	$\mathbf{F}_{pa}$: 0.40
Target reference points		$\mathbf{F}_{y}$ not defined

Yield and spawning biomass per Recruit
F-reference points

	Fish Mort Ages 3-5	Yield/R	SSB/R
Average last 3 years	0.367	0.003	0.011
$\mathbf{F}_{max}$	N/A		
$\mathbf{F}_{0.1}$	0.516	0.004	0.009
$\mathbf{F}_{med}$	0.312	0.003	0.012

$\mathbf{F}_{0.1}$ is not a suitable candidate for high long-term yield, because it is higher than $\mathbf{F}_{pa}$.

Technical basis

$\mathbf{B}_{lim}$: MBAL	$\mathbf{B}_{pa}$: $\mathbf{B}_{lim}$*1.38; some sources of uncertainty in the assessment are taken into account
$\mathbf{F}_{lim}$: -	$\mathbf{F}_{pa}$: ~ average $\mathbf{F}_{med}$ in recent years, allowing for variable natural mortality.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The agreed IBSFC management plan (F =0.4) implies catches of 439 000 t in 2006.

Outlook for 2006

Basis: F(2005) = 0.367 (*status quo* assumption); Landings (2005) = 429; SSB(2005) = 1564.
The fishing mortality applied according to the agreed management plan (F(management plan)) is 0.40.
The maximum fishing mortality which would be in accordance with precautionary limits (**F_{pa}**) is 0.40.

Rationale	TAC (2006)[1]	F(2006)	Basis	SSB(2006)	SSB(2007)
Zero catch	0	0	F=0	1 428	1 634
Status quo	408	0.367	F_{sq}	1 264	1 151
Agreed management plan	50	0.04	F(management plan) * 0.1	1 408	1 576
	123	0.10	F(management plan) * 0.25	1 381	1 482
	237	0.20	F(management plan) * 0.50	1 336	1 346
	341	0.30	F(management plan) * 0.75	1 292	1 225
	401	0.36	F(management plan) * 0.90	1 267	1 159
	439	0.40	F(management plan)	1 251	1 117
	476	0.44	F(management plan) * 1.1	1 234	1 076
	529	0.50	F(management plan) * 1.25	1 210	1 020

Weights in '000 t. Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

Catches of 439 000 tonnes (the management plan) is expected to decrease the SSB to 1.12 million t in 2007. The strong year classes of 2002–2003 contribute 65% to this high yield. The 2004 year class is predicted to be weaker than recent year classes.

The current level of SSB is very high and is well above **B_{pa}**. In 2006–2007 the stock and the catch opportunities under the current management plans will still be good due to strong year classes 2002 and 2003, and in 2007 these two strong year classes will still be about 40% of the SSB. The 2004 year class is estimated to be weaker than those two year classes; therefore, the prospect of sprat fishery in the next years will to a great extent depend on the 2005 year class. The strength of the 2005 year class is not known yet. 55% of the predicted SSB in 2007 is the estimated 2004 year class and younger year classes with unknown (but assumed) strength.

The fishing mortality rate, which this stock can sustain in the long term, depends on natural mortality, which is linked to the abundance of cod. Strong recruitment and low predation in recent years contributed to the high SSB in the mid-1990s and 2000s. The exploitation rate on sprat may have to be reduced if the cod stock should recover.

Fishing at a range of fishing mortalities (80% to 120% **F_{sq}**) in the medium term shows a declining biomass. However, all of these levels of exploitation show a high probability of the stock remaining above **B_{pa}**.

The catch possibilities can vary considerably from year to year because of the recruitment pattern with the occasional large year classes. The stock is a candidate for a management plan, which will include some catch stabilisation mechanisms.

Factors affecting the fisheries and the stock

Most sprat are taken in a mixed pelagic fisheries together with herring. This means that the fishing options for sprat should take account of the state of Baltic herring stocks – the stocks overlap in distribution and fishing area. In setting a TAC or other management regulations it is the central Baltic herring stock that is the overriding concern because the central Baltic herring is at a low level. Management of the pelagic fisheries requires independent and transparent monitoring of catches in the various fisheries and effective in-season mechanisms to keep the total catches of Central Baltic herring in mixed fisheries below threshold levels.

Regulations and their effects

The mesh size (16-mm mesh opening) and TAC quota are the only two regulatory measures adopted for the Baltic sprat fishery.

The environment

Variations in temperature may be large enough to affect sprat biology. Sprat in the Baltic Sea are located near the northern limit of the species' geographic distribution from the Black Sea to southern-central Norway. Low temperatures can therefore be expected to be detrimental for production and survival in the Baltic Sea. Laboratory experiments have shown that cold water prevents hatching of sprat eggs from the North and Baltic Seas. Field studies show that the temperatures which suppress sprat egg development in the laboratory also occur in the Baltic Sea at times, places and depths where sprat eggs occur. Comparison of interannual variability in sea temperatures at main sprat spawning time (May) with sprat recruitment shows a statistically significant positive relationship. The same temperatures that affect sprat recruitment are themselves influenced by winter severity indices, including ice coverage in the Baltic Sea and a winter index (January–February) of the North Atlantic Oscillation.

Scientific basis

Data and methods

The age-structured assessment is based on catch data and two age-structured acoustic survey indices.

Uncertainties in assessment and forecast

Better sampling of industrial fisheries has improved the quality of the data input to the assessment, but the data on species composition of mixed pelagic fisheries is likely imprecise.

Environment conditions

Since the 1990s, trends in Baltic sprat have been driven mainly by reduced predation by cod and high (although varying) recruitment success. The latter may be related to the unusual high state of the North Atlantic Oscillation (NAO), resulting in unusually high temperature conditions. One of the mechanisms in which the increase in temperature may have affected sprat recruitment is the change in the food environment. Sprat larvae have a strong preference for the copepod *Acartia* spp., which has drastically increased since the 1990s in parallel to the increase in temperature. This may have lead to a generally higher larval survival. Besides an increase in temperature, the unusual climate situation during the 1990s resulted in a change in the circulation pattern and thus a change in the drift pattern of sprat larvae. Recent investigations using 3D-hydrodynamic models have shown that retention vs. dispersion in the Baltic deep basins have a strong influence on the recruitment success of sprat.

Comparison with previous assessment

The sprat assessment was reviewed throroughly in the so-called benchmark procedure. The database for the two survey series used for tuning, i.e.the international acoustic survey and the Latvian/Russian acoustic survey on age 0 were revisited and the database revised. Therefore, tuning indices and settings for the assessment have been revised since 2004. The revisions did not change the perception of the stock development, but the recent SSB have been revised down and F revised up by 10–20% compared to the 2004 assessment.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

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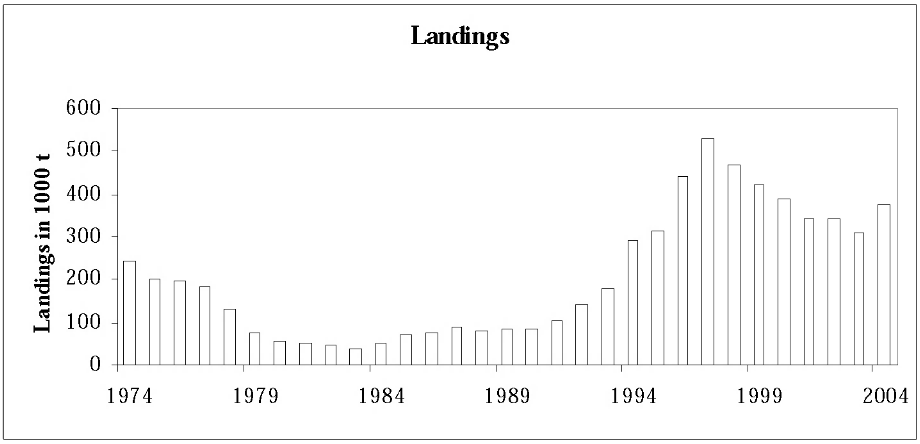
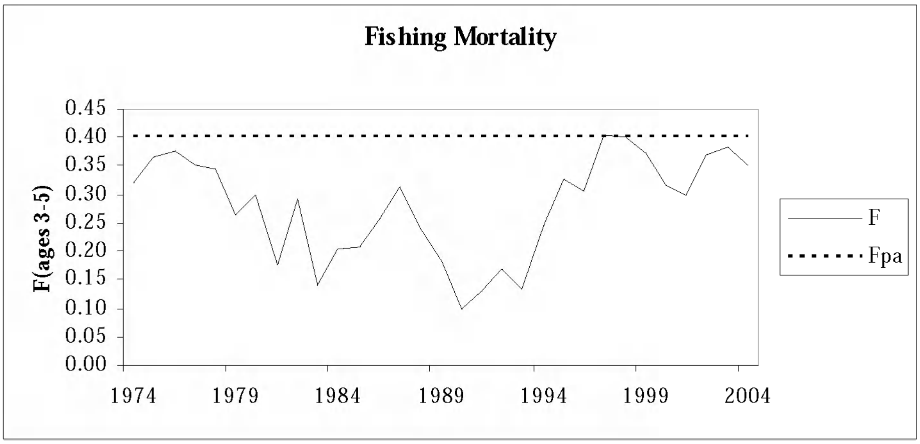
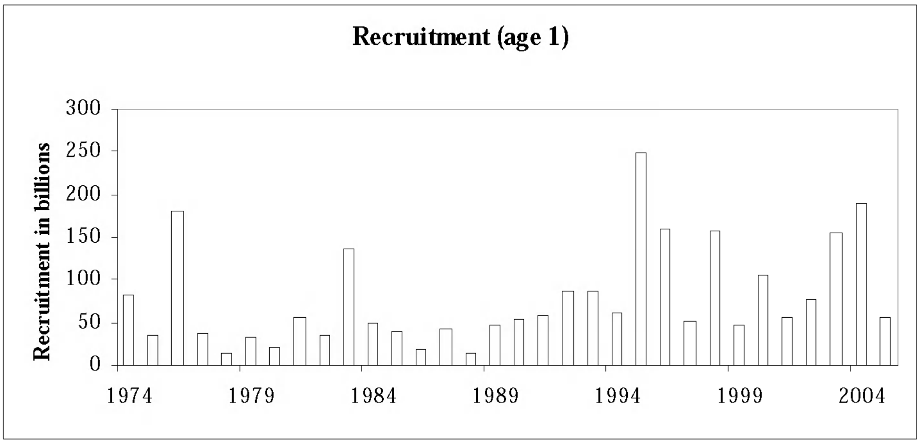
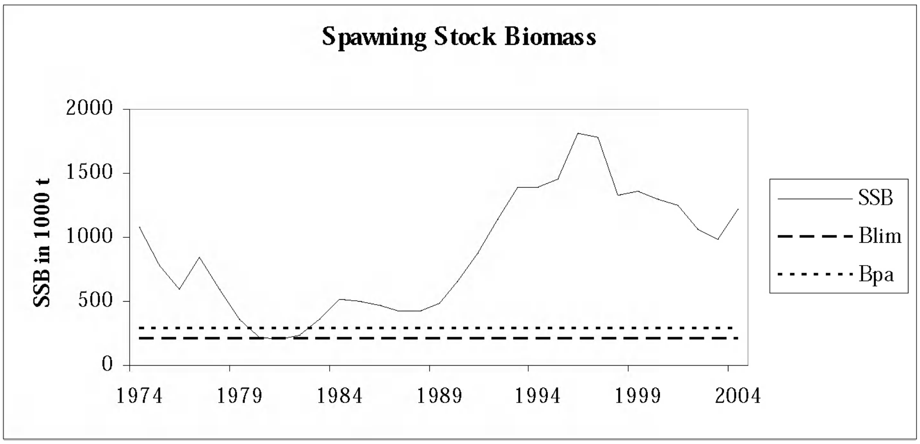
Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	ACFM catch
1987					117.2	88
1988	Catch could be increased in SD 22–25		-		117.2	80
1989			72		142	86
1990			72		150	86
1991	TAC		150		163	103
1992	*Status quo* F		143		290	142
1993	Increase in yield by increasing F		-		415	178
1994	Increase in yield by increasing F		-		700	289
1995	TAC		205		500	313
1996	Little gain in long-term yield at higher F		279		550	441
1997	No advice		-		550	529
1998	*Status quo* F		343		550	471
1999	Proposed $\mathbf{F}_{pa}$		304		467.5	421
2000	Proposed $\mathbf{F}_{pa}$		192		400	389
2001	Proposed $\mathbf{F}_{pa}$		314		355	342
2002	Proposed $\mathbf{F}_{pa}$		369		380	343
2003	Below proposed $\mathbf{F}_{pa}$ (TAC should be set on Central Baltic Herring considerations)		300		310	308
2004	Below proposed $\mathbf{F}_{pa}$(TAC should be set on Central Baltic Herring considerations)		474		420	374
2005	TAC should be set on Central Baltic Herring considerations	Proposed $\mathbf{F}_{pa}$	Much lower than 614	614	550	
2006	Agreed Management Plan	Management plan F	439	439		

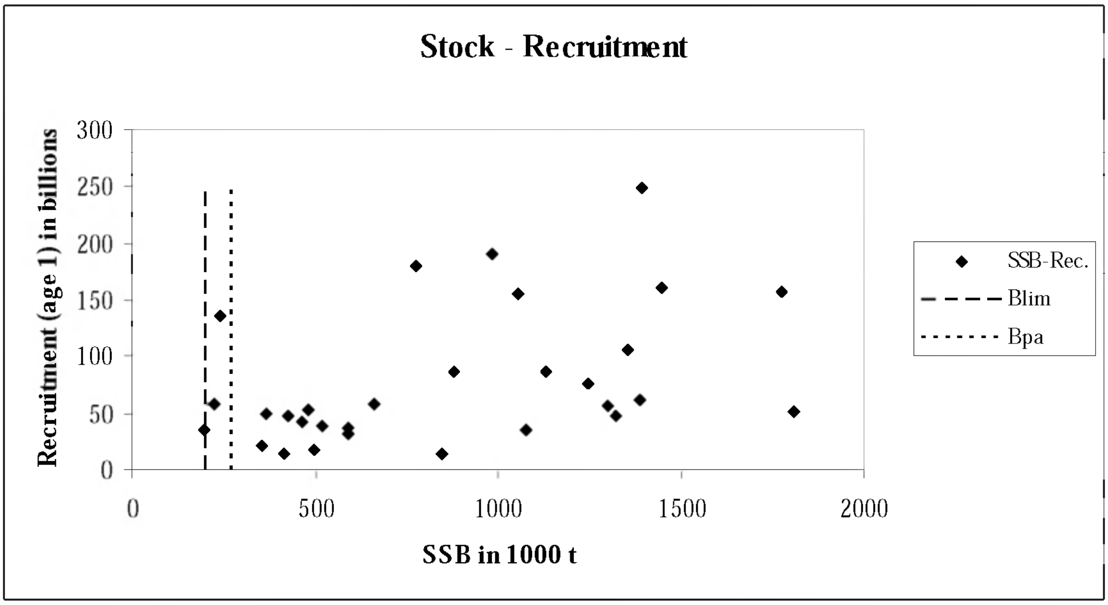
Weights in '000 t.

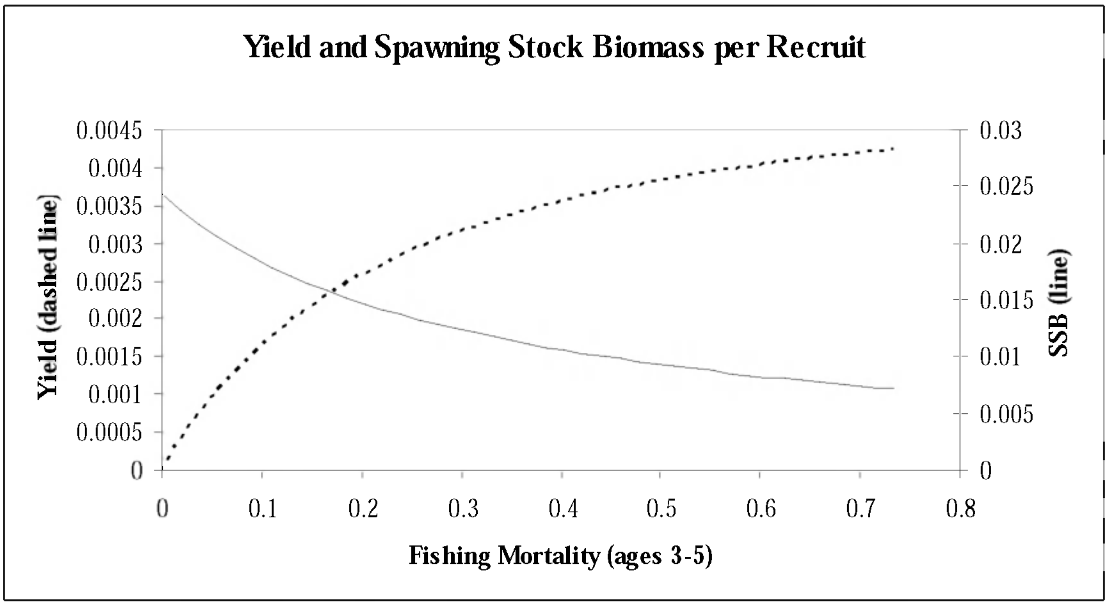

Landings
Landings in 1000 t
600
500
400
300
200
100
0
1974
1979
1984
1989
1994
1999
2004


Fishing Mortality
F(ages 3-5)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1974
1979
1984
1989
1994
1999
2004
F
Fpa


Recruitment (age 1)
Recruitment in billions
300
250
200
150
100
50
0
1974
1979
1984
1989
1994
1999
2004


Spawning Stock Biomass
SSB in 1000 t
2000
1500
1000
500
0
1974
1979
1984
1989
1994
1999
2004
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
300
250
200
150
100
50
0
0
500
1000
1500
2000
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.03
0.025
0.02
0.015
0.01
0.005
0
SSB (line)
Fishing Mortality (ages 3-5)

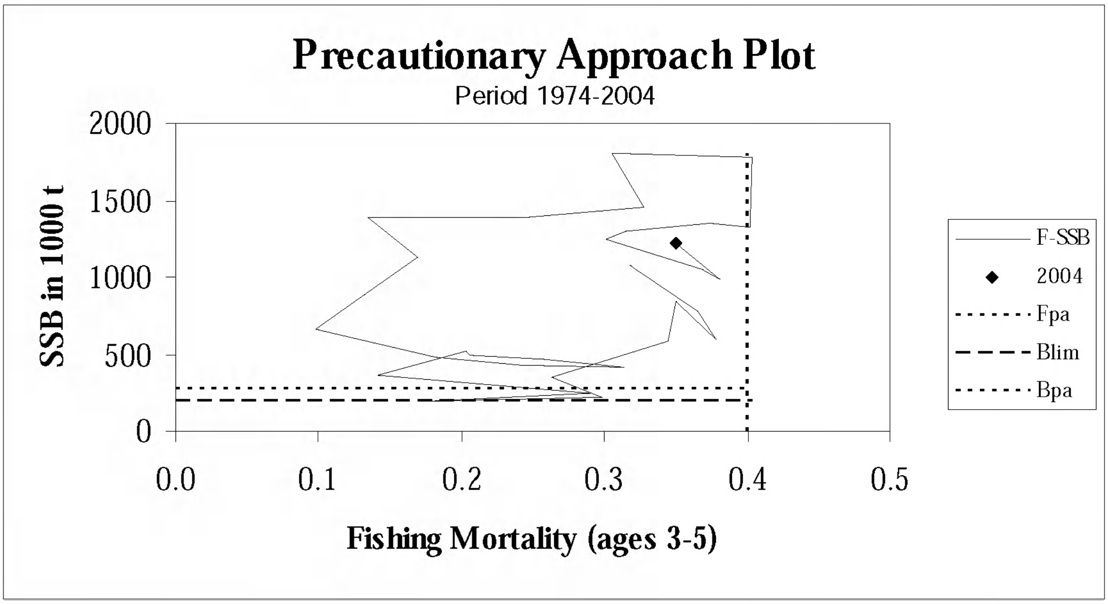

Precautionary Approach Plot
Period 1974-2004
SSB in 1000 t
2000
1500
1000
500
0
0.0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 3-5)
F-SSB
2004
Fpa
Blim
Bpa

