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Book 8
Baltic Sea

International Council for the Exploration of the Sea

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BOOK 8

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8 THE BALTIC SEA

8.1 Ecosystem Overview

8.1.1 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.

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.

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).

8.1.2 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.

8.1.3 The major effects of the ecosystem on fish stocks

Central Baltic cod

The spawning areas for Central Baltic cod have in the past been the Bornholm, Gdansk, and Gotland Deeps (Figure 8.1). 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 8.2) 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).

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 (e.g. Köster et al. 2003). 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 (ICES 2006, WKIAB). 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.

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.

Seals

Predation pressure by seals on fish such as herring and salmon are potentially important in the northern Baltic Sea. The impact of seal predation on the herring in SD 30 have been investigated and found to have very limited impact on stock dynamics at present (ICES 2006, ACFM: WGBFAS).

8.2 Human impacts on the ecosystem

8.2.1 Fishery effects on benthos and fish communities

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).

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).

8.2.2 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).

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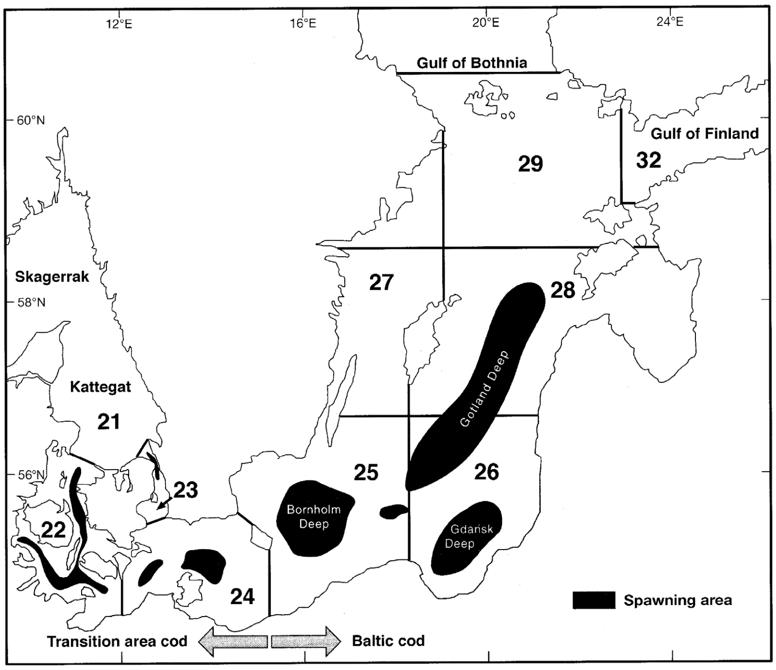

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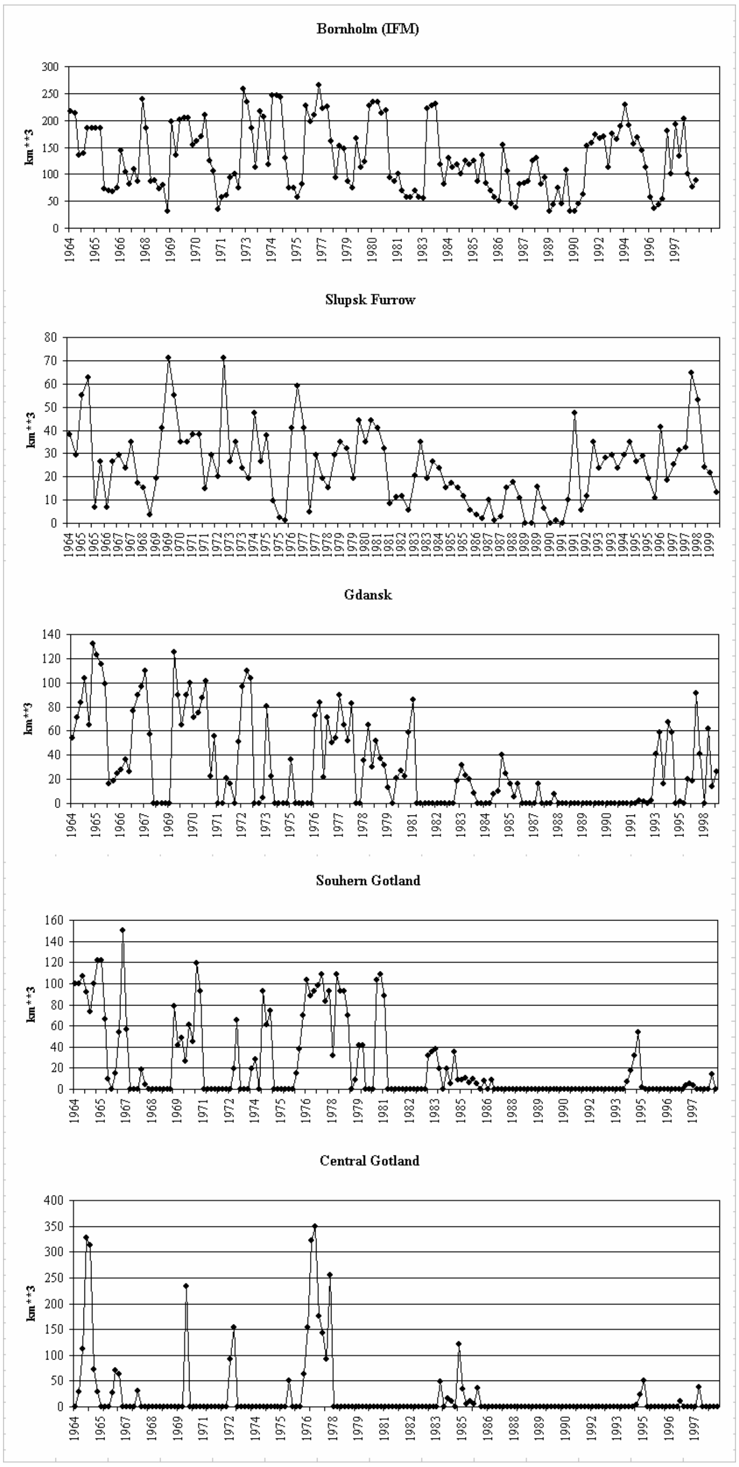