Table 1.4.8.1 Sprat landings in Subdivisions 22-32 (thousand tonnes)

Year	Denmark	Finland	German Dem. Rep.	Germany Fed. Rep.	Poland	Sweden	USSR	Total
1977	7.2	6.7	17.2	0.8	38.8	0.4	109.7	180.8
1978	10.8	6.1	13.7	0.8	24.7	0.8	75.5	132.4
1979	5.5	7.1	4.0	0.7	12.4	2.2	45.1	77.1
1980	4.7	6.2	0.1	0.5	12.7	2.8	31.4	58.1
1981	8.4	6.0	0.1	0.6	8.9	1.6	23.9	49.3
1982	6.7	4.5	1.0	0.6	14.2	2.8	18.9	48.7
1983	6.2	3.4	2.7	0.6	7.1	3.6	13.7	37.3
1984	3.2	2.4	2.8	0.7	9.3	8.4	25.9	52.5
1985	4.1	3.0	2.0	0.9	18.5	7.1	34.0	69.5
1986	6.0	3.2	2.5	0.5	23.7	3.5	36.5	75.8
1987	2.6	2.8	1.3	1.1	32.0	3.5	44.9	88.2
1988	2.0	3.0	1.2	0.3	22.2	7.3	44.2	80.3
1989	5.2	2.8	1.2	0.6	18.6	3.5	54.0	85.8
1990	0.8	2.7	0.5	0.8	13.3	7.5	60.0	85.6
1991	10.0	1.6		0.7	22.5	8.7	59.7*	103.2

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1992	24.3	4.1	1.8	0.6	17.4	3.3	28.3	8.1	54.2	142.1
1993	18.4	5.8	1.7	0.6	12.6	3.3	31.8	11.2	92.7	178.1
1994	60.6	9.6	1.9	0.3	20.1	2.3	41.2	17.6	135.2	288.8
1995	64.1	13.1	5.2	0.2	24.4	2.9	44.2	14.8	143.7	312.6
1996	109.1	21.1	17.4	0.2	34.2	10.2	72.4	18.2	158.2	441.0
1997	137.4	38.9	24.4	0.4	49.3	4.8	99.9	22.4	151.9	529.4
1998	91.8	32.3	25.7	4.6	44.9	4.5	55.1	20.9	191.1	470.8
1999	90.2	33.2	18.9	0.2	42.8	2.3	66.3	31.5	137.3	422.6
2000	51.5	39.4	20.2	0.0	46.2	1.7	79.2	30.4	120.6	389.1
2001	39.7	37.5	15.4	0.8	42.8	3.0	85.8	32.0	85.4	342.2
2002	42.0	41.3	17.2	1.0	47.5	2.8	81.2	32.9	77.3	343.2
2003	32.0	29.2	9.0	18.0	41.7	2.2	84.1	28.7	63.4	308.3
2004	44.3	30.2	16.6	28.5	52.4	1.6	96.7	25.1	78.3	373.7

* Sum of landings by Estonia, Latvia, Lithuania, and Russia.

Table 1.4.8.2 **Sprat landings in the Baltic Sea by country and Subdivision (thousand tonnes).**

Year 2000

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**51.5**	9.4	0.8	41.2[1)]	-	-	-	-	-	-	-
Estonia	**39.4**	-	-	-	-	-	6.1	13.9	-	-	19.4
Finland	**20.2**	-	-	-	-	-	-	3.6	4.8	0	11.9
Germany	**0**	0		-	-	-	-	-	-	-	-
Latvia	**46.2**	-	-	2.6	7.3	-	36.3	-	-	-	-
Lithuania	**1.7**	-	-	-	1.7	-	-	-	-	-	-
Poland	**79.2**	-	0.8	40.5	37.9	-	-	-	-	-	-
Russia	**30.4**	-	-	-	28.3	-	2	-	-	-	-
Sweden	**120.6**	-	2.1	31.7	13.2	31.5	23.9	18.1	-	-	-
Total	**389.1**	**9.5**	**3.7**	**116**	**88.4**	**31.5**	**68.3**	**35.5**	**4.8**	**0**	**31.4**

1) Danish landings in Subdivision 25 include landings in Subdivision 22 and 24.

Year 2001

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**39.7**	-	-	39.7	-	-	-	-	-	-	-
Estonia	**37.5**	-	-	-	-	-	6.3	16.1	-	-	15.1
Finland	**15.4**	-	-	-	-	-	-	4.5	3.2	0.001	7.6
Germany	**0.8**	0.02	0.8	-	-	-	-	-	-	-	-
Latvia	**42.8**	-	-	1.1	7	-	34.7	-	-	-	-
Lithuania	**3**	-	-	-	3	-	-	-	-	-	-
Poland	**85.8**	-	0.4	46.3	39.1	-	-	-	-	-	-
Russia	**32**	-	-	-	29.6	-	2.3	-	-	-	-
Sweden	**85.4**	-	1	2.9	4.8	27.8	30.2	18.1	-	-	0.5
Total	**342.2**	**0.02**	**2.1**	**90**	**83.5**	**27.8**	**73.5**	**38.7**	**3.2**	**0.001**	**23.2**

Year 2002

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**42.0**	4.7	1.0	22.5	7.7	0.7	4.6	0.9	-	-	-
Estonia	**41.3**	-	-	-	-	-	7.7	17.0	-	-	16.6
Finland	**17.2**	-	0.8	2.3	0.004	0.1	0.001	3.7	4.8	-	5.5
Germany	**1.0**	0.03	-	0.1	0.4	0.1	0.1	0.2	-	-	-
Latvia	**47.5**	-	-	1.4	4.5	-	41.7	0.0	-	-	-
Lithuania	**2.8**	-	-	0.0	2.8	-	-	-	-	-	-
Poland	**81.2**	-	0.04	39.7	41.5	-	-	-	-	-	-
Russia	**32.9**	-	-	-	29.9	-	2.9	-	-	-	-
Sweden	**77.3**	-	3.0	13.3	5.6	27.2	19.9	8.3	-	-	-
Total	**343.2**	**4.8**	**4.8**	**79.3**	**92.4**	**28.1**	**76.8**	**30.1**	**4.8**	**0.0**	**22.1**

Year 2003

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**32.0**	8.2	0.7	10.4	8.9	1.8	1.7	0.3	-	-	-
Estonia	**29.2**	-	-	-	-	-	11.1	11.6	-	-	6.5
Finland	**9.0**	-	0.03	0.4	0.0	0.2	0.1	4.6	1.5	0.001	2.0
Germany	**18.0**	0.2	0.5	0.8	3.0	9.5	2.8	1.1	-	-	-
Latvia	**41.7**	-	-	0.8	7.8	-	33.2	-	-	-	-
Lithuania	**2.2**	-	-	-	2.2	-	-	-	-	-	-
Poland	**84.1**	-	0.0	26.7	57.4	-	-	-	-	-	-
Russia	**28.7**	-	0.0	0.0	27.2	-	1.4	-	-	-	-
Sweden	**63.4**	-	2.1	5.5	8.6	24.1	19.3	3.8	-	-	-
Total	**308.3**	**8.3**	**3.5**	**44.6**	**115.1**	**35.6**	**69.6**	**21.5**	**1.5**	**0.001**	**8.5**

Year 2004

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**44.3**	16.0	5.5	16.8	0.5	0.5	3.9	1.1	-	-	-
Estonia	**30.2**	-	-	-	-	-	8.9	10.1	-	-	11.1
Finland	**16.6**	-	0.5	2.5	0.0	0.1	0.0	9.3	3.0	0.0	1.1
Germany	**28.5**	0.8	0.9	1.4	6.0	8.2	6.8	4.4	-	-	-
Latvia	**52.4**	-	-	2.3	7.5	0.2	42.4	0.0	-	-	-
Lithuania	**1.6**	-	-	-	1.6	-	-	-	-	-	-
Poland	**96.7**	-	1.4	33.6	61.6	0.0	0.0	-	-	-	-
Russia	**25.1**	-	-	-	23.9	-	1.2	-	-	-	-
Sweden	**78.3**	-	1.4	9.2	7.6	25.8	22.3	12.0	-	-	-
Total	**373.7**	**16.8**	**9.7**	**65.8**	**108.8**	**34.8**	**85.6**	**36.9**	**3.0**	**0.003**	**12.2**

Table1.4.8.3 Sprat in Subdivisions 22 to 32.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-5
1974	81903280	1077487	241700	0.3182
1975	35059024	778524	201434	0.3657
1976	179608928	591377	194775	0.3778
1977	37591660	846039	180800	0.3508
1978	14982713	588426	132360	0.3443
1979	32083636	354688	77100	0.2632
1980	20948782	225618	58100	0.2989
1981	57393444	195426	49300	0.1768
1982	35778764	241059	48700	0.2906
1983	136716304	366975	37320	0.1417
1984	49999496	517326	52560	0.2028
1985	39482748	495451	69497	0.2058
1986	18129460	466734	75800	0.2579
1987	42766164	417348	88276	0.3136
1988	14855399	426712	80300	0.2422
1989	47647144	479640	85817	0.1814
1990	53812696	661327	85578	0.0987
1991	57788568	880491	103200	0.1312
1992	87081688	1133385	142195	0.1699
1993	87275864	1390270	178100	0.1350
1994	61912556	1393893	288700	0.2463
1995	248371392	1449673	313000	0.3284
1996	160050816	1806329	441100	0.3051
1997	50873384	1777980	529400	0.4038
1998	157824240	1323756	470770	0.4014
1999	47436632	1354150	421397	0.3734
2000	105748672	1301450	389140	0.3151
2001	56776488	1244432	342200	0.3005
2002	76440128	1057062	343191	0.3690
2003	154744176	982989	308260	0.3816
2004	190954400	1216545	373675	0.3503
2005	57227000*	1564000**		
Average	78102051	872341	206572	0.2815

* estimate from RCT3.
** projected.

1.4.9 Flounder in Subdivisions 22–32

State of the stock

The size of most flounder stocks is unknown. Results from an exploratory assessment of the stock in Subdivisions 24–25 indicate a stable spawning stock in the entire period of the assessment (since 1978). There are indications of above average recruitment in recent years, fishing mortality has increased slightly over this period, and landings have increased since the late 90s.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No reference points have been defined for this stock.

Management considerations

Ecosystem considerations

For the flounder stock in Subdivisions 24–25, the appropriate habitat for reproductive success is defined by salinity $\geq$ 12.0 psu and dissolved oxygen concentration $\geq$ 2 ml O_2 /l.

Factors affecting the fisheries and the stock

Flounder is mostly caught as bycatch in the cod-directed fishery. Germany in Subdivision 24 (by trawl) and Poland in Subdivision 25 (mainly by gillnet) have a flounder-directed fishery. On average about 49% of the flounder landings are reported for Subdivisions 24 + 25, followed by Subdivision 26 (18%) and Subdivision 22 (16%). Total landings fluctuated between 8421 t and 19 640 t. The peak was in 2002. During the mid-1990s flounder landings were misreported from the cod trawl fishery, mainly for Subdivisions 24 and 25. Total landings in 2004 amounted to 17 398 t. This means an upwards trend compared to 2003.

It is assumed that the amount discarded during the cod fisheries is high. Discard levels depend on the length composition in a given fishery, the minimum landing size (25 cm), and on market demand (price, size category). The level of discarding has not been evaluated yet.

Implementation of the IBSFC Fishery Rule to use only the BACOMA net in the cod trawl fishery has not been evaluated with regard to flounder discard rates.

Scientific basis

Data and methods

The analytical assessment is still considered exploratory and is based on long-term catch data and two BITS surveys (1^{st} and 4^{th} quarter).

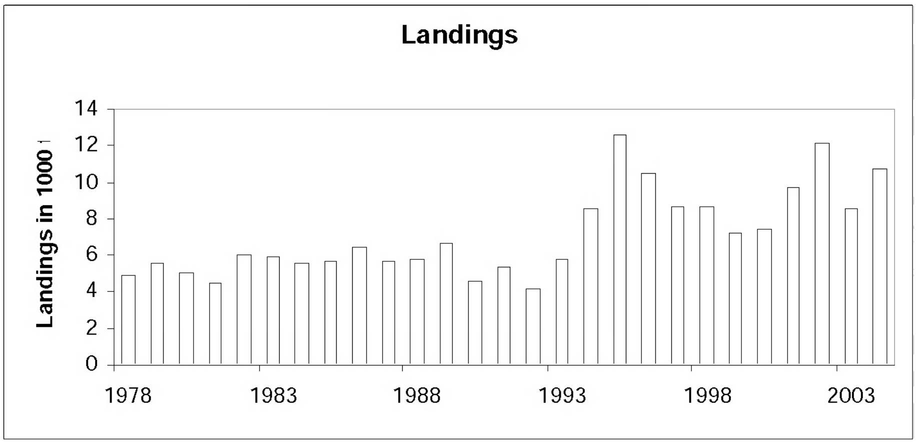
Comparison with previous assessment and advice

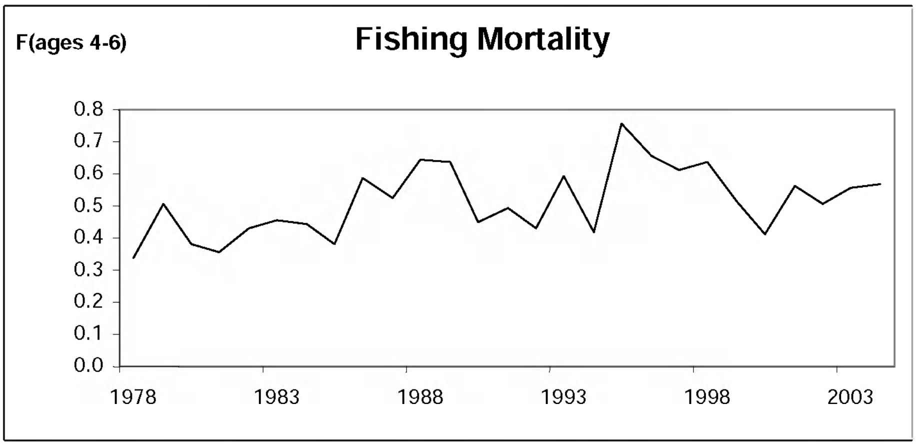
Updating the input series, the current assessment has not changed the long-term trends in this stock.

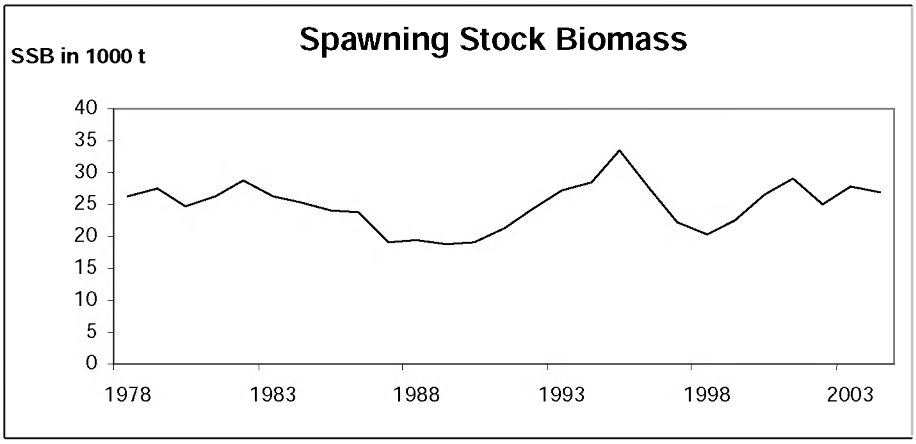
Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

Flounder in Subdivisions 24 and 25







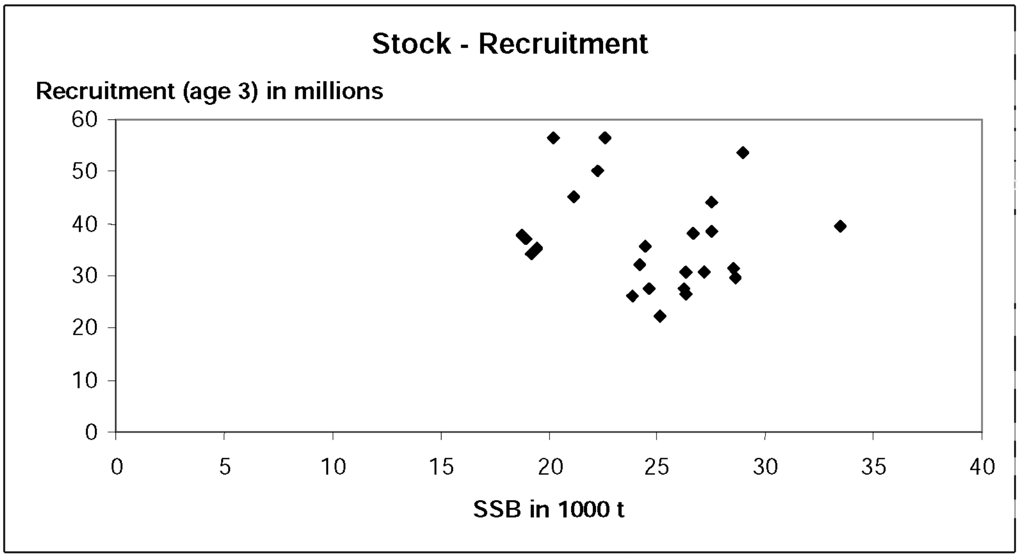

Stock - Recruitment
Recruitment (age 3) in millions
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
SSB in 1000 t

Table 1.4.9.1 Flounder in the Baltic Sea: total landings (tons) by Sub-division and country.
(There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark[1]					Finland					German Dem. Rep.[2]			Germany, Fed. Rep.				Poland		Sweden[3]									
	22	23	24.25	26	28(29)27	24	25	29[6]	30[7]	32	22	24	25(+26)	22	24(+25)	26	28	25(+24)	26	22	23	24	25	26	27	28	29	30	31
1973	1 983		386								181	1 624	1 516	349	4			1 580	2 070				502						
1974	2 097		2 578								165	1 482	654	304	3			1 635	2 473				470						
1975	1 992		1 678					113	22	47	163	1 469	406	469	1			1 871	2 585				400						
1976	2 038		482					118	23	59	174	1 556	901	392	2			1 549	2 289				400						
1977	1 974		389					115	32	56	555	2 708	1 096	393	4			2 071	2 089				416						
1978	2 965		415					174	61	155	348	2 572		477	1			996	2 106				346						
1979	2 451		405					192	54	153	189	2 509		259	3			1 230	1 860				315						
1980	2 185		286					194	69	165	138	2 775		212	1			1 613	1 380			16	46		20	181	32		
1981	1 964		548					227	56	135	271	2 595		351	1			1 151	1 541			21	30		21	194	34		
1982	1 563	104	257					219	58	144	263	3 202		248	1			2 484	1 623			22	33		65	16	3		
1983	1 714	115	450					181	67	120	280	3 572		418	1			1 828	905			72	108		212	52	9		
1984	1 733	85	306					174	108	135	349	2 719		371	1			2 471	1 288			18	27		53	13	2		
1985	1 561	130	649					157	97	137	236	3 253		199	4			2 063	1 302			16	24		47	12	2		
1986	1 525	65	1 558					199	128	181	127	2 838		125	10			3 030	1 784			20	31		60	15	3		
1987	1 208	122	1 007					159	106	143	71	2 096		114	11			2 530	1 745			17	26		51	13	2		
1988	1 162	125	990					177	118	159	92	2 981		133	5			1 728	1 292			23	35		68	17	3		
1989	1 321	83	1 062					175	122	163	126	3 616		122	2			1 896	1 089			22	34		66	16	3		
1990	941		1 389					219	81	161	52	1 622		183	10			1 617	599				120						
1991	925		1 497					236	81	167				246	1 814			2 008	1 905			24	31		88	20			
1992	713	185	975					405	40	627				227	1 972			1 877	1 869			41	88	3	86	11	3		
1993	649	194	635					438	57	683				235	1 230			3 276	1 229		26	27	63	1	83	10			
1994	882	181	1 016					445	33	87				44	4 262	2	3	3 177	1 266		84	20	18	37	33	55	10		
1995	859	231	2 110					398	28	131				286	2 825	4	40	7 437	1 482		58	28	186	7	81	18			
1996	1 041	227	2 306				1	365	78	271				189	1 322	10	9	6 069	2 556	2	58	101	718	48	114	31			
1997	1 356		2 421	31	10		1	283	69	299				655	1 982	12	4	3 877	1 730		42	62	308	31	105	370			
1998	1 372		2 393				4	284	59	297				411	1 729	2		4 215	1 370		61	49	187	18	70	117			
1999	1 473		1 206				1	286	57	276				510	1 825			4 015	1 435		37	24	87	47	15				
2000	1 896		1 757			15	6	276	43	275				660	2 089			3 423	1 668		41	49	122		73	28			
2001	2 030		3 048			9	69	224	28	267				458	1 886			4 608	1 433		52	31	96	3	90	178			3
2002	1 490		2 883	2		9	69	109	77	21				317	2 066		0	6 979	1 512		42	30	111	4	90	48	0	5	
2003	1 063		1 786	1	1	2	7	103	69	22				241	1 490	0		5 068	1 425		33	45	105		57	17	0		
2004[5]	952		2 615			0	1	85	65	24				315	1 591			6 364	1 900		31	19	86		45	18	0	0	

continued

Table1.4.9.1 (cont.)

Year	USSR				Estonia					Latvia			Lithuania[8]		Russia		Total											Total
	26	28	29	32	25	26	28	29	32	24+25	26	28	25	26	26	28	22	23[1]	24	25[4]	26	27	28	29	30	31	32	22-32
1973		2610															2 513		2 014	3 598	2 070		2 610					12 805
1974		2510															2 566		4 063	2 759	2 473		2 510					14 371
1975		6455															2 624		3 148	2 677	2 585		6 455	113	22		47	17 671
1976	471	1779	409	359													2 604		2 040	2 850	2 760		1 779	527	23		418	13 001
1977	210	1081	321	414													2 922		3 101	3 583	2 299		1 081	436	32		470	13 924
1978	288	1290	334	395													3 790		2 988	1 342	2 394		1 290	508	61		550	12 923
1979	158	1170	330	1012													2 899		2 917	1 545	2 018		1 170	522	54		1 165	12 290
1980	93	798	334	1080													2 535		3 078	1 659	1 473	20	979	560	69		1 245	11 618
1981	58	742	445	1078													2 586		3 165	1 181	1 599	21	936	706	56		1 213	11 463
1982	195	665	615	1121													2 074	104	3 482	2 517	1 818	65	681	837	58		1 265	12 901
1983	209	551	497	1114													2 412	115	4 095	1 936	1 114	212	603	687	67		1 234	12 475
1984	145	202	286	1226													2 453	85	3 044	2 498	1 433	53	215	462	108		1 361	11 712
1985	268	189	265	806													1 996	130	3 922	2 087	1 570	47	201	424	97		943	11 417
1986	442	159	281	556													1 777	65	4 426	3 061	2 226	60	174	483	128		737	13 137
1987	1315	203	279	397													1 393	122	3 131	2 556	3 060	51	216	440	106		540	11 615
1988	578	439	257	331													1 387	125	3 999	1 763	1 870	68	456	437	118		490	10 713
1989	783	512	214	214													1 569	83	4 702	1 930	1 872	66	528	392	122		377	11 641
1990	752	390	144	141													1 176		3 021	1 737	1 351		390	363	81		302	8 421
1991						49	1	135	51		123	323		125	216	10	1 171		3 335	2 039	2 418	88	354	371	81		218	10 075
1992							47	47	46		26	664		399	146		940	185	2 988	1 965	2 443	86	722	455	40		673	10 497
1993							52	86	55		99	389		155	225		884	220	1 892	3 339	1 709	83	451	524	57		738	9 897
1994								3	4		31	276		218	167		926	265	5 298	3 195	1 721	33	334	458	33		91	12 354
1995					8		16	52	35		39	322	8	187	271		1 145	289	4 963	7 639	1 990	81	396	450	28		166	17 147
1996							44	99	145		74	215		316	740		1 232	285	3 729	6 788	3 744	114	299	464	78		416	17 149
1997					15		101	96	125		78	284		554	1 001		2 011	42	4 465	4 201	3 437	105	769	379	69		424	15 902
1998					10		146	79	87	2	88	274		737	1 188		1 783	61	4 171	4 418	3 403	70	537	363	59		384	15 249
1999					8		92	150	164		140	365		547	964		1 983	37	3 055	4 111	3 133	15	457	436	57		440	13 724
2000					2	1	65	150	126	3	113	302		575	1 236		2 556	41	3 910	3 556	3 593	73	395	426	43		401	14 994
2001							100	161	221		201	412		1 127	1 355		2 488	52	4 974	4 773	4 119	90	690	385	28	3	488	18 090
2002							91	199	226		221	375		1 077	1 314		1 807	42	4 988	7 159	4 130	90	514	308	82		247	19 367
2003							122	192	128		281	392		1 066	1 402		1 304	33	3 323	5 180	4 175	57	532	295	69		150	15 118
2004[5]							89	144	167	7	169	600		834	1277		1 267	31	4 225	6 458	4 180	45	707	229	65		191	17 398

[1] For the years 1973-1981 the catches of Sub-division 23 are included in Sub-division 22.
[2] From October-December 1990 landings of Germany, Fed. Rep. are included.
[3] For the years 1973-1979 and 1990 the catches of Sub-divisions 24-29 are included in Sub-division 25.
[4] For the years 1973-1979 and 1990 the Swedish catches of Sub-divisions 24-29 are included in Sub-division 25.
[5] Provisional.
[6]Landings of Sub-division 27/28 are included
[7]Landings of Sub-division 31 are included
[8]Lithuanian landings for 1992 to 1997 are revised in 2005

1.4.10 Plaice in Subdivisions 22–32

State of the stock

The only information available for this stock is landing statistics, therefore it is not possible to evaluate the state of the stock.

Management objectives

No management objectives have been defined for this stock.

Reference points

No reference point are defined for this stock.

Factors affecting the fisheries and the stock

The highest total landings were taken at the end of the 1970s (8300 t in 1979) and the lowest around the 1990s (270 t in 1993). Since 1994, the landings have increased and reached 2800 t in 2002. Landings in 2004 were 1820 t. ICES Subdivision 22 is the main fishing area, and Subdivisions 24 and 25 are secondary areas. The fluctuations are presumed to be caused by migration of plaice from the Kattegat into the western Baltic Sea.

Scientific basis

There is no assessment for this stock.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

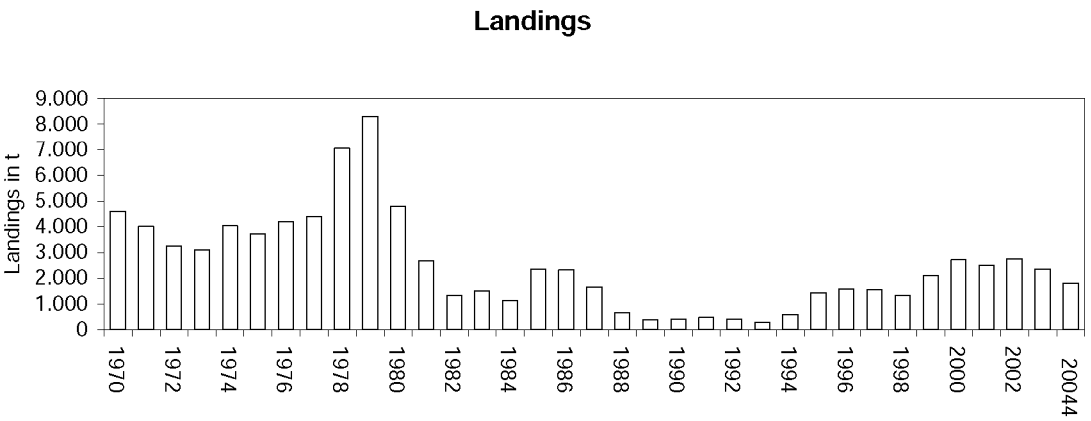


Table 1.4.10.1 Total landings (tons) of PLAICE in the Baltic Sea by ICES Subdivision and country (There are some gaps in the information, therefore "Total" is preliminary)

	Denmark					Germ. Dem. Rep.[1]		Germany, FRG			Poland		Sweden[2]							
Year/SD	22	23	24(+25)	25	26	22	24	22	24(+25)	28	25(+24)	26	22	23	24	25	26	27	28	29
1970	3,757		49					20	1						14					
1971	3,43		31					16							10					
1972	2,72		29					15							7					
1973	2,39		20				4	16			17	3			7					
1974	3,44		12			3	1	16			11	8			6					
1975	2,81		18			1	6	30			15	14			4					
1976	3,32		17			1	8	30			16	7			4					
1977	3,45		22				3	34			26	2			4					
1978	3,84		68			3	1,19	34			63	29			3					
1979	3,55		2,02			1	1,60	19			55	22			11					
1980	2,21		1,65				30	8			38	5			11					
1981	1,19		93				5	7	3		23	2			11					
1982	71		39				2	3			4	6			4					
1983	90		29				1	3	1		6	1			13	2		2		
1984	80		16					2			10				2					
1985	64		77			6	59	2	4		11	4			2					
1986	57		1,01			3	37	2			17	5			4					
1987	41		79				14	1	1		18				6	1		1		
1988	23		32				1								4					
1989	16		14								1				3					
1990	23		10												5					
1991	32		11					1												
1992	31		7					1												
1993	17		6					1												
1994	35		15								4									
1995	60	6	34					7	9		23			1	1	1				
1996	85	8	26					4	7		18			1	2	2	1			
1997	90		20					5	5		30			1						
1998	64		27					21	4		10	1		1		1				
1999	1,45		18					24	4		14			1		1				
2000	1,93		16					14	3		40			2		1				
2001	1,62		17					5	4		54			3		1				
2002	1,75		15	15	0.			4	14		42			4	1	1				
2003	1,02		32	29				3	9		48	1		2	1	5		0	0	
2004[4]	91		16	23				6	6		29			3		3				

continued

Table 1.4.10.1 continued

Year	Total by SD								Total
	22	23	24[3]	25	26	27	28	29	SD 22-29
1970	3.959		659						4.618
1971	3.595		423						4.018
1972	2.880		370						3.250
1973	2.564		323	174	30				3.091
1974	3.642		198	114	86				4.040
1975	3.127		297	158	142				3.724
1976	3.641		307	164	76				4.188
1977	3.805		300	265	26				4.396
1978	4.227		1.914	633	290				7.064
1979	3.759		3.751	555	224				8.289
1980	2.305		2.073	383	53				4.814
1981	1.273		1.138	239	27				2.677
1982	761		464	49	64	7	1		1.346
1983	943		456	84	12	24	2		1.521
1984	833		199	109		4	1		1.146
1985	742		1.429	123	49	5	1		2.349
1986	629		1.446	178	59	9	1		2.322
1987	432		1.020	198	5	12	1		1.668
1988	244		389	16	1	9	1		660
1989	174		188	15		6	1		384
1990	245		152	6					403
1991	343		126	4	1	2			476
1992	327		81	7		1			416
1993	187	2	76	4					269
1994	356	6	163	50	4				579
1995	676	76	447	243	3		1		1.446
1996	903	94	368	206	15	1			1.587
1997	953	13	264	316	3	1			1.550
1998	855	13	325	118	14	1			1.326
1999	1.701	13	234	155	1				2.104
2000	2.072	26	207	420	3				2.728
2001	1.685	39	225	562	3				2.514
2002	1.805	42	309	603	3,4				2.763
2003	1.059	26	438	830	13	0	0		2.366
2004[4]	971	35	238	568	8				1.820

[1] From October-December 1990 landings of Germany, Fed. Rep. are included.
[2] For the years 1970-1981 and 1990 the catches of Sub-divisions 25-28 are included in Sub-division 24.
[3] For the years 1970-1981 and 1990 the Swedish catches of Sub-divisions 25-28 are included in Sub-division 24.
[4] Preliminary data
[5] Danish catches in 2002 in SW Baltic were separated according to Sub-divisions 24 and 25

1.4.11 Dab in Subdivisions 22–32

State of the stock

The state of the stock is unknown.

Management objectives

There are no explicit management objectives for this stock.

Reference points

There are no defined reference points.

Factors affecting the fisheries and the stock

Total landings have decreased from 3106 t in 1994 to 715 t in 2002. Since 2002 the landings have increased to 1894 t in 2004. This species is discarded, mainly in the cod fishery. The level of discarding has not been evaluated yet.

Scientific basis

No analytical assessment has been performed in the present or in previous years.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

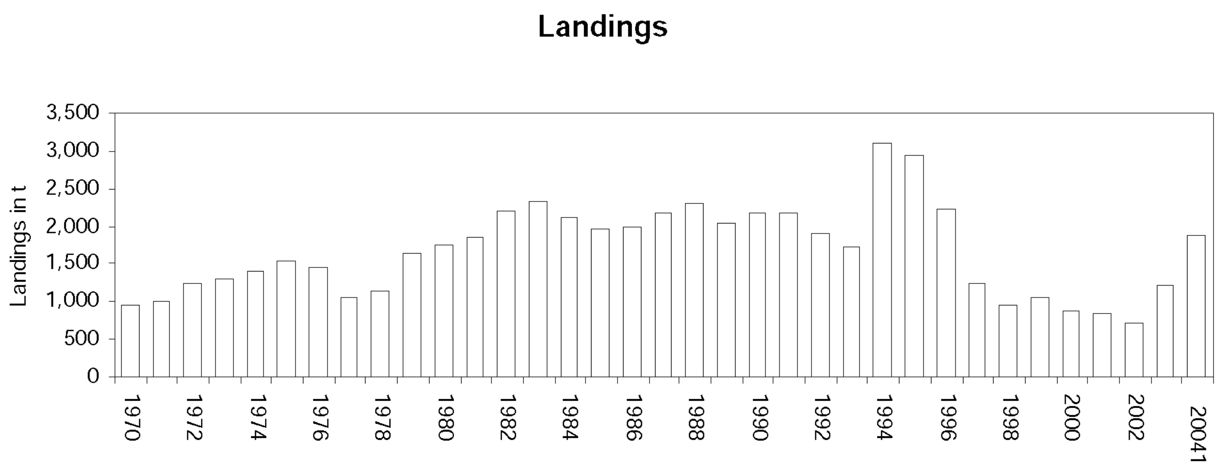


Table 1.4.11.1 **Landings (tons) of DAB in the Baltic Sea by Subdivision and country**
(There are some gaps in the information. therefore "Total" is preliminary)

	Denmark				Ger.Dem.Rep.[1]		Germany. FRG				Sweden[2]								Total									Total
Year/SD	22	23	24(+25)	25-28	22	24	22	24	25	26	22	23	24	25	27	28	29	30	22	23	24[3]	25[5]	26	27	28	29	30	SD 22-30
1970	845		20		11		74												930		20							950
1971	911		26		10		64												985		26							1.011
1972	1110		30		9		63						23						1.182		53							1.235
1973	1087		58		18		118						30						1.223		88							1.311
1974	1178		51		18		118						34						1.314		85							1.399
1975	1273		74		20		131						32						1.424		106							1.530
1976	1238		60		17		114						27						1.369		87							1.456
1977	889		32		13		89						25						991		57							1.048
1978	928		51		19	14	128	4											1.075		69							1.144
1979	1413		50		18	25	123	1					9						1.554		85							1.639
1980	1593		21		15	25	101						3						1.709		49							1.758
1981	1601		32		24	39	164						5						1.789		76							1.865
1982	1863		50		46	38	182	4					6	5	8	6		1	2.091		98	5		8	6		1	2.209
1983	1920		42		46	28	198						24	20	32	22		2	2.164		94	20		32	22		2	2.334
1984	1796		65		30	47	175	2					4	3	5	4		1	2.001		118	3		5	4		1	2.132
1985	1593		58		52	51	187	2					3	3	5	3		1	1.832		114	3		5	3		1	1.958
1986	1655		85		36	35	185	1					1	1	1	1			1.876		122	1		1	1			2.001
1987	1706		93		14	87	276	4					1	1	1	1			1.996		185	1		1	1			2.184
1988	1846		75		22	91	281	1					1	1	1	1			2.149		168	1		1	1			2.320
1989	1722		48		26	19	218	1					1	1	2	1			1.966		69	1		2	1			2.039
1990	1743		146		14	11	252	1					8						2.009		166							2.175
1991	1731		95				340	5					1						2.071		101							2.172
1992	1406		81				409	6						1	1		4		1.815		87	1		1		4		1.908
1993	996		155				556	10				7	1	1			1		1.552	7	166	1				1		1.727
1994	1.621		163				1.190	80	45			5	1	1					2.811	5	244	46						3.106
1995	1.510	47	127	10			1.185	49	3			5	1	5		1			2.695	52	177	18			1			2.943
1996	913	37	128				991	134	13	2	3		3	4	1				1.907	37	265	17	2	1				2.229
1997	728		60				413	21	2			5	5	10	3	1			1.141	5	86	12		3	1			1.248
1998	569		89				280	6	2			7	3	3	1				849	7	98	5		1				960
1999	664		59				339	4				3	1	1					1.003	3	64	1						1.071
2000	612		46				212	3				2		1					824	2	49	1						876
2001	586		72				191	5				4	1	2					777	4	78	2						861
2002	502		31				173	5				4							675	4	36							715
2003	559		171				494	7	0			1	0						1.053	1	179	0						1.233
2004[4]	953		185				745	10	0			1	1	0					1.698	1	196	0						1.894

[1] From October-December 1990 landings of Germany. Fed. Rep. are included.
[2] For the years 1970-1981 and 1990 the catches of Subdivisions 25-28 are included in Subdivision 24.
[3] For the years 1970-1981 and 1990 the Swedish catches of Subdivisions 25-28 are included in Subdivision 24.
[4] Preliminary data.
In 1995 Danish landings of Subdivisions 25-28 are included.