Figure 8.2 Time-series of reproductive volume for each spawning site. From MacKenzie, B. R., Hinrichsen, H.-H., Plikshs, M., Wieland, K., Zezera, A. 2000. Quantifying environmental heterogeneity: estimating the size of habitat for successful cod *Gadus morhua* egg development in the Baltic Sea. Marine Ecology Progress Series 193: 143-156. With updates by Maris Plikshs (Pers. Comm.).

8.3 Assessments and advice

8.3.1 Stock trends

Analytical assessments are carried out for all cod, herring and sprat stocks and for one flounder stock. Results of the assessments are presented in the subsequent sections of the report.

Cod in Subdivisions 22-24 (Western Baltic cod). The cod stock in the Western Baltic has historically been much smaller than the neighbouring Eastern Baltic stock, from which it is biologically distinct. It appears to be a highly productive stock, which has sustained a very high level of fishing mortality for many years. Recruitment is rather variable and the stock is highly dependent upon the strength of incoming year classes. Spawner biomass has been at or below Bpa since 2002.

Cod in Subdivisions 25-32 (Eastern Baltic cod). The Eastern Baltic cod Stock is biologically distinct from the adjacent Western Baltic (Subdivisions 22-24) stock although there is some migration of fish between areas. Spawning is confined to the deep basins where egg survival depends on oxygen concentration in the deep saline water layer where fertilized eggs are neutrally buoyant. The total and spawning stock biomass increased by the end of the 1970s due to the extremely abundant year classes in 1976, 1977 and 1980 and favourable reproduction conditions in the southern and central Baltic Sea. The spawning stock declined from the historically highest level during 1982–1983 to the lowest level on record in 2004 and 2005. The decline of the stock was a result of an increase of the effort in the traditional bottom trawl fishery, introduction of gillnet fishery, and decreased egg and larval survival due to unfavourable oceanographic conditions (i. e., low oxygen concentrations for eggs and low food supply for larvae). Since the mid-1980s cod reproduction has only been successful in the southern spawning areas - Bornholm Basin and Slupsk Furrow. Although the present estimates of stock are uncertain due to misreporting of landings, discarding and age reading problems, all available information indicates that the SSB is at a very low level and the stock is considered to be below the biological reference points. Recruitment since the late 1980s has continued to be at a low level, although the year classes 2000 and 2003 may be stronger than other recent year classes.

Flounder in Subdivisions 24&25. The stock structure of the flounder in the Baltic Sea is uncertain. Stock identifications differ between studies relying on migration patterns (Aro 1989, Bagge and Steffensen 1989), spawning behaviour (Nissling et al. 2000), or microsatellite analyses (Florin and Höglund, in prep.). Migration studies indicate that there are several rather distinct flounder stocks (populations). Flounder is regularly distributed in all parts of the Baltic Sea, except in the Bothnian Bay, the most eastern part of the Gulf of Finland and the deepest areas of the Gotland Deep. According to migration studies (Aro 1989), there are at least three stocks in the south-western and south-eastern Baltic (ICES Sub-divisions 22-26), three in the central and north eastern Baltic (ICES Sub-divisions 27-28), in the Åland Sea, one in the Archipelago Sea and the southern Bothnian Sea , and two in the Gulf of Finland.