1.4.12 Turbot in Subdivisions 22–32

State of the stock

The state of the stock is unknown.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No reference points have been defined for this stock.

Factors affecting the fisheries and the stock

Turbot is mainly distributed in southern and western parts of the Baltic proper. Total landings of turbot increased from 42 t in 1965 to 1210 t in 1996. The landings decreased to approximately 500 t in the 2000s.

Scientific basis

No analytical assessment has been performed in the present or in previous years.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

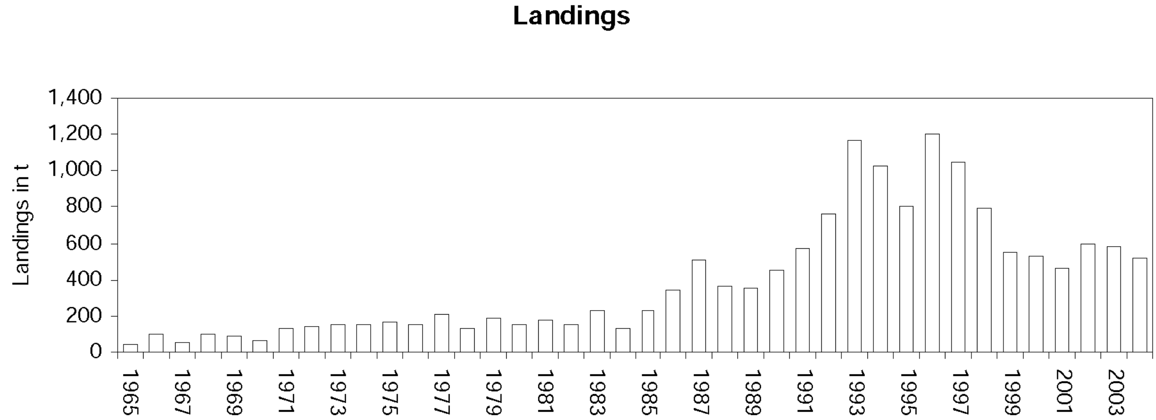


Table 1.4.12.1 Total landings (tonnes) of TURBOT in the Baltic Sea by ICES Subdivision and country (There are some gaps in the information, therefore "Total" is preliminary)

	Denmark					Germ. Dem. Rep.[1]		Germany, FRG				Poland		Sweden[2]							Latvia		Lithuania[5]	Russia
Year/SD	22	23	24(+25)	25	26	22	24	22	24	25	27	25(+24)	26	22	23	24	25	26	27	28(+29)	26	28	26	26
1965						3	39																	
1966	16		21			5	53																	
1967	14		20			7	10																	
1968	14		18			3	67																	
1969	13		13			4	57																	
1970	11		13			5	40									2								
1971	11		26			4	86									2								
1972	10		26			3	100									3								
1973	11		30			3	33					58	13			5								
1974	14		40			2	23					34	36			6								
1975	27		48			3	38	15				23	6			7								
1976	29		24				52	11				14	12			7								
1977	32		37				55	9				12	55			8								
1978	33		37			2	27	9				7	3			10								
1979	23		38			3	39	6				29	34			12								
1980	28		38				30	9				12	20			15								
1981	28		62			1	46	8				10	19			7								
1982	31		51			1	27	7				2	17			3	4		4	3				
1983	33		40			3	9	8				5	4			31	41		35	24				
1984	41		45			4	8	12				13	2			3	4		3	2				
1985	56		34			5	22	15				67	15			4	5		4	3				
1986	99		81			6	32	25				32	37			6	8		7	5				
1987	134		93			4	34	30				155	21			8	11		9	6				
1988	117		117			3	28	34				7	10			12	16		14	9				
1989	135		109			7	22	20					11			11	15		13	9				
1990	178		181			4	2	26				24	25			14								
1991	228		137					44	39			73	20			2	12		16					
1992	267		127					55	68			80	55			12	12		21	36				30
1993	159	29	152					74	56			520	72		2	4	14		13	38				34
1994	211	18	166					52	57	10		380	30		2	3	18	1	17	44				15
1995	257	11	94					65	53	4		30	15		2	3	54	9	31	83	34	27		20
1996	207	12	95					36	47	4	1	288	92	1	3	15	100	5	54	104	42	3	76	25
1997	151		68					60	52	3		290	70		2	6	70	1	53	86	33	14		25
1998	138		80					44	55	1		66	68		2	4	58	1	18	69	12	24		96
1999	106		59					23	48			18	15		2	4	41	3	17	60	20	34		48
2000	97		58					23	54			90	12		2	3	39		16	39	7	9		53
2001	76		53					19	31			121	10		2	5	16		9	29	5	1		69
2002	73		22	3.5	0.2			20	32	2		245	65		5	2	15		7	21	2	8		50
2003	48		28	5	0			10	39	1		184	178		1	2	18		3	14	7	2		28
2004[4]	61		27	7				12	27	1		225	96		1	1	8		3	14	3	8	7	15

Table 1.4.12.1 continued

Year	Total by SD							Total
	22	23	24[3]	25	26	27	28(+29)	SD 22-28(+29)
1965	3		39					42
1966	21		74					95
1967	21		30					51
1968	17		85					102
1969	17		70					87
1970	16		55					71
1971	15		114					129
1972	13		129					142
1973	14		68	58	13			153
1974	16		69	34	36			155
1975	45		93	23	6			167
1976	40		83	14	12			149
1977	41		100	12	55			208
1978	44		74	7	3			128
1979	32		89	29	34			184
1980	37		83	12	20			152
1981	37		115	10	19			181
1982	39		81	6	17	4	3	150
1983	44		80	46	4	35	24	233
1984	57		56	17	2	3	2	137
1985	76		60	72	15	4	3	230
1986	130		119	40	37	7	5	338
1987	168		135	166	21	9	6	505
1988	154		157	23	10	14	9	367
1989	162		142	15	11	13	9	352
1990	208		197	24	25			454
1991	272		178	85	20	16		571
1992	322		207	92	85	21	36	763
1993	233	31	212	534	106	13	38	1.167
1994	263	20	226	408	46	17	44	1.024
1995	322	13	150	88	93	31	110	807
1996	244	15	157	392	236	55	107	1.206
1997	211	2	126	363	188	53	100	1.043
1998	182	2	139	125	239	18	93	798
1999	129	2	111	59	144	17	94	556
2000	120	2	115	129	95	16	48	525
2001	95	2	89	137	102	9	30	464
2002	93	5	56	266	135	7	29	591
2003	58	1	69	208	225	3	16	579
2004[4]	73	1	55	241	121	3	22	516

[1] From October-December 1990 landings of Germany, Fed. Rep. are included

[2] For the years 1970-1981 and 1990 the catches of Sub-divisions 25-28 are included in Sub-division 24

[3] For the years 1970-1981 and 1990 the Swedish catches of Sub-divisions 25-28 are included in Sub-division 24

[4] Preliminary data

Danish catches in 2002-2004 in SW Baltic were separated according to Sub-divisions 24 and 25

In 2005 Lithuanian landings are reported for 1995 onwards

1.4.13 Brill in Subdivisions 22–32

State of the stock

The state of the stock is unknown.

Management objectives

No explicit objectives have been defined for this stock.

Reference points

No reference points have been defined for this stock.

Factors affecting the fisheries and the stock

This species is caught in the mixed fishery, mainly in Subdivision 22. High landings in the period 1994-1996 may be misreporting from the cod trawl fishery.

Scientific basis

There is no analytical assessment for this stock.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

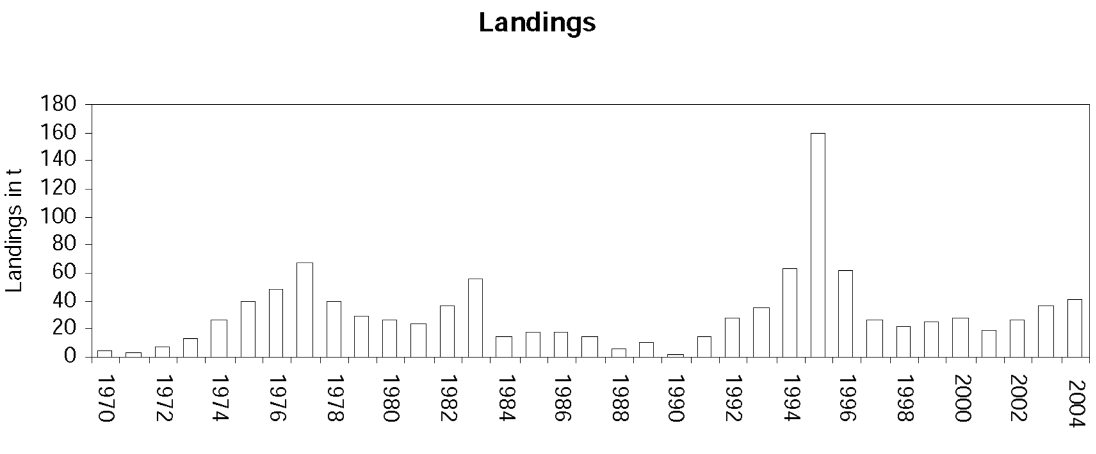


Table 1.4.13.1 Total landings (tonnes) of BRILL in the Baltic Sea by Subdivision and country (There are some gaps in the information, therefore "Total" is preliminary)

	Denmark			Germany, FRG	Sweden		Total			Total
Year	22	23	24-28	22	23	24-28	22	23	24-28	SD 22-28
1970	4						4			4
1971	3						3			3
1972	7						7			7
1973	11		2				11		2	13
1974	25		1				25		1	26
1975	38		1	1			39		1	40
1976	45		1	2			47		1	48
1977	60		2	5			65		2	67
1978	37			3			40			40
1979	30						30			30
1980	26						26			26
1981	22			1			23			23
1982	19					17	19		17	36
1983	13					42	13		42	55
1984	12					3	12		3	15
1985	16					1	16		1	17
1986	15					3	15		3	18
1987	12					3	12		3	15
1988	5					1	5		1	6
1989	9					1	9		1	10
1990						1			1	1
1991	15						15			15
1992	28						28			28
1993	29	5	1				29	5	1	35
1994	57	4	1			1	57	4	2	63
1995	134	12	1		5	8	134	17	9	160
1996	56	6					56	6		62
1997	25				1		25	1		26
1998	21				1		21	1		22
1999	24				1		24	1		25
2000	27				1		27	1		28
2001	19						19			19
2002	25.5		0.2		1		25.5	1	0.2	27
2003	35		1		0		35	0	1	36
2004[1]	39		1		1	0	39	1	1	41

[1] Preliminary data

1.4.14 Salmon in the Main Basin and the Gulf of Bothnia (Subdivisions 22–31)

In order to better support the management of the wild salmon stocks, ICES has established five new assessment units for the Baltic Main Basin and Gulf of Bothnia (see Figure 1.4.14.3). The grouping of stocks into units is based on management objectives and biological and molecular genetic characteristics of the stocks. Stocks of a particular unit are assumed to exhibit similar migration patterns. It can therefore be assumed that they are subjected to the same fisheries, experience the same exploitation rates, and could be managed in the same way (e.g. through the use of coastal management possibilities to improve the status of stocks in a specific assessment unit). Even though stocks of units 1 – 3 have the highest current smolt productions and therefore have an important role in sustaining economically viable fisheries, the stocks in units 4 and 5 have a relatively high proportion of overall genetic variability of Baltic salmon stocks.

Assessment unit	Name	Salmon rivers included
1	Northeastern Bothnian Bay stocks	On the Finnish-Swedish coast from Perhonjoki northward to the river Råneälven, including River Tornionjoki
2	Western Bothnian Bay stocks	On the Swedish coast between Lögdeälven and Luleälven
3	Bothnian Sea stocks	On the Swedish coast from Dalälven northward to Gideälven and on the Finnish coast from Paimionjoki northwards to Kyrönjoki
4	Western Main Basin stocks	Rivers on the Swedish coast in Divisions 25–29
5	Eastern Main Basin stocks	Estonian, Latvian, Lithuanian, and Polish rivers

State of the stock

The long-term management objective of reaching at least 50% of potential production by 2010 is met for some of the larger rivers while the status of the less productive wild stocks is poor, and many of these stocks are not expected to reach the long-term objective, at least not by 2010. Currently a higher proportion of wild salmon in catches are based on the successful management operations in the past.

The total wild smolt production has increased by about five times since the Salmon Action Plan (SAP) was adopted in 1997 and is now estimated at around half the overall smolt production potential. However, this development is not uniform among rivers; the number of smolts increased in the larger salmon rivers, whereas numbers remained low in many smaller stocks. The number of spawners is particularly low in the 'potential' rivers, i.e. rivers where salmon were extirpated and are now being reintroduced.

The probability of reaching 50% of the natural production capacity has been evaluated for the assessment units 1–3. For the wild salmon populations of unit 1, the smolt production in the beginning of the 90s has been hampered by high M74 mortality rates. The decrease in the exploitation of wild salmon in the mid-90s resulted in an increase in wild spawners and an increase in the number of smolts produced near the turn of the century. Once these smolts were ready to spawn, the M74 mortality had gone down, resulting in high smolt predictions. As a whole the stocks of unit 1 have between 40 to 60% probability of having reached 50% of the smolt production capacity in 2004. Of the stocks of unit 1, the rivers Simojoki and Råneälven have the lowest probability. The rivers of assessment units 2 and 3 are unlikely to have reached the IBSFC objective by 2004.

In the Main Basin, parr densities are high on the west side (unit 4), but seem to decrease on the east side (unit 5). The production of wild smolts seems very low in the Estonian river Pärnu.

Figure 1.4.14.4 summarises the status on a river basis, relative to the 1998–2000 potential smolt capacity numbers.

Production of wild and reared smolt (in millions) in the whole Baltic, excl. the Gulf of Finland. Estimates of wild smolt are revised downwards (about 10%) compared to data presented in the 2004 ICES Advisory Report (*ICES Advice*, 2004), based on an improved estimation procedure; general trends are not affected:

Salmon	Wild	Reared	Total
1996	*0.35*	*4.47*	*4.82*
1997	*0.53*	*4.94*	*5.47*
1998	*0.67*	*5.20*	*5.87*
1999	*1.07*	*5.02*	*6.09*
2000	*1.85*	*5.25*	*7.10*
2001	*1.87*	*4.99*	*6.86*
2002	*1.72*	*4.73*	*6.45*
2003	*1.55*	*4.70*	*6.25*
2004	*1.67*	*4.46*	*6.13*

The total nominal salmon catch in the Baltic Sea has declined, starting in 1990 from 5636 tonnes and decreasing to 2017 tonnes in 2004. The nominal catch in the sea increased by 9% from 226 427 salmon in 2003 to 247 455 salmon in 2004; in the coastal fisheries the increase was 40% and the number of salmon caught by the river fisheries increased by 3%. The TAC of 460 000 salmon in the Main Basin and the Gulf of Bothnia was utilised to 86% only, but is considered restrictive for the different fishery segments.

Management objectives

In 1997 IBSFC adopted the Salmon Action Plan (SAP) running 1997–2010 where the long-term objectives are:

1. To prevent the extinction of wild populations, further decrease of naturally produced smolts should not be allowed.
2. The production of wild salmon should gradually increase to attain by 2010 for each salmon river a natural production of wild Baltic salmon of at least 50% of the best estimate potential and within safe genetic limits, in order to achieve a better balance between wild and reared salmon.
3. Wild salmon populations shall be re-established in potential salmon rivers.
4. The level of fishing should be maintained as high as possible. Only restrictions necessary to achieve the first three objectives should be implemented.
5. Reared smolts and earlier salmon life stage releases shall be closely monitored.

Fishing in the sea and in the coastal areas affects the number of spawners. The salmon biology with a freshwater phase of 3–4 years means that an increase in spawners will only affect the smolt production about 4 years later. Therefore, the TAC in 2006 will have only marginal influence on whether the SAP objective is reached in 2010 or not. ICES recommends that managers should consider updating management objectives so they become relevant for action in the coming years.

For the purpose of advising TAC options for 2006 ICES has assumed that management continues to pursue the SAP 50% target together with the wish for maintaining fishing as high as possible, i.e. that the SAP as described above would remain the objective to be reached as soon as possible.

Reference points

In relation to the Management Objective the relevant stock indicator is the smolt production and the corresponding reference point is the 50% level of the natural production capacity on a river-by-river basis.

Smolt production estimates on a river basis are updated annually based on electrofishing in rivers and smolt trapping. Estimates of smolt production capacity are also updated annually based on surveys in the individual rivers.

For the purpose of advising on how well the SAP 50% target is reached, ICES maintains the use of the potential smolt capacities that were established in 1998–2000. ICES is investigating alternative estimation procedures but has not yet decided on the best way forward. Indications are that the 1998–2000 estimates are lower than the actual potentials.

Single-stock exploitation boundaries

The new estimates of the stock-recruitment relationship enable probabilistic forecasts of stock development. Estimated trends in smolt production and spawner numbers based on current exploitation in the marine areas suggest that a continuation of the current exploitation pressure will provide a high probability (70–80%) to reach the management objectives by 2010 for stocks of assessment unit 1.

Some rivers such as the rivers Rickleån (unit 2) and Ljungan (unit 3) are unlikely to reach the objective in 2006 and 2010. For Rickleån there is about 70% probability that the status of the stock has improved since 1996. For Ljungan this probability is only about 50%.

The smaller stocks are unlikely to reach 50% of the smolt production capacity by 2010. Some of the stocks of unit 5 have seen a decrease in smolt abundance in recent years.

The number of spawners in 2006 will determine the smolt abundances in 2010, i.e. the final target year of the Salmon Action Plan. As such, the TAC for 2006 offers the last chance to impact the probability of reaching the objective.

Because of the biology of salmon, actions on fishery in sea in 2007 and later will not influence the production of smolts in 2010 and before.

Exploitation boundaries in relation to existing management plans

Trends in smolt production and spawner numbers based on current exploitation in the marine areas suggest that a continuation of the current exploitation pressure will not impair the possibilities for reaching the management objective for the larger stocks (units 1 and 4).

The possibility for reaching the productivity objective in 2010 for the smaller stocks in units 2, 3, and 5 seems unlikely even under a complete fishing ban in 2006.

It is known that even small bycatches (in absolute numbers) can hinder the recovery of small stocks (e.g. stocks in units 2, 3, and 5) and therefore exploitation should be designed such that these stocks are given maximum protection. To achieve the long-term objective after 2010 for such stocks, either very large reductions in overall catches are required, or fisheries have to be moved to places where catches from small stocks are unlikely, such as in the rivers and estuaries supporting the strong stocks. However, while fishing on mixed stocks can prevent recovery, no fishing will not guarantee their recovery; there may be dispensatory population dynamic effects and adverse environmental conditions that prevent recovery. In particular, the productive quality of the freshwater habitats of the small stocks may have deteriorated in some rivers.

Long-term benefits for the smaller stocks are expected from a reduction of the fishing pressure, although it is uncertainwhether this is sufficient to rebuild these stocks to the level indicated in the SAP.

Management considerations

The overall catch has in recent years been well below the agreed TAC.

The number of spawners in 2006 will determine the smolt abundances in 2010, i.e. the final target year of the Salmon Action Plan. As such, the TAC for 2006 offers the last chance to impact the probability of reaching the IBSFC smolt objective. However, the impact of changes in TAC is limited because only salmon returning to spawn in 2006 can be affected and because fishing in 2005 already has affected their abundance.