The migrations between the mature flounder stocks are quite sparse (Aro 1989). The natural boundaries of the stock in the south-western and central southern Baltic (ICES Subdivisions 24 an 25) may be drawn from the southern part of the Öland Island to the Rozewie on the Polish coast in the east and the Darßer Schwelle in the west. Spawning takes place in the Arkona Deep, the Slupsk Furrow and the Bornholm Deep at a depth of 40-80 m in the period from the second half of February to May. After spawning feeding migrations are directed to the shallow coastal areas, southwards to the coasts of Germany (to the west up to the Island Rügen) and Poland (to the east up to the areas of Rozewie) and northwards to the south coast of Sweden. During the late autumn and early winter there is a spawning migration to the main spawning grounds, and some part of the mature stock feeding in the Arkona region migrates to the Bornholm Basin to spawn.

A preliminary genetic study (Florin and Höglund, in prep.) of flounder from 12 different places ranging from Åland in the northern Baltic Sea to the Danish west coast supports the notion of genetically differentiated flounder stocks, by showing that genetic distance is significantly correlated to geographic distance. However, the results indicate that rather than a high number of small stocks, three major different groups of flounder could be identified: (1) Skagerrakk/Kattegat (subdivisions 20-21), (2) Southwest Baltic Sea (subdivisions 22-25), and (3) Western Baltic Sea (subdivisions 26-32) (for more details, see Gårdmark and Florin, 2006).

Herring in Sub-divisions 25-29&32 excl. Gulf of Riga (Central Baltic herring) is the largest herring stock assessed for the Baltic and it comprises a number of spawning components. This stock complex experienced a high biomass level in the early 1970s, but has declined since then. The proportion of the various spawning components has varied in both landings and in stock. The southern components growing to a relatively large size has declined and at present the more northerly components where individuals are reaching a maximum length of only about 18-20 cm, are dominating in the landings. The recruitment has been below the long-term average since the beginning of the 1990s. The 2002 year class is relatively large and the spawning stock has increased slightly in the most recent years. The amount of reported landings is uncertain as it is mostly caught in mixed fisheries together with sprat.

Gulf of Riga herring. The stock is classified to have a full reproduction capacity. The spawning stock biomass of the Gulf of Riga herring has been rather stable at the level of 40,000-60,000 t in the 1970s and 1980s. The SSB started to increase in the late 1980s, reaching the record high level of 120,000 t in 1994. Since then the SSB has been in the range of 85,000-120,000 t. The year-class abundance of this stock is significantly influenced by hydro-meteorological conditions (by the severity of winter, in particular). Mild winters in the second half of 1990s have supported the formation of series of rich year-classes and increase of SSB. Due to low and only occasional presence of sprat in the Gulf, there is no mixed pelagic fishery in the Gulf of Riga.

Herring in Subdivision 30. The spawning stock of Bothnian Sea herring was at a relatively low level of 100 000 – 150 000 t until the mid-1980s, after which the SSB more than tripled by 1994. In 1995–2001, the SSB declined from the highest value of 410,000 t in 1994. Since 2001, the SSB has been increasing, and it was 380,000 t in 2005. Although recruitment has been on average much higher during the high biomass period, favourable environmental conditions (i.e. warm summers in late-1980s, 1997, 2001 and 2002) have contributed to the production of the large year classes. The 2002 year class is estimated to be more than twice the size of the second largest year class in the time series.

Herring in Subdivision 31 is one of the smallest stocks assessed in the Baltic. The dynamics of the stock appears to be largely influenced by the environmental factors. The spawning stock biomass of the Bothnian Bay herring fluctuated between 26 000 t and 39 000 t during the 1980s. The SSB declined to a very low level in the late 1990s, but since year 2000 the SSB has doubled due to several good year classes in recent years, being more than 21 000 t in 2005.

Sprat in Subdivisions 22-32 is the largest stock assessed in the Baltic and is considered to be exploited sustainably and to have full reproductive capacity. The spawning stock biomass has been low in the first half of the 1980s. In the beginning of the 1990s the stock started to increase rapidly and in 1996-1997 it reached the maximum observed spawning stock biomass of 1.8 million tonnes. The stock size increased due to the combination of strong recruitments and declining natural mortality (effect of low cod biomass). In the following years a decreasing trend in stock size was observed as the result of a rather high fishing mortality (0.35-0.4). In 2005-2006 the stock is predicted to increase again due to strong year classes of 2002 and 2003. The year class 2004 is assessed as weak, and the 2005 is estimated above the average. The main part of the sprat catches is taken in mixed sprat-herring fishery, and the species composition of these catches is very imprecise in some fishing areas /periods.