To illustrate the influence of the 2006 TAC, ICES has calculated the probability of reaching the IBSFC objective in 2010 for Råneälven. This calculation used the revised 2005 potential smolt production. The resulting probability was 70% if the TAC for 2006 is set at the same level as in 2005; if the 2006 TAC is half of the 2005 TAC the probability increases to 72%. Even with 0 TAC, the probability only increases to 75%.

The limited impact of the TAC on the probability of reaching the IBSFC objectives by 2010 illustrates the fact that the opportunity to influence this probability has already been lost and that new management objectives are needed.

In spite of continuously high releases of reared salmon smolts in the Gulf of Bothnia and the Main Basin (currently around 4.5 million), catch samples from year 2004 indicate that the proportion of reared salmon was less than 50% in many of the Baltic Sea fisheries. On the basis of the wild/released ratio in the smolt phase, the expected proportion of reared salmon would have been about 73%. This suggests a significantly lower initial survival for the reared smolts compared to wild smolts, which is also supported by the available tagging results.

Recent efforts to re-establish self-sustaining salmon stocks in 'potential' rivers, where salmon stocks existed in the past but have been extirpated, present exceptional challenges to management. The numbers of spawners in the 'potential rivers' is likely to be particularly low following the initial re-introductions, and productivity of the river systems is likely to be lower than average (contributing to the extirpation of the original stock at exploitation rates which did not extirpate salmon in more productive systems). The same considerations as presented above for the weak existing salmon stocks also apply to re-established stocks. Therefore even small mortality rates in fisheries may be enough to deter re-establishment and recovery of salmon in these 'potential' rivers. If there is to be even a moderate likelihood of lasting benefits to accrue from the often expensive efforts at re-establishing salmon in these 'potential' rivers, fisheries must be distributed in space and time in ways which have very low probabilities of intercepting these salmon.

Improvement since the mid-1990s of Gulf of Bothnia wild salmon stocks in larger rivers is a consequence of the favourable coincidences in mortality factors (i.e. lower incidence of M74) associated with the salmon life cycle, together with the regulatory measures in the fisheries. The factors influencing the development of M74 are poorly understood and therefore future mortality rates due to M74 cannot be predicted. The M74 mortality has varied over the years and sudden changes in the incidence of the disease are likely to occur in the future. If these occur together with other factors decreasing spawning stock size, the drop of the wild stocks may be fast.

Where there are terminal fisheries to harvest reared salmon, extending the duration of the seasonal closures can reduce the mortality on wild salmon returning to the same areas to enter their natal rivers. If stock-specific measures could be developed to harvest surplus reared salmon without bycatch of wild salmon, such harvesting could proceed, and be incremental to the TAC without causing a conservation concern. However, any such harvesting programs should be reviewed by ICES prior to implementation, to ensure that they provide protection to wild stocks. A genetic stock composition evaluation of salmon taken in such areas should be applied, as this method can establish the origin of fish on a stock basis.

More than 80% of the salmon catch in the Gulf of Bothnia is taken by trapnets. If adipose finclipping of reared fish were introduced, it may be possible to retain finclipped fish, while wild fish could be released. However, if such selective fishery was introduced on a large scale its impact on the mortality of wild salmon is difficult to predict. In Sweden, all salmon and sea trout smolt released to the Baltic from 2005 and forward will be adipose finclipped.

Factors affecting the fisheries and the stock

Regulations and their effects

The overall TAC is effective in safeguarding wild salmon as a whole in the Main Basin to allow them to survive to the beginning of their spawning run. Restricting coastal and river fisheries directed at homing wild salmon requires additional technical measures. Many such measures have been in place during the recovery period of wild stocks, nearly all established nationally. These measures are essential for the continued increase of wild salmon and should be maintained unaltered. In Finland and Sweden the date of opening coastal fisheries in the Gulf of Bothnia has been delayed to restrict the harvest of the early run when the share of wild salmon is the largest. In most countries there are fishery closures near the mouths of salmon rivers.

The Salmon Action Plan adopted in 1997 resulted in reduced fishing mortality. Both the TAC and coastal management actions have decreased harvest rates and more salmon escaped to rivers for spawning. The stock has responded with an increase in smolt production as expected.

The driftnet fishery will be phased out starting with 2006 and will be completely phased out by the end of 2007. This may reduce the fisheries on mixed stocks. However, the reduction may be offset by an expansion of longlining and coastal trapnetting. Reducing fishing on mixed stocks in the open sea will allow selective coastal management of stocks, e.g. stocks that have not recovered.

The environment

Environmental conditions have a marked effect on the status of salmon stocks, particularly conditions in freshwater where river damming and habitat deterioration has had a devastating effect on the stocks.

Seal populations have increased during the 1990s in the Gulf of Bothia, in the Gulf of Finland, and in Subdivision 29. Seals interfere with salmon gears and affect salmon fisheries in several different ways:

1. Damaging salmon caught in the nets, leading to direct landing losses.
2. Damaging gears, leading to escapement of salmon caught and to capital losses due to damages of gear.
3. Predation on the salmon, reducing the fishable stock.

Catch losses from seal damage have decreased due to changes in the fishing gear and are expected to decrease further as more fishers change fishing gear. These losses are not included in the TAC, but are a source of mortality associated with the fisheries.

All these effects are difficult to quantify. Losses associated with damage to the gears and to the salmon in traps or in nets have been estimated although with major uncertainty (see ICES ACFM report 2002, *ICES Cooperative Research Report* No. 255). The indirect effects can only be very crudely estimated and an estimate of the effect of the seal population on the recruitment of commercial species is not possible, since this requires a precise estimate of the total seal population size together with information on its diet.

Dioxin levels in Baltic salmon generally exceed the maximum level set for fish and fishery products of 4 pg WHO-PCDD/F-TEQ/g fresh weight (Council Regulation (EC) No 2375/2001). Finland and Sweden have a dispensation from the EU until 2006 allowing national use of the salmon provided dietary advice is given to the public. At the present time it is still uncertain if the dispensation given to Sweden and Finland for the national use of salmon will be continued after 2006. Denmark allows commercial marketing of salmon weighing less than 4.4 kg fresh weight (ungutted weight). Larger salmon need to be landed and destroyed. Sweden allows salmon with the same weight limits to be exported to EU member states. A large part of the catches in the Baltic area have traditionally been put on the market on the Danish island of Bornholm. Since this is not longer possible for larger fish, the entire market for Baltic salmon has changed. In Latvia landing and marketing of salmon has been prohibited since the beginning of 2005. Latvia, Lithuania, Estonia, and Poland have also applied for exceptions from the EU regulation on dioxine.

Scientific basis

Data and methods

The main information on the abundance and exploitation of wild salmon in the Baltic comes from electrofishing, smolt-trapping, and mark-recapture data. This information is supplemented by catch and effort data from the fisheries and by stock composition data.

The assessment uses a Bayesian estimation procedure. This technique allows an explicit incorporation of expert opinions and other prior knowledge on parameters in the assessment. Within this approach uncertainties about estimated quantities are formulated as probability distributions.

The results of the assessment models are used to calculate the probability that IBSFC's objective of reaching 50% of the carrying capacity will be reached, and to assess future probabilities of reaching this objective under different assumptions about future exploitation and states of nature.

Uncertainties in assessment and forecast

Interpretation of the recapture data is difficult because of an unknown rate of non-reported recaptures and because effort data are incomplete. In recent years, no Swedish tagging data have been available. This may also have changed the reporting rates of Finnish tags by Swedish fishers, thereby affecting the quality of the remaining tagging data. For each year the Swedish tagging data is not available for the assessment, its impact on the reliability of the assessment results increases. Genetic stock proportion estimates from catch samples can be regarded as alternative sources of information to estimate the exploitation rate of wild salmon stocks, if the samples are taken to be representative of the catches.

The current results of the assessment methodology illustrate the importance of collecting information from wild salmon stocks within each assessment unit. Based on the current assessment methodology, the minimum data collected under the EU Data Collection Regulation would need to cover parr density data from each wild salmon river, as well as smolt trapping data, spawner abundance data, and tagging data from at least one wild salmon index river within each assessment unit. The combination of parr density data from every wild salmon river with data from index rivers would make it possible to apply the same assessment methods used this year for the wild salmon stocks of assessment unit 1 to all units within the Baltic Sea.

Comparison with previous assessment and advice

The assessment and methodology has expanded compared to the assessment presented in 2004. This year, appropriate stock-recruitment relationships have been estimated for stocks of unit 1, and quantitative stock-projections have been done up to 2010. The general view on the status of the stocks is slightly more pessimistic than last year.

Up to 2004 ICES has advised that IBSFC should maintain a constant TAC of 410 000 individuals until there is firm evidence of improved smolt production. Evidence of such improvement is seen for stocks of assessment unit 1 but not for wild salmon stocks from other units, e.g. units 2 and 3. Smolt abundance estimates for some wild salmon stocks of unit 5 have even decreased (Table 1.4.14.1).

Smolt production capacities are based on expert opinions on different factors affecting the carrying capacity, like area suitable for production, habitat quality, and mortality of smolts during downstream migration. These opinions show a large variation, implying that estimated capacities are highly uncertain. The current assessment includes, and future assessments will include new information on stock-recruitment relationships for Baltic salmon stocks, allowing for an update on the smolt production capacity estimates in case the additional information is informative. Such an update can be expected in each assessment year as new data accumulates. The amount of annual change in the capacity estimates can be expected to be highest in the first year when data is brought in.

The IBSFC objective states that the production of wild Baltic salmon needs to reach 50% of the smolt production capacity by 2010.

Formulating the Salmon Action Plan recovery objective in probabilistic terms would be: "to ensure that the probability that the smolt production is below the target is low". This requires a specification of a low probability (e.g. 10%?) from managers. An element in the revision of the estimation procedures is to consider appropriate values for discussion with the Commission. For each stock, managers should evaluate what risk they are willing to take in order to decide if the probability to reach IBSFC objectives is sufficient for a particular stock.

Source of information

Report of the Baltic Salmon and Trout Assessment Working Group, 2005 (ICES CM 2005/ACFM:18).

Year	ICES Advice	Catch corresp. to advice '000 tons	Rec TAC '000 fish	Agreed TAC[1] '000 t	Agreed TAC[1] '000 fish
1987	No increase in effort	-	-		
1988	Reduce effort	<3.00			
1989	TAC	2.90	850		
1990	TAC	1.68			
1991	Lower TAC	-[2]	-[2]	3.35	
1992	TAC		688	3.35	
1993	TAC		500[3]		650
1994	TAC		500[3]		600
1995	Catch as low as possible in offshore and coastal fisheries	-	-		500
1996	Catch as low as possible in offshore and coastal fisheries	-	-		450
1997	Catch as low as possible in offshore and coastal fisheries	-	-		410
1998	Offshore and coastal fisheries should be closed	-	-		410
1999	Same TAC and other management measures as in 1998	-	410		410
2000	Same TAC and other management measures as in 1999	-	410		450
2001	Same TAC and other management measures as in 2000	-	410		450
2002	Same TAC and other management measures as in 2001	-	410		450
2003	Same TAC and other management measures as in 2002	-	410		460
2004	Same TAC and other management measures as in 2003	-	410		460
2005	Current exploitation pressure will not impair the possibilities for reaching the management objective for the stronger stocks.	-	-		460
2006	Current exploitation pressure will not impair the possibilities for reaching the management objective for the larger stocks. Long-term benefits for the smaller stocks are expected from a reduction of the fishing pressure, although it is uncertain whether this is sufficient to rebuild these stocks to the level indicated in the SAP.	.	-		

[1]TAC does not include river catch. [2]TAC much below present levels. [3]Equivalent to 2.25–2.70 thousand t.

Landings

Year	Rivers		Coast			Offshore	Coast and Offshore[1]			Total
	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish[2]	'000 t	'000 fish[2]
1987	0.05		0.39		3.21		3.59	891	3.64	897
1988	0.06		0.41		2.43		2.85	784	2.90	791
1989	0.08		0.65		3.27		3.92	1035	4.00	1049
1990	0.13		1.31		3.65		4.96	1113	5.08	1131
1991	0.12		1.03		3.00		4.03	757	4.15	776
1992	0.12		1.24		2.66		3.90	710	4.02	727
1993	0.11		0.83		2.57		3.40	679	3.52	657
1994	0.10		0.58		2.25		2.83	584	2.93	595
1995	0.12		0.67		1.98		2.65	553	2.77	571
1996	0.21	36	0.73	168	1.77	366	2.50	534	2.65	570
1997	0.28	45	0.78	149	1.53	282	2.31	431	2.59	476
1998	0.19	30	0.55	104	1.56	314	2.11	418	2.30	449
1999	0.17	30	0.57	104	1.25	256	1.82	360	1.99	390
2000	0.18	30	0.52	100	1.45	313	1.97	413	2.15	443
2001	0.16	30	0.57	121	1.19	262	1.76	383	1.92	413
2002	0.14	28	0.59	126	1.03	234	1.62	360	1.75	388
2003	0.11	24	0.41	108	0.96	226	1.37	334	1.47	359
2004[3]	0.13	25	0.71	147	1.12	248	1.83	395	1.95	420

[1]For comparison with TAC. [2]Catch in numbers before 1993 based on estimates. [3]Preliminary.

Table 1.4.14.1 Nominal catches and registered discards (incl. seal damaged salmon) of Baltic Salmon in tonnes round fresh weight, from sea coast and river by country in 1972-2004 in Subdivisions 22-32.

Year	Country										Total	discards	GT
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	USSR	reported catches		
1972	1045	na	403	117	na	na	13	na	477	107	2162	na	na
1973	1119	na	516	107	na	na	17	na	723	122	2604	na	na
1974	1224	na	703	52	na	na	20	na	756	176	2931	na	na
1975	1210	na	697	67	na	na	10	na	787	237	3008	na	na
1976	1410	na	688	58	na	na	7	na	665	221	3049	na	na
1977	1011	na	699	77	na	na	6	na	669	177	2639	na	na
1978	810	na	532	22	na	na	4	na	524	144	2036	na	na
1979	854	na	558	31	na	na	4	na	491	200	2138	na	na
1980	886	na	668	40	na	na	22	na	556	326	2498	na	na
1981	844	25	663	43	184	36	45	61	705		2606	na	na
1982	604	50	543	20	174	30	38	57	542		2058	na	na
1983	697	58	645	25	286	33	76	93	544		2457	na	na
1984	1145	97	1073	32	364	43	72	88	745		3659	na	na
1985	1345	91	963	30	324	41	162	84	999		4039	na	na
1986	848	76	1000	41	409	57	137	74	966		3608	na	na
1987	955	92	1051	26	395	62	267	104	1043		3995	na	na
1988	778	79	797	41	346	48	93	89	906		3177	na	na
1989	850	103	1166	52	523	70	80	141	1416		4401	na	na
1990	729	93	2294	36	607	66	195	148	1468		5636	na	na
1991	625	86	2171	28	481	62	77	177	1096		4803	na	na
1992	645	32	2121	27	278	20	170	66	1189		4548	na	na
1993 1)	575	32	1626	31	256	15	191	90	1134		3966	na	na
1994	737	10	1209	10	130	5	184	45	851		3181	na	na
1995	556	9	1324	19	139	2	133	63	795		3040	na	na
1996	525	9	1316	12	150	14	125	47	940		3138	na	na
1997	489	10	1357	38	170	5	110	27	824		3030	na	na
1998	495	8	850	42	125	5	118	36	815		2494	na	2894
1999	395	14	720	29	166	6	135	25	672		2162	na	2435
2000	421	23	757	44	149	5	144	27	771		2342	186	2528
2001	443	16	606	39	136	4	180	37	616		2076	213	2289
2002	334	16	509	29	108	11	197	66	572		1841	136	1977
2003 2)	454	10	409	29	47	3	198	22	365		1537	79	1616
2004 2)	370	7	584	35	34	3	88	16	879		2017	69	2086
Mean 1999-2003	409	16	600	34	121	6	171	35	599	0	1992	137	2155
Mean	771	44	946	40	249	27	101	70	803	190	2996	137	2261

All data from 1972-1994 includes sub-divisions 24-32, while it is more uncertain in which years sub-divisions 22-23 are included. The catches in sub-divisions 22-23 are normally less than one ton. From 1995 data includes sub-divisions 22-32.

Catches from the recreational fishery are included in reported catches as follows: Finland from 1980, Sweden from 1988, Denmark from 1998. Other countries have no, or very recreational catches.

Danish, Finnish, German, Polish and Swedish catches are converted from gutted to round fresh weight w by multiplying by 1.1.

Estonian, Latvian, Lithuanian and Russian catches before 1981 are summarized as USSR catches.

Estonian, Latvian, Lithuanian and Russian catches are reported as whole fresh weight.

Sea trout are included in the sea catches in the order of 3 % for Denmark (before 1983), 3% for Estonia, Germany, Latvia, Lithuania, Russia, and about 5% for Poland (before 1997).

Estimated non-reported coastal catches in Sub-division 25 has from 1993 been included in the Swedish statistics.

Danish coast catches are non-profesional trolling catches.

1. In 1993 fishermen from the Faroe Islands caught 16 tonnes, which are included in total Danish catches.

From 2000 to 2002 total discards includes registered and questimated discards. From 2003 discards only includes registered discards from Finland.

Swedish data from 2003, and Polish data from 2004 will be redovised in the repport for 2005.

In 2004 data from Finland, Russia and Sweden are preliminary.

Table 1.4.14.2 Salmon smolt production in Baltic rivers with natural reproduction of salmon in the 1980's and 1990's grouped by assessment units used in modeling. Most probable number (x 1000) of smolts from natural reproduction with the associated uncertainty (95% Probability interval). In the previous report medians of the probability distributions were presented in the corresponding smolt production table. Because of the change in presentation, current point estimates are generally lower than previous ones (see Fig. 6.1.1). Extention of these time series backwards are made to provide longer time series as results of the modeling; the extension is based on old WGBAST reports and should be regarded as preliminary. The reproduction area and potential production estimates of the Gulf of Bothnia rivers are partly results of the Bayesian modeling of expert knowledge of Uusitalo et al., and partly updated expert opinions collected during the meeting. Uncertainty associated with some of the estimates of the Main basin and the Gulf of Finland are still missing. Also some of the predictions of the 2005-2006 are not available.

Assessment unit, sub-division, country	Category	Reprod. area (ha, mode)	Potential ('1000) 1998-2000	Potential ('1000)	Wild smolt production (x 1000) 1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Pred 2005	Pred 2006	Method of estimation Pot. prod.	Pres. prod.	Reared smolts 2004
Gulf of Bothnia, Sub-div. 30-31:																											
Finland:																											
Simojoki	wild	254	75	76	2	2	10	10	9	13	11	9	2	1	3	8	15	50	64	56	53	38	47	42	1	1	2
95% PI		218-299		30-728	1-4	1-4	6-20	6-20	5-16	8-25	7-22	5-20	1-4	1-3	2-6	5-16	9-29	33-84	44-99	38-89	36-85	26-62	29-90	21-133			
Finland/Sweden:																											
Tornionjoki;Tornealven	wild	4997	500	826	50	66	64	78	92	106	168	213	133	100	87	108	199	492	670	578	515	507	489	463	1	1	4
95% PI		3877-6695		318-10900	27-123	36-164	35-155	53-129	65-140	73-169	119-254	145-344	84-243	69-157	59-138	76-164	151-276	375-674	524-888	477-715	401-687	391-686	362-697	295-836			
Sweden:																											
Kalixalven	wild	2570	250	398	28	38	37	78	124	102	158	81	70	63	40	71	156	225	215	203	181	261	402	392	1	1 (1990-) 4 (-1989)	0
95% PI		2062-3295		159-3336	13-115	17-152	17-148	30-1121	48-1566	40-1133	61-1826	31-1141	27-970	24-843	16-454	27-797	60-2554	88-2416	83-2618	78-2518	70-2145	101-2863	156-4591	152-4398			
Assessment unit 1, total				**1748**	**115**	**152**	**156**	**266**	**368**	**336**	**513**	**414**	**302**	**242**	**181**	**268**	**568**	**1029**	**1217**	**1072**	**973**	**1099**	**1379**	**1389**			6
95% PI				712-12462	67-248	88-328	93-324	104-2761	144-3600	136-2500	206-4089	169-2943	121-2437	96-2051	77-1053	110-1806	220-6708	441-5525	522-6473	452-6206	417-5207	462-6516	558-10312	566-9856			
Råneälven	wild	384	20	36			0.6	0.6	0.6	0.6	0.6	1.5	0.6	0.6	1.3	2.5	4	9	10	7	5	8	11		1	1 (1994-) 4 (-1993)	0
95% PI		325-462		15-282			0.2-18	0.2-18	0.2-18	0.2-18	0.2-18	0.6-71	0.2-29	0.2-19	0.5-24	1-46	2-158	3-205	4-175	3-133	2-84	3-140	4-285				
Piteälven	wild	425	33	46			1	1	1	1	1	1	3	3	5	6	4	5	18	12	7	9	7	21	7	5**	0
95% PI		359-511		32-67			0.5-2.5	0.5-2.5	0.5-2.5	0.5-2.5	0.5-2.5	0.5-2.5	2-7	2-7	3-12	3-14	2-10	3-13	10-44	6-29	4-17	5-22	4-18	13-37			
Åbyälven	wild	84	16	8.4			1.0	0.5	0.8	1.5	2.0	0.9	0.8	0.6	1.3	1.2	1.5	3.2	4.3	3.2	1.7	2.1	1.0	1.0	1	1 (1990-) 4 (1989)	0
95% PI		67-108		3-123			0.4-50	0.2-27	0.3-31	0.6-38	0.8-54	0.4-71	0.3-20	0.2-28	0.5-39	0.5-55	0.6-31	1.2-61	1.7-95	1.2-69	0.7-52	0.8-42	0.4-35	0.4-30			
Byskealven	wild	560	80	45			9	9	9	15	32	21	11	12	11	20	32	42	52	41	28	33	49	49	1	1 (1990-) 4 (1989)	0
95% PI		473-673		17-812			3-279	3-188	4-107	6-172	12-376	8-323	4-144	5-118	4-115	8-218	13-355	16-434	21-500	16-427	11-310	13-311	19-479	19-477			
Rickleån	wild	15	4	3.6			0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.04	0.04	0.03	0.03	0.03	0.02	1	1	0
95% PI		9.2-29		1.4-40			0-1.6	0-0.8	0-0.6	0-0.5	0-0.5	0-0.5	0-1.4	0-1.3	0-1.2	0-1.3	0-1.3	0.01-1.9	0.02-2.9	0.02-3.2	0.01-4.6	0.01-3.1	0.02-3.5	0.01-2.9			
Sävarån	wild	21	5	1.6			0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.3	0.3	0.4	0.5	0.3	0.4		1	1	0
95% PI		13-40		0.62-33			0.04-12	0.05-6	0.05-6	0.09-8	0.05-6	0.03-4	0.05-6	0.03-4	0.03-4	0.11-9	0.07-7	0.1-8	0.12-10	0.15-12	0.18-13	0.13-11	0.17-15				
Ume/Vindelalven	wild	1242	200	83	12	8	4	13	19	9	11	11	7	3	5	9	39	81	48	59	65	53	97	96	1	1	0
95% PI		917-1778		32-1960	5-282	3-214	2-440	5-564	8-489	4-323	4-357	4-239	3-120	1-79	2-103	3-148	15-1033	31-1813	18-817	23-1018	25-1069	20-1005	37-1692	37-1503			
Orealven	wild	105	20	7.15	0.5	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3	0.3	0.5	0.3	0.3	1	1	0
95% PI		84-135		3-146	0.2-26	0.1-16	0.1-16	0.0-18	0-11	0-9	0-10	0.03-8	0-8	0-11	0-11	0.05-13	0.06-14	0.09-15	0.1-17	0.1-19	0.1-28	0.2-38	0.2-41	0.2-43			
Lögdealven	wild	104	19	39	0.3	0.1	0.1	0.1	0.1	0.2	0.4	0.2	0.2	0.3	0.3	0.6	0.8	1.2	1.6	1.3	1.1	1.2	1.7	2.2	1	1	0
95% PI		82-136		6-248	0.1-24	0.04-16	0.04-7	0.06-9	0.05-8	0.1-9	0.2-16	0.1-14	0.1-10	0.1-13	0.1-12	0.2-27	0.3-28	0.5-33	0.6-41	0.5-38	0.4-28	0.5-31	0.7-51	0.9-68			
Assessment unit 2, total				**545**			**59**	**49**	**57**	**61**	**99**	**84**	**47**	**40**	**50**	**83**	**145**	**226**	**253**	**218**	**178**	**182**	**286**	**247**			0
95% PI				233-2995			23-774	19-714	22-579	25-459	41-631	35-497	21-229	18-180	23-203	38-337	58-1290	89-2129	112-1177	92-1298	73-1263	75-1234	117-2034	101-1769			
Ljungan	mixed	17	20	5.9					0.10	0.06	0.10	0.06	0.02	0.04	0.13	0.16	0.20	0.46	0.36	0.26	0.13	0.04	0.08	0.06	1	1	0
95% PI		9.8-37		1.3-27					0.04-8	0.02-4	0.04-7	0.03-6	0.01-2.5	0.02-4	0.06-11	0.07-11	0.1-13	0.2-16	0.14-16	0.1-13	0.05-7	0.02-3	0.04-5	0.02-4			
Assessment unit 3, total				**5.9**					**0.10**	**0.06**	**0.10**	**0.06**	**0.02**	**0.04**	**0.13**	**0.16**	**0.20**	**0.46**	**0.36**	**0.26**	**0.13**	**0.04**	**0.08**	**0.06**			0
95% PI				1.3-27					0.04-8	0.02-4	0.04-7	0.03-6	0.01-2.5	0.02-4	0.06-11	0.07-11	0.1-13	0.2-16	0.14-16	0.1-13	0.05-7	0.02-3	0.04-5	0.02-4			
Total Gulf of B., Sub-divs.30-30				**2789**					**523**	**483**	**724**	**591**	**387**	**309**	**272**	**413**	**910**	**1712**	**1706**	**1552**	**1417**	**1530**	**2044**	**1973**			6
95% PI				1219-13639					213-3769	206-2630	304-4286	255-3092	160-2515	127-2118	124-1121	182-1925	366-7130	817-6032	784-6838	703-6579	656-5538	682-6853	876-10898	849-10351			
Sweden:																											
Emån	wild	21.7	15	15			5	5	5	15	5	4.5	3	2.5	4	3.5	4	5	3	3	3	2.5	3		7	4**	0
95% PI				11-21			3.6-7	3.6-7	3.6-7	11-22	3.6-7	3.3-7	2.2-4	1.8-3.7	2.9-6	2.5-5	2.9-6	3.6-7	2.2-4	2.2-4	2.2-4	1.8-3.7	2.3-4				
Morrumsån	wild	44	100	90			120	120	120	100	90	60	30	35	60	60	76	98	70	67.7	55	75.5	50	60	7	4**	0
95% PI				66-128			86-178	86-180	86-180	72-150	64-135	43-90	22-45	25-52	43-90	43-90	54-114	70-147	50-105	49-102	39-82	54-113	40-66	47-79			
Assessment unit 4, total				**103**			**125**	**125**	**125**	**116**	**95**	**65**	**33**	**38**	**64**	**64**	**80**	**103**	**73**	**71**	**58**	**78**	**53**				0
95% PI				79-140			91-185	91-185	91-185	86-165	69-140	47-95	24-48	28-55	47-94	46-93	58-118	75-152	53-108	51-104	42-85	57-116	42-69				
Estonia																											
Pärnu	wild	3	3.5	3.5											3	2	1	0.1	0.1	0.1	0	0	0		3	3, 4	0
95% PI															1.3-16	0.9-11	0.4-5	0-0.5	0-0.5	0-0.5	0-0	0-0	0-0				
Latvia																											
Salaca	wild		30	30							22	15	15	20	20	29	27	19	29	29	25	10			7	2	0
95% PI				26-35							15-36	10-25	10-25	14-33	14-33	20-48	18-44	13-31	20-48	20-48	17-41	7-16					
Vitrupe	wild			4							5	5	5	5	5	4	4	4	2	2	2	2			7	5	0
95% PI				2.6-7.2							2.8-12	2.8-12	2.8-12	2.8-12	2.8-12	2.2-9	2.2-9	2.2-9	1.1-5	1.1-5	1.1-5	1.1-5					
Peterupe	wild			5							5	5	5	5	5	4	4	4	2	2	2	2			7	2, 5	0
95% PI				3.2-9							2.8-12	2.8-12	2.8-12	2.8-12	2.8-12	2.2-9	2.2-9	2.2-9	1.1-5	1.1-5	1.1-5	1.1-5					
Gauja	mixed			28							17	13	13	14	14	13	13	13	12	15	15	10			7	2, 5	124
95% PI				18-51							11-28	9-22	9-22	9-23	9-23	9-22	9-22	9-22	8-20	10-25	10-25	7-17					
Daugava***	mixed			10							5	5	5	5	5	5	5	5	2	5	2	2			7	5, 7	608
95% PI				6-18							2.8-12	2.8-12	2.8-12	2.8-12	2.8-12	2.8-12	2.8-12	2.8-12	1.1-5	2.8-12	1.1-5	1.1-5					
Irbe	wild			4							10	10	8	7	7	7	7	7	5	5	5	4			7	5	0
95% PI				2.6-7.2							6-23	6-23	5-19	3.9-16	3.9-16	3.9-16	3.9-16	3.9-16	2.8-12	2.8-12	2.8-12	2.2-9					
Venta	mixed			15****							15	15	15	15	12	12	12	12	10	12	10	10			7	2, 5	50
95% PI				10-27							10-27	10-27	10-27	10-27	8-22	8-22	8-22	8-22	6-18	8-22	6-18	6-18					
Saka	wild			8							10	10	10	10	8	7	7	7	2	7	2	2			7	5	0
95% PI				5-14							6-18	6-18	6-18	6-18	5-15	5-13	5-13	5-13	1.3-3.6	4.5-13	1.3-3.6	1.3-3.6					
Uzava	wild			4							2	2	2	2	2	1	2	2	2	1	2	2			7	5	0
95% PI				2.6-7.2							1.1-5	1.1-5	1.1-5	1.1-5	1.1-5	0.6-2.3	1.1-5	1.1-5	1.1-5	0.6-2.3	1.1-5	1.1-5					
Barta	wild			4							2	2	2	2	2	1	1	1	2	1	2	2			7	5	0
95% PI				2.6-7.2							1.1-5	1.1-5	1.1-5	1.1-5	1.1-5	0.6-2.3	0.6-2.3	0.6-2.3	1.1-5	0.6-2.3	1.1-5	1.1-5					
Lithuania																											
Nemunas river basin	wild			150							20	20	20	20	20	20	2	5	4	4	3	4			6	3, 4	0
95% PI											17-25	17-25	17-25	17-25	17-25	17-25	1.8-2.7	4.2-6	3.5-5	3.3-5	2.8-4	3.7-6					
Assessment unit 5, total				**268**											**161**	**162**	**97**	**96**	**85**	**97**	**81**	**63**					782
95% PI				249-289											129-208	129-210	72-137	72-135	62-124	72-137	59-119	45-94					
Total Main B., Sub-divs. 22-29				**374**											**229**	**229**	**181**	**204**	**162**	**171**	**143**	**144**					**782**
95% PI				340-413											190-282	189-283	145-233	163-262	129-211	137-221	113-186	114-190					
Gulf of B.+Main B., Sub-divs. 22-31				**3206**											**532**	**670**	**1073**	**1847**	**1871**	**1721**	**1546**	**1669**					**788**
95% PI				1441-13958											288-1334	330-2142	440-7399	880-6548	875-7057	793-6827	725-5785	756-7071					

Table 1.4.14.3 The M74 frequency or the mean offspring M74-mortality (in %) of searun female spawners belonging to reared populations of Baltic salmon in hatching years 1985-2002 with projections for year 2003. All data originate from hatcheries.

River	Sub-div	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Simojoki (2)	31		*6*	2	6	*3*	*14*	4	53	74	*53*	92	*86*	91	31	59	44	41	47	7	7	
Torne älv (2)	31				5	6	1	29	70	76	89	76			*25*	*61*	34	41	*69*	3	*0*	
Lule älv	31								58	66	62	50	52	38	6	34	21	29	37	4	4	2
Skellefteälven	31								40	49	69	49	77	16	5	42	12	17	19	7	0	
Ume/Vindelälven	30	40	20	25	19	16	31	45	77	88	90	69	78	37	16	53	45	39	38	15	4	
Angermanälven	30								50	77	66	46	63	21	4	28	21	25	46	13	4	
Indalsälven	30	4	7	8	7	3	8	7	45	72	68	41	64	22	1	20	22	6	20	4	0	
Ljungan	30								64	*96*	*50*	56	28	29	10	25	10	0	55	0		
Ljusnan	30							17	33	75	64	56	72	22	9	41	25	46	32	17	0	
Dalälven	30	28	8	9	20	11	9	21	79	85	56	55	57	38	17	33	20	33	37	13	4	7
Mörrumsan	25	47	49	65	46	58	72	65	55	90	*80*	63	56	23								
Neva/Åland (2)	29									70	50											
Neva/Kymijoki (2)	32								45	60-70		57	*40*	*79*	42	*42*	23		*43*	*11*	*6*	
Mean River Simojoki and Torne Älv			6	2	5.5	4.5	7.5	16.5	61.5	75	71	84	86	91	28	60	39	41	58.0	5.4	3.5	
Mean River Lule, Indalsälven, Dalälven (5)		16.0	7.5	8.5	13.5	7.0	8.5	14.0	60.7	74.3	62.0	48.7	57.7	32.7	8.0	29.0	21.0	22.7	31.3	7.0	2.7	
Mean total		29.8	18.0	21.8	17.2	16.2	22.5	26.9	55.8	76.5	66.4	59.2	61.2	37.8	15.1	39.8	25.2	27.7	40.3	8.6	2.9	

1) All estimates known to be based on material from less than 20 females in italics.
2) The estimates in the rivers Simojoki, Tornionjoki/Torne älv and Kymijoki are, if possible, given as the percentage of females affected by M74 and secondly, as the mean percentage of yolk-sac-fry mortality.

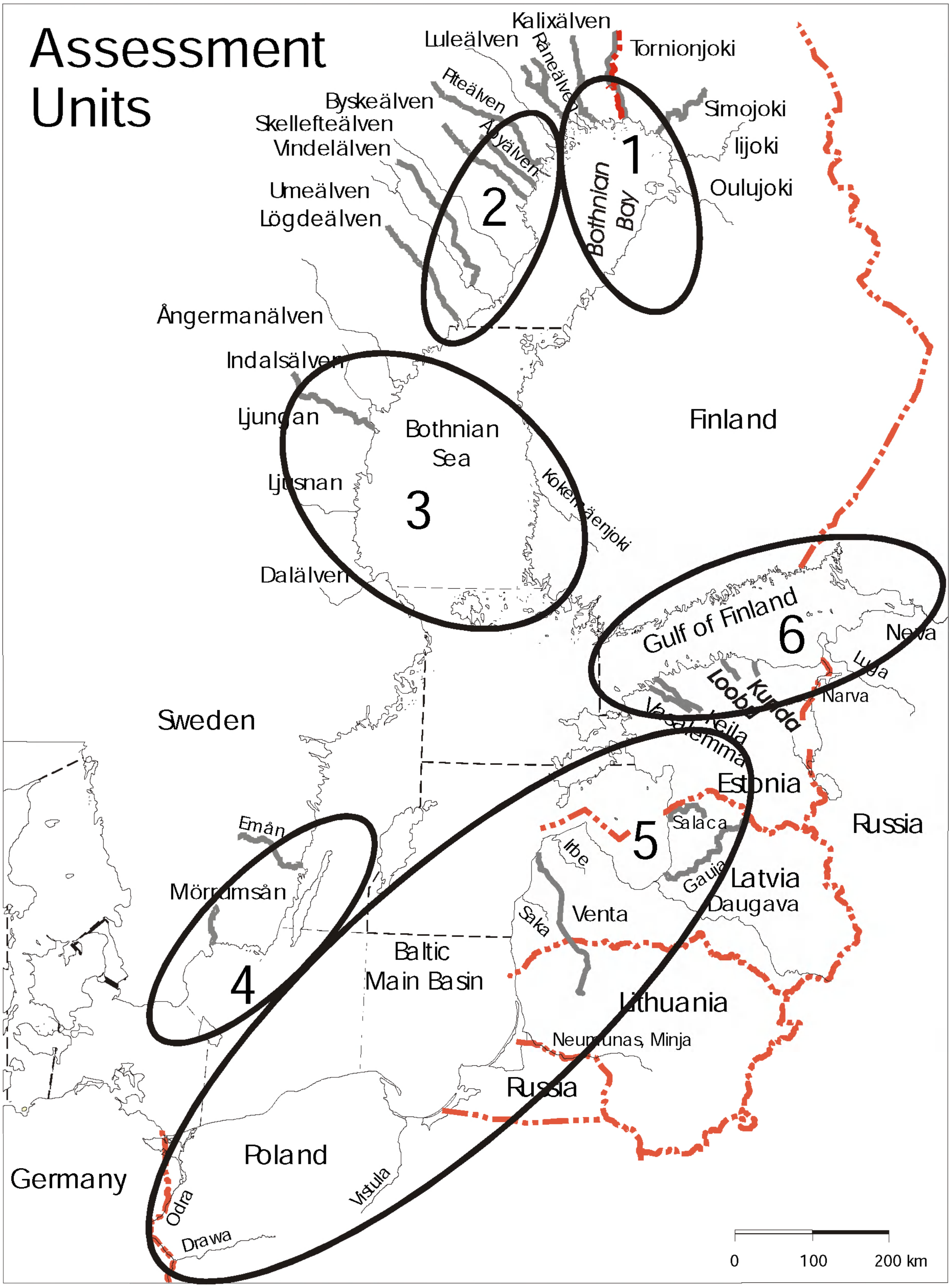
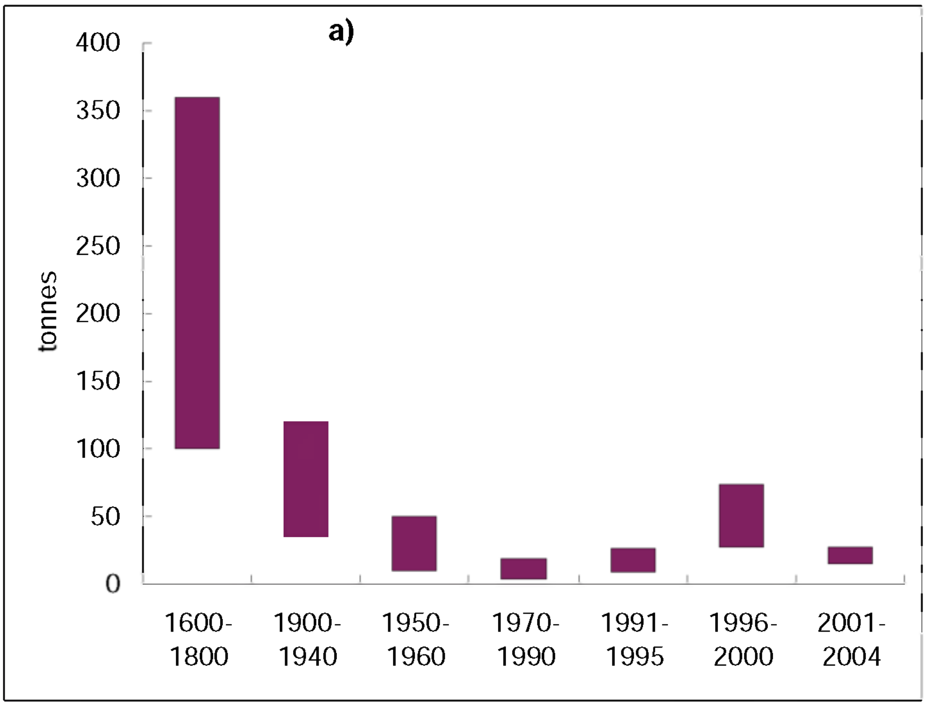


Figure 1.4.14.1 The six assessment units and the management areas for Baltic salmon.



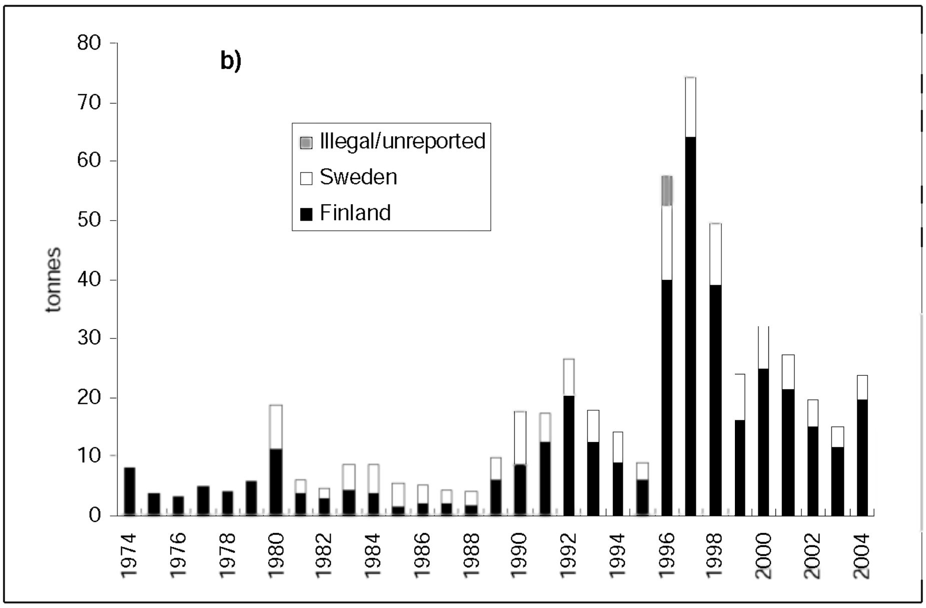


Figure 1.4.14.2 Total river catches in the River Torniojoki (assessment unit 1). a) Comparison of the periods from 1600 to present. b) 1974–2004. Swedish total catch estimates are provided from 1980 onwards.

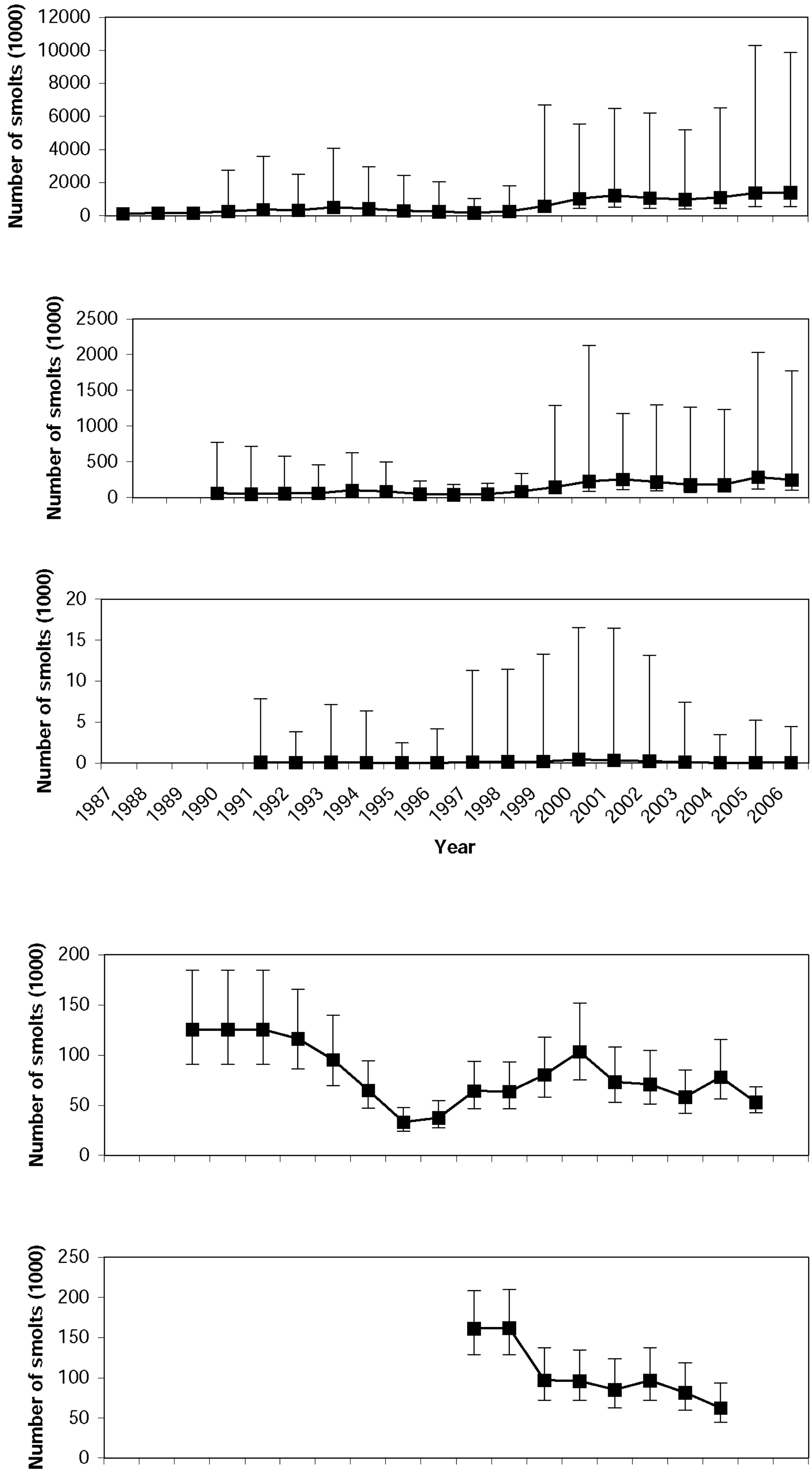
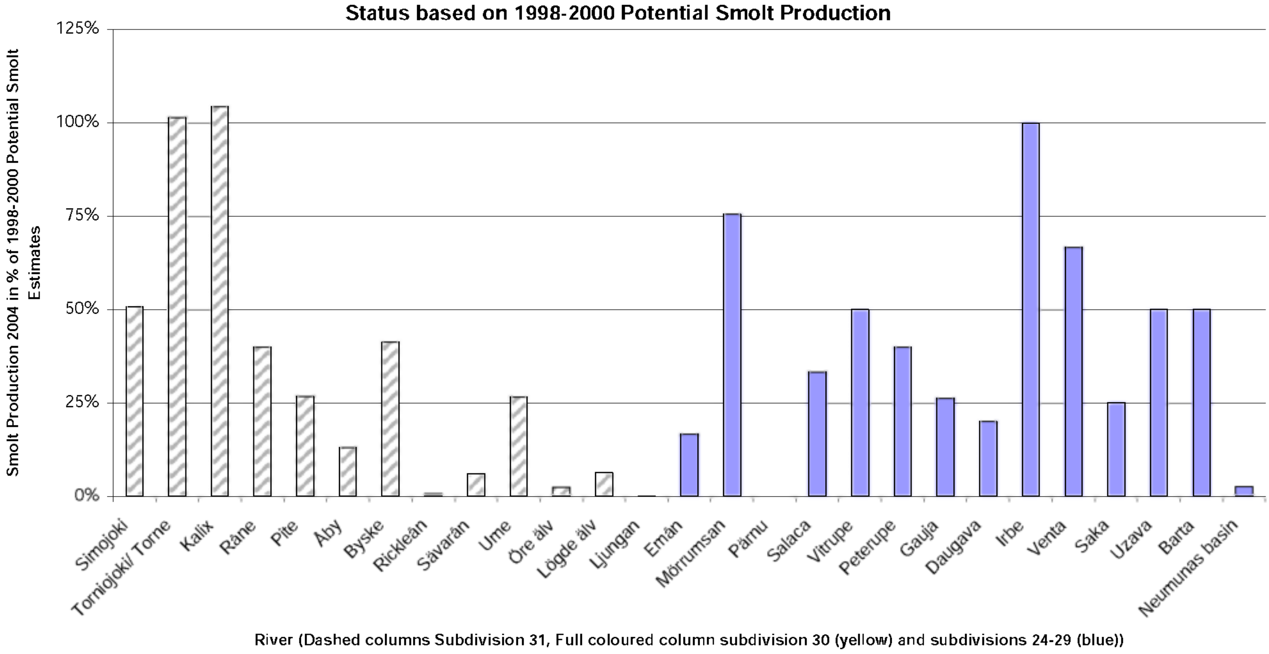


Figure 1.4.14.3 Posterior probability distributions of annual smolt production from rivers in assessment **units 1-5 (from top to bottom)**. Boxes connected with lines represent the most probable smolt production and error bars indicate the 95% probability interval. These results were obtained by using the hierarchical Bayesian regression model described in Section 6.3.5.

Figure 1.4.14.4
River based Status 2004 of Salmon in Subdivisions 24-31
Status based on 1998-2000 Potential Smolt Production



1.4.15 Salmon in the Gulf of Finland (Subdivision 32)

State of the stock

The condition of the wild stocks is poor. Although the estimates on smolt production as well as potential production capacity of the extant wild salmon rivers are uncertain the status of these populations are considered to be precarious. Parr densities are very low also in other salmon reproducing rivers despite the enhancement releases.

Catches of salmon in the area are low, and although commercial effort is low there is substantial (but poorly quantified) effort and catches by recreational fishers. The total catches in the Gulf of Finland were 12 246 salmon or 72 tonnes, being about the same as in 2003. This was the lowest recorded catch since 1981 and represents about 11% of the maximum recorded catch of salmon (in 1991).

Salmon smolt production in the Gulf of Finland is shown below (in thousands):

Year	Wild[1]	Reared[2]	Total
1987	na	808	na
1988	na	611	na
1989	na	541	na
1990	na	574	na
1991	na	500	na
1992	na	477	na
1993	na	516	na
1994	na	496	na
1995	23[4]	561	584
1996	23[4]	665	688
1997	25[4]	526	551
1998	23[4]	552	575
1999	19[4]	705	724
2000	23[4]	668	691
2001	19[4]	886	905
2002	27	705	732
2003	20	650	670
2004[3]	11	820	831

[1]Revised wild smolt production numbers since 1995 are estimated by Bayesian modelling of expert knowledge and updated expert opinions.
[2]The earlier number of reared smolts is revised. Earlier the 1-year-old smolts were counted as smolts, although some of these fish stayed in the river as parr.
[3]Preliminary data.
[4]Data on wild production in Russia reported for 1995–2001: 11 000 smolts annually. Not included in table.
na = Not available.

Wild stocks: There have been wild salmon populations in 9 Estonian rivers in the Gulf of Finland. However, six of these populations have been supported by smolt releases in the last few years. The only self-sustainable wild salmon populations of the area exist in three Estonian rivers. In one of these rivers (Kunda) the estimated smolt production has been about 25% of the potential in the last few years. In the other two rivers (Keila and Vasalemma) smolt production has been even lower, and in 2004 no smolts came out from these rivers. The wild salmon populations are genetically distinctive from each other, which indicates that there are still original salmon stocks left, but there is some evidence of straying among rivers. Surveys indicate that parr densities vary greatly over time in these rivers, but densities are generally much lower than in similar rivers at these latitudes.

Wild salmon production was lost from rivers on the Finnish side of the Gulf of Finland by the 1950s, due to pollution and damming of rivers. There is some suitable habitat below the dams on the River Kymijoki, and a small amount of production has been observed from spawning by returning salmon that were released as smolts.

Surveys also indicate that some natural reproduction occurs in two Russian rivers. These two populations are supported by long-term releases. However, there are no national plans to attain self-sustainable populations in these rivers.

Reared stocks: Most of the salmon catch in the Gulf of Finland originates from smolt releases. Despite major releases, the catches have decreased considerably in the last few years with no evidence of improvements in stock status. This pattern indicates a lowered initial smolt survival of released salmon. Tagging results also provide evidence of decreased survival of reared smolts.

Management objectives

The IBSFC objective is to increase the natural production of wild Baltic salmon to at least 50% of the natural production capacity of each river by 2010, while retaining the catch as high as possible.

In 1997 IBSFC adopted the Salmon Action Plan (SAP) running 1997–2010 where the long-term objectives are:

1. To prevent the extinction of wild populations, further decrease of naturally produced smolts should not be allowed.
2. The production of wild salmon should gradually increase to attain by 2010 for each salmon river a natural production of wild Baltic salmon of at least 50% of the best estimate potential and within safe genetic limits, in order to achieve a better balance between wild and reared salmon.
3. Wild salmon populations shall be re-established in potential salmon rivers.
4. The level of fishing should be maintained as high as possible. Only restrictions necessary to achieve the first three objectives should be implemented.
5. Reared smolts and earlier salmon life stage releases shall be closely monitored.

As for salmon in the Main Basin, it is proposed that management should re-evaluate the SAP objective with respect to the target year.

Single-stock exploitation boundaries

Exploitation boundaries in relation to management objectives

In light of the precarious state of the wild stocks in the Gulf of Finland and the very low wild smolt production in recent years, fisheries should only be permitted at sites where there is virtually no chance of taking wild salmon from the Gulf of Finland stocks along with reared salmon. It is particularly urgent that national conservation programmes to protect wild salmon be enforced around the Gulf of Finland.

The poor response of these stocks to the decrease in fishing that has taken place could be due to the reproduction being hampered by poor conditions in the rivers. However, the survival rate from smolt to entering the spawning runs is low compared to other salmon stocks in the Baltic Sea. Before habitat restoration projects are launched on a grand scale it should be firmly established that sea survival is sufficient to provide the basis for reproduction.

Management considerations

At present wild salmon populations occur in nine Estonian rivers and many of these populations are at risk of extinction, or at least loss of genetic variability. Genetic analysis has shown that the wild Estonian stocks are genetically separate stocks.

The potential smolt production is very small compared to all other wild salmon populations in the Baltic Sea, but smolt production has increased somewhat since the early 1990s. Fish ladders would increase the size of reproduction areas, which could increase productivity and create more buffer for stocks to stand the variability. Unlike the Gulf of Bothnia rivers there are no positive signs of increasing parr densities in the rivers draining into the Gulf of Finland. Even though the survival of the populations may be strongly driven by environmental factors, fisheries management must ensure adequate escapement to these rivers, if natural populations are ever to recover. The offshore fishery and coastal fisheries must be reduced to a level that ensures a sufficient escapement to spawning migration.

To improve selectivity of harvesting, coastal fisheries at sites likely to be on migration paths of wild salmon from Estonian rivers should be prohibited. Poaching occurs in some rivers and must be stopped. All possible means should be used to prevent all fishing in rivers and river mouths supporting wild stocks.

M74 caused high mortality among offspring of sea-run females in Finnish hatcheries in 1992–1997, but M74-related mortality has decreased since 1998. Hatchery experiments suggest that M74-related mortality is low in Estonian salmon populations.

Factors affecting the fisheries and the stock

Regulations and their effects

The TAC has been gradually reduced since 1996 and is at present 35 000 fish. TAC is not fully utilized (35%) and therefore not considered restrictive on harvest. The fishery is also regulated by a number of national and international regulatory measures.

It is difficult to evaluate the response of the Gulf of Finland stocks to management measures. Further reductions to make the TAC restrictive on catches would not necessarily protect wild stocks. Any TAC consistent with the production of reared salmon in this area may cause a bycatch of wild salmon, which leads to unsustainable exploitation.

Protection of wild salmon would require adoption of fishing methods that would be highly selective for reared stocks or alternatively closures of fisheries which take wild Gulf of Finland salmon, rather than merely restrictive TACs in mixed stock fisheries. The decision to close fisheries to protect these stocks should take note that these stocks migrate also to the Main Basin. Therefore to give these stocks effective protection basically all Main Basin and Gulf of Finland fisheries taking salmon may have to be closed.

Changes in fishing technology and fishing patterns

The catch distribution between offshore, coastal, and river catches has drastically changed in recent years. Exploitation has changed from targeting mixed stocks offshore to now focusing on local stocks in coastal areas and in rivers. The coastal fishery with trapnets has moved from outer archipelago to areas closer to coast and river mouths. Trapnets with modifications to prevent seal entering the trap are in use in some parts of the coastal fishery and under development in other parts.

The environment

For a short discussion, see Section 1.4.14 on the Main Basin salmon. At least 3823 salmon were discarded in the Gulf of Finland in 2004 due to damages caused by seals.

Scientific basis

Data and methods

The assessment is based on catch-at-age estimated from tag recoveries and catch samples. Estimates of wild production are based on limited surveys and do not include all rivers. Lack of data on the productivity in the freshwater phase, and the potential mixed harvest of reared and wild salmon, prevents calculation of the appropriate TAC strategy to meet any target based on wild smolt production.

Comparison with previous assessment and advice

No changes in the basis of the assessment. The assessment results and the advice are unchanged.

Source of information

Report of the Baltic Salmon and Trout Assessment Working Group, 2005 (ICES CM 2005/ACFM:18).

Year	ICES Advice	Catch corresp. to advice '000 fish	Agreed TAC t	Agreed TAC '000 fish
1987	No advice	-		
1988	No advice	-		
1989	No advice			
1990	No advice			
1991	No advice		430	
1992	No advice		430	
1993	TAC for reared stock	109[1]		109
1994	TAC for reared stock	65[2]		120
1995	Catch as low as possible in offshore and coastal fisheries	-		120
1996	Catch as low as possible in offshore and coastal fisheries	-		120
1997	Offshore and coastal fisheries should be closed	-		110
1998	Offshore and coastal fisheries should be closed	-		110
1999	Offshore and coastal fisheries should be closed	-		100
2000	Only fishery on released salmon should be permitted	-		90
2001	Only fishery on released salmon should be permitted	-		70
2002	Only fishery on released salmon should be permitted	-		60
2003	Only fishery on released salmon should be permitted	-		50
2004	Only fishery on released salmon should be permitted	-		35
2005	Only fishery on released salmon should be permitted	-		17
2006	Only fishery on released salmon should be permitted	-		

[1] Equivalent to 600 t.
[2] Equivalent to 400 t.

Year	River t	Coast t	Offshore t	Coastal and offshore[2] t	Coastal and offshore[2] '000 fish	Total t	Total '000 fish
1987	2	61	290	351		353	
1988	2	112	156	268		270	
1989	2	145	254	399		401	
1990	6	369	178	347		553	
1991	5	398	250	648		653	
1992	3	418	111	529		532	
1993	6	310	133	443		449	111
1994	7	142	106	248		255	57
1995	7	201	58	259	38	266	39
1996	12	327	93	420	78	432	80
1997	10	345	93	438	76	448	77
1998	13	160	21	181	29	194	31
1999	10	137	29	166	28	176	30
2000	16	144	37	181	32	197	35
2001	16	121	20	141	23	157	26
2002	16	56	18	84	14	100	18
2003	9	60	3	63	11	72	13
2004[1]	11	59	3	62	10	73	12

[1] Preliminary. Table revised because of additional data.
[2] For comparison with TAC.

Table 1.4.15.1 Densities of wild salmon parr in electrofishing surveys at permanent stations in rivers discharging into the Gulf of Finland, Subdivision 32.

River	Year	Number of parr/100m^2		Number of parr
		0+	1+ and older	in survey
Kunda				
	1992	7,4	12,9	118
	1993	0	4,5	26
	1994	2,4	0,0	7
	1995	15,4	3,1	60
	1996	22,6	13,7	98
	1997	1,2	21,5	78
	1998	13,8	0,9	68
	1999	6,4	18,1	103
	2000	20,8	7,6	75
	2001	30,3	14,7	156
	2002	13,2	4,9	55
	2003	0,7	3,6	13
	2004	23,8	0,3	70
Selja				
	1995	1,3	6,5	18
	1996	0,0	0,4	1
	1997	0,0	0,0	0
	1998	0,0	0,0	0
	1999	0,1	2,3	26
	2000	1,2	0,4	32
	2001	1,4	3,7	33
	2002	0,0	0,0	0
	2003	0,0	0,1	1
	2004	0,0	0,6	3
Loobu				
	1994	1,2	2,8	23
	1995	0,2	0,2	2
	1996	0,0	0,4	2
	1997	0,0	0,3	3
	1998	0,2	0,0	1
	1999	10,5	0,8	70
	2000	0,6	0,8	17
	2001	0,0	0.5	3
	2002	0.1	0.1	2
	2003	0,0	2,9	21
	2004	1,0	3,9	30
Valgejõgi				
	1998	0	0	0
	1999	2,4	0	26
	2000	0,4	1	14
	2001	4,4	1,6	58
	2002	7,1	0	3
	2003	0,2	0,8	5
	2004	0,5	3,7	16
Jägala				
	1998	0	0	0
	1999	0,5	0	2
	2000	0	0	0
	2001	16,2	0	38
	2002	0	0	0
	2003	0	0	0
	2004	0,5	0	3
Pirita				
	1992	1,9	0,7	11
	1993*)			
	1994	0	0	0
	1995	0	0	0
	1996	0	+	1
	1997*)			
	1998	0	0	0
	1999	6,5	0	55
	2000	0	0.9	13
	2001	1,2	0.3	18
	2002	0	0.3	10
	2003	0	2,3	38
	2004	0,2	1,5	8
Vaana				
	1998	0	0,1	1
	1999	0	0	0
	2000	0,1	0	1
	2001	0	0	0
	2002	0	0,2	1
	2003	0	0	0
	2004	0	0	0
Keila				
	1994	1,1	1,1	12
	1995	6,9	0,3	105
	1996	11,7	1,1	115
	1997	0	5,2	47
	1998	0	1,1	10
	1999**)	95	1,3	154
	2000	3,8	6,6	52
	2001	0	2,2	21
	2002	6,3	0.7	38
	2003	0,0	0	0
	2004	0,2	0	2
Vasalemma				
	1992	3,4	2,6	23
	1993*)			
	1994	1,9	0	7
	1995	18,7	0,4	99
	1996	4,8	5	51
	1997	0	1,5	8
	1998	0	0,2	2
	1999	13,5	0	80
	2000	3,5	1,7	27
	2001	0,4	0,9	3
	2002	7,1	0.3	23
	2003	0	0	0
	2004	0	0	0

*) = no electrofishing
**)= Flow was extremely small and fish were concentrated on little area
+ = minor production.

Table 1.4.15.2 General overview of the salmon rivers in the Gulf of Finland.

River and category	Ascending distance km	Reproduction area ha	Potential smolt production	Smolt production								Releases in 2000-2004 (average)
				1997	1998	1999	2000	2001	2002	2003	2004	
Vasalemma wild	4..5	1 below dam, 2 above	1500	300	100	100	0	100	100	20	0	0
Keila wild	1,7	3.5 below waterfall 3 above	6000	300	1200	300	300	1500	200	200	0	0
Vääna mixed	20	4	5000	na	na	100	0	0	0	20	0	17600
Pirita mixed	24	10 below dam, 1 above	10000	100	na	0	0	600	0	300	1500	38400
Jägala mixed	1,5	0.3 below dam, 2 above	1500	0	0	0	0	0	0	0	0	10400
Valgejõgi mixed	9	1.5 below dam, 13 above	16000	0	0	0	0	100	100	0	100	36200
Loobu wild	10	6 below dam, 1 above	8000	600	100	0	300	300	400	40	1200	6600
Selja mixed	30	9	10000	200	0	0	1400	200	100	0	100	33600
Kunda wild	2	1.5 below dam, 17 above	20000	1400	2100	100	1800	800	400	500	400	0
Narva reared	18	0	0	0	0	0	0	0	0	0	0	36200 1) 129000 2)
Luga mixed	353	40	80000	4000	4000	4400	5000	2500	8000	7200	2100	107800 3)
Neva mixed	74	20	20000	7000	7000	8000	6500	5900	na	na	na	94800 3)
Kymijoki mixed	9	14 below dam, 35 above		4000	4000	4000	4000	4000	4000	4000	4000	296000 3)
Vantaanjoki reared	20	15	7000	0	0	0	0	0	0	0	0	32000 3)

1) Releases by Estonia
2) Releases by Russia
3) Releases in 2005

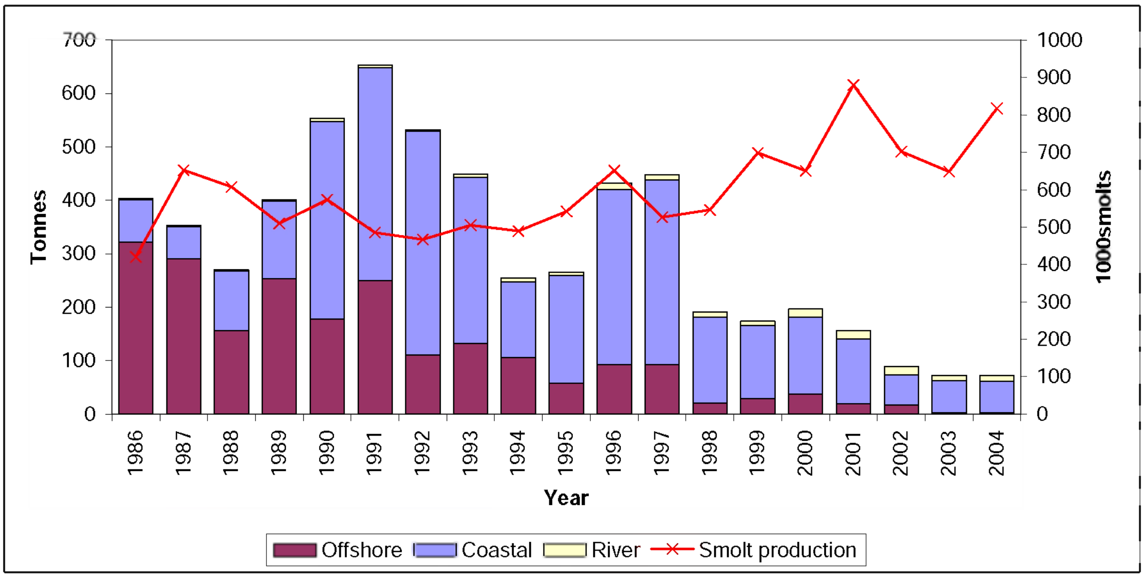


Figure 1.4.15.1 Salmon catches and smolt releases in the Gulf of Finland in 1986-2004.

1.4.16 Sea Trout in the Baltic

State of the stock

Currently approximately 400 rivers in the Baltic Sea support wild populations of sea trout. There are no estimates of the original number of sea trout populations or quantitative estimates of the total natural smolt production. There are large differences in the production capacity (growth rate, postsmolt survival) between different areas and stocks. This means as well that the risks for stock collapses may be very variable in different parts of the Baltic. These area-specific differences must be the basis of any management considerations.

Stocks in several rivers in the Main Basin are considered to be in good or satisfactory condition with nursery areas well utilised. These populations do not seem to be subjected to as high exploitation rates as some of the populations in the Gulf of Bothnia and and in the Gulf of Finland where sea trout is caught as a bycatch in e.g. whitefish and pike-perch fisheries. However, populations in numerous small Danish brooks are assessed to be in poor condition.

In the Gulf of Bothnia, a large number of the natural sea trout stocks may have died out due to a combination of recruitment overfishing and loss or decreased quality of freshwater habitat. The status of remaining populations is very weak. In many rivers both in the Swedish and Finnish side of the Gulf, densities of 0+ parr observed in electrofishing surveys were zero or close to zero. Many of the remaining stocks are endangered due to the high fishing mortality rates.

The situation of sea trout populations in the Gulf of Finland is similar. Many populations have disappeared due to pollution and damming of the rivers and the remaining populations are heavily affected by a high exploitation rate in the fishery. The fishery is to a large extent a gillnet fishery with variable, but small mesh sizes that do not allow sea trout to grow and survive to mature size. The age composition of sea trout has changed to younger ages during the last 15 years. In 1985–87 the proportion of 3- and 4-year-old sea trout was around 60–70% in the catches, while currently it is about 15% .

The total sea trout catch from the Baltic Sea was 1082 tonnes in year 2004, which is 39 tonnes less than in 2003. Catches of sea trout increased from 200 tonnes in 1979 to 1869 tonnes in 1993 and have since then, except for the years 1995–1997, been at a level of 1100–1300 tonnes; however, in the years 2000–2004 a decreasing trend was observed.

Management considerations

Many stocks are international in the sense that stock migrations cross state boundaries. This makes it necessary to have international cooperation regarding the management of these stocks.

There is no TAC set for the sea trout. National regulations include minimum landing size and local and seasonal closures. The status of the weak sea trout populations has not been improving with present regulations. To protect the sea trout populations, spatial fishing restrictions, minimum mesh size for gillnet, and effort limitations should be implemented in order to decrease the exploitation and increase the number of spawners in rivers.

ICES considers that the current status of some of the wild sea trout stocks in the Gulf of Bothnia and the Gulf of Finland is critical. There is an urgent need to decrease the exploitation of these sea trout stocks. As some of them have relatively long migration and are exploited by more than one country, ICES recommends that a management plan should be considered established for sea trout stocks. As sea trout and salmon have many similarities concerning their ecological demands, life cycle, and fishing exploitation, the Salmon Action Plan could be beneficial for the recovery of the sea trout.

The genetic concerns for stocks in the Main Basin are not as severe, as they seem to be subjected to lower exploitation rates than those in more northern Baltic areas.

Factors affecting stocks and fisheries

Sea trout in the Baltic Sea is dependent on stocking. Sea trout stocks in the Baltic Sea have two types of migration pattern. Most of the stocks migrate in the coastal area within about 150 km of the point of release, but particularly those from Poland and some from southern Sweden migrate further into offshore areas. The fish that migrate only short distances are mainly exploited in coastal and river fisheries, and they are also affected by the coastal salmon fisheries. Fish that migrate offshore are to a large extent taken as a bycatch in the offshore salmon fishery. The stocks remaining in coastal waters are only exploited in local fisheries and may therefore be managed on a national or local basis, but the stocks migrating into offshore areas are partly dependent on international management measures.

The return rates of sea trout taggings have decreased during the last ten years in the Finnish sea trout taggings, both in the Gulf of Bothnia and the Gulf of Finland. If a similar poor postsmolt survival occurs also for wild sea trout stocks, this must be considered as an additional risk factor for sea trout.

Most of the sea trout is caught as bycatch, either in open-sea fisheries for salmon or in coastal fisheries for salmon and whitefish. The exploitation pattern is variable in different areas. In the Gulf of Bothnia and the Gulf of Finland sea trout are to a large extent caught in gillnets for whitefish, and to a minor extent in a recreational net fishery or in trapnets.

Source of information

Report of the Baltic Salmon and Trout Assessment Working Group, 2005 (ICES CM 2005/ACFM:18).

Table 1.4.16.1. Status of monitored wild and mixed sea trout population in 2004.

	Poor	Satisfactory	Good	Not known	Total number
Gulf of Bothnia					
Sub-div 31					
Finland	2				2
Finland/Sweden	1				1
Sweden	10	2			12
Sub-div 30					
Sweden	13	9	1	16	39
Finland	1				1
Gulf of Finland					
Finland	5				5
Russia	5			14	19
Estonia	17	11	5	5	38
Main Basin					
Sweden	25	23	11	15	74
Estonia	13	6	4		23
Latvia	2	5	8		15
Lithuania	12	11	9	6	38
Poland	5	2	7	16	30
Danmark (Sub-div 22-25)	122	90	27		239
Russia	2			5	7
Total	**235**	**159**	**72**	**77**	**543**

Number of populations.

Table 1.4.16.2 Nominal catches (in tonnes round fresh weight) of sea trout in the Baltic Sea. S=Sea, C=Coast and R=River.

Year	Denmark[1,4]	Estonia	Finland[2]		Germany[4]	Latvia	Lith.	Poland			Sweden[4]			Total Main Basin	Gulf of Bothnia: Finland[2]			Gulf of Bothnia: Sweden			Total Gulf of Bothnia	Gulf of Finland: Estonia	Gulf of Finland: Finland[2]		Total Gulf of Finland	Grand Total
	S + C	C	S	S + C	C	S + C	C	S[9]	S + C	R	S[6]	C[6]	R		S	C	R	S[6]	C[6]	R		C	C	R		
1979	3	na		10	na	na	na	na	81[3]	24	na	na	3	121		6	na	na	na	na	6	na	73	0	73	200
1980	3	na		11	na	na	na	na	48[3]	26	na	na	3	91		87	na	na	na	na	87	na	75	0	75	253
1981	6	na		51	na	5	na	na	45[3]	21	na	na	3	131		131	na	na	na	na	131	2	128	0	130	392
1982	17	na		52	1	13	na	na	80	31	na	na	3	197		134	na	na	na	na	134	4	140	0	144	475
1983	19	na		50	na	14	na	na	108	25	na	na	3	219		134	na	na	na	na	134	3	148	0	151	504
1984	29	na		66	na	9	na	na	155	30	na	na	5	294		110	na	na	na	na	110	2	211	0	213	617
1985	40	na		62	na	9	na	na	140	26	na	na	13	290		103	na	na	na	na	103	3	203	0	206	599
1986	18	na		53	na	8	na	na	91	49	7	9	8	243		118	na	1	24	na	143	2	178	0	180	566
1987	31	na		66	na	2	na	na	163	37	6	9	5	319		123	na	1	26	na	150	na	184	0	184	653
1988	28	na		99	na	8	na	na	137	33	7	12	7	331		196	na	na	44	42	282	3	287	0	290	903
1989	39	na		156	18	10	na	na	149	35	30	17	6	460		215	na	1	78	37	331	3	295	0	298	1,089
1990	48[3]	na		189	21	7	na	na	388	100	15	15	10	793		318	na	na	71	43	432	4	334	0	338	1,563
1991	48[3]	1		185	7	6	na	na	272	37	26	24	7	613		349	na	na	60	54	463	2	295	0	297	1,373
1992	27[3]	1		173	na	6	na	na	221	60	103	26	1	618		350	na	na	71	48	469	8	314	0	322	1,409
1993	59[3]	1		386	14	17	na	na	202	70	125	21	2	897		160	na	na	47	43	250	14	704[7]	0	718	1,865
1994	33[8,3]	2		384	15[8]	18	+	na	152	70	76	16	3	769		124	na	na	24	42	190	6	642	0	648	1,607
1995	69[8,3]	1		226	13	13	3	na	187	75	44	5	11	647		162	na	na	33	32	227	5	114	0	119	993
1996	71[8,3]	2		76	6	10	2	na	150	90	93	2	9	511		151	25	na	20	42	238	14	78	3	95	844
1997	53[8,3]	2		44	+	7	2	na	200	80	72	7	7	474		156	12	na	16	54	238	8	82	3	93	805
1998	60	8		103	4	7	na	208	184	76	88	3	6	747		192	12	0	9	39	252	6	150	3	159	1,158
1999	110[8,3]	2		84	9	10	1	384	126	116	51	2	3	898		248	12	0	18	41	319	8	93	3	104	1,321
2000	58	4		64	9	14	1	443	299	70	42	4	3	1011		197	12	0	14	36	259	10	56	3	69	1,339
2001	54	2	5	57	10	12	1	486	219	11	23	1	3	884	2	221	7	0	14	44	288	8	68	3	79	1,251
2002	35	5	2	75	12	13	2	539	272	53	11	1	3	1023	0	78	7	0	23	38	147	11	31	3	45	1,215
2003	40	2	1	71	9	6	+	583	169	72	3	1	0	958	0	70	11	0	15	30	127	7	27	2	36	1,121
2004[5]	46	3	1	72	12	7	1	606	122	36	9	2	3	919	1	68	11	0	18	29	126	7	27	2	36	1,082

[1]Additional sea trout catches are included in the salmon statistics for Denmark until 1982 (table 3.1.2).
[2]Finnish catches include about 70 % non-commercial catches in 1979 - 1995, 50 % in 1996-1997, 75% in 2000-2001.
[3]Rainbow trout included.
[4]Sea trout are also caught in the Western Baltic in Sub-divisions 22 and 23 by Denmark, Germany and Sweden.
[5] Preliminary data.
[6]Catches reported by licensed fishermen and from 1985 also catches in trapnets used by nonlicensed fishermen.
[7]Finnish catches include about 85 % non-commercial catches in 1993.
[8]ICES Sub-div. 22 and 24.
\+ Catch less than 1 tonne.
[9]Catches in 1979-1997 included sea and coastal catches,since 1998 costal (C) and sea (S) catches are registered separately
na=Data not available

Table 1.4.16.3 Sea trout smolt production of reared origin (in thousands).

Year	Baltic Main Basin	Gulf of Bothnia	Gulf of Finland	Total
1987	994	1081	358	2433
1988	1312	1083	226	2621
1989	1537	906	198	2641
1990	1237	1035	237	2509
1991	665	1186	259	2110
1992	1023	1247	314	2584
1993	1576	1171	251	2998
1994	1485	985	285	2755
1995	1967	1243	378	3588
1996	1509	1416	139	3064
1997	2726	970	220	3916
1998	2545	943	378	3866
1999	2506	971	355	3832
2000	1825	987	353	3164
2001	2397	1076	488	3961
2002	2040	973	430	3433
2003	1772	1016	398	3186
2004	2213	553	318	3082