8.3.2 Mixed fisheries and fisheries interactions

Officially reported fish catches in the Baltic until 2004 are given in Tables 8.3.1–8.3.5. These are the catches officially reported to ICES by national statistical offices for publication in the *ICES Fishery Statistics*. For use in the assessments, ICES estimate discards and 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 8.4. 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 8.3.1 may, therefore, not correspond to those on which assessments have been based, and are presented for information only, without any comment from ICES.

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. Tonnes or effort in 2007
	SSB in relation to precautionary limits	**F in relation to precautionary limits**	**F in relation to target reference points**	**In relation to agreed management plan**	**In relation to precautionary limits**	**In relation to target reference points**	
Cod in 22–24	Full reproductive capacity	Not available	Overexploited	No formally accepted plan	Keep SSB above Bpa; 20 500 t.	No targets agreed	20 500 t
Cod in 25–32	Reduced reproductive capacity	Harvested unsustainably	Overexploited	No formally accepted plan	Fishery closure	No targets agreed	0 t
Herring in 22–24 and IIIa	Unknown	Unknown	Unknown	No management plan	F=F*status quo ;* 99 000 t	No targets agreed	99 000 t
Herring in 25–29 (excl GoR) and 32	Unknown	Harvested sustainably	No targets agreed	No management plan	F below $\mathbf{F}_{pa}$ 0.19; 164 000 t	No targets agreed	164 000 t.
Herring in Gulf of Riga	Full reproductive capacity	Harvested sustainably	No targets agreed	No management plan	F below $\mathbf{F}_{pa}$ =0.4; 33 900 t.	No targets agreed	33 900 t
Herring in 30	Full reproductive capacity	Harvested sustainably	No targets agreed	No management plan	F below $\mathbf{F}_{pa}$ =0.21 83 400 t	No targets agreed	83 400 t.
Herring in 31	Unknown	Unknown	No targets agreed	No management plan	Recent catches (2002–2005): 4700 t	No targets agreed	4700 t.
Sprat in 22–32	Full reproductive capacity	Harvested sustainably	Harvested sustainably	F (0.4) IBSFC management plan: 477 000 t in 2007.	F below $\mathbf{F}_{pa}$ =0.4; 477 000 t in 2007.	No targets agreed	477 000 t.
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	

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary. Tonnes or effort in 2007
	SSB in relation to precautionary limits	F in relation to precautionary limits	F in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	In relation to target reference points	
Salmon in Main Basin and Gulf of Bothnia			Target is likely to be met for several large stocks in Northern Baltic.	Catches should not increase. Long-term benefits for smaller stocks are expected from a reduction of F Technical regulations should be continued. For stocks of unit 5 implement special stock rebuilding measures, including habitat restoration and removal of physical barriers.			
Salmon in Gulf of Finland			Condition of wild stocks poor and will not reach the target.	Catches should not increase. 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. National conservation programmes to protect wild salmon should be enforced.			
Sea trout			Stocks in Main Basin: good. Gulf of Finland and Gulf of Bothnia: poor.	There is an urgent need to decrease F for some sea trout stocks. A management plan should be established.			

Identification of critical stocks

The table above identifies the stocks outside precautionary reference points, i.e. Eastern Baltic cod.

ICES advice for fisheries management

Fisheries in the Baltic should in 2007 be managed according to the following rules:

- **For Baltic Cod:**
    - **for eastern Baltic cod, fishery should be closed;**
    - **for western Baltic cod, a catch not exceeding 20 500 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 99 000 t;**
- **for Herring in Subdivisions 25–29+32 (excl. Gulf of Riga): catches should be less than 164 000 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 164 000 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 management of the fisheries in the Baltic is based on annual TACs supplemented by gear regulations, minimum landing sizes, and closed seasons and areas.

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.

Review of the Management Plan

As a consequence of the termination of the IBSFC, the EC is in the process of developing a multi-annual plan for the two cod stocks in the Baltic to be implemented in 2007. These plans target fishing mortalities resulting in a low risk to reproduction and high long-term yields as proposed by ACFM in 2005. The objective of the plans are to ensure sustainable exploitation for both cod stocks in the Baltic by gradually reducing fishing mortalities until sustainable levels are met and to maintain those levels thereafter. The plan includes measures to set catch limits and defines a number of technical measures to reduce fishing effort respectively.

The overall objective of the salmon action 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.

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

The IBSFC has implemented a long-term management plan for the sprat stock which is consistent with a precautionary approach and despite the termination of the IBSFC, the TAC for sprat in 2006 was set in line with this management plan. This plan consists 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.

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 8.4.

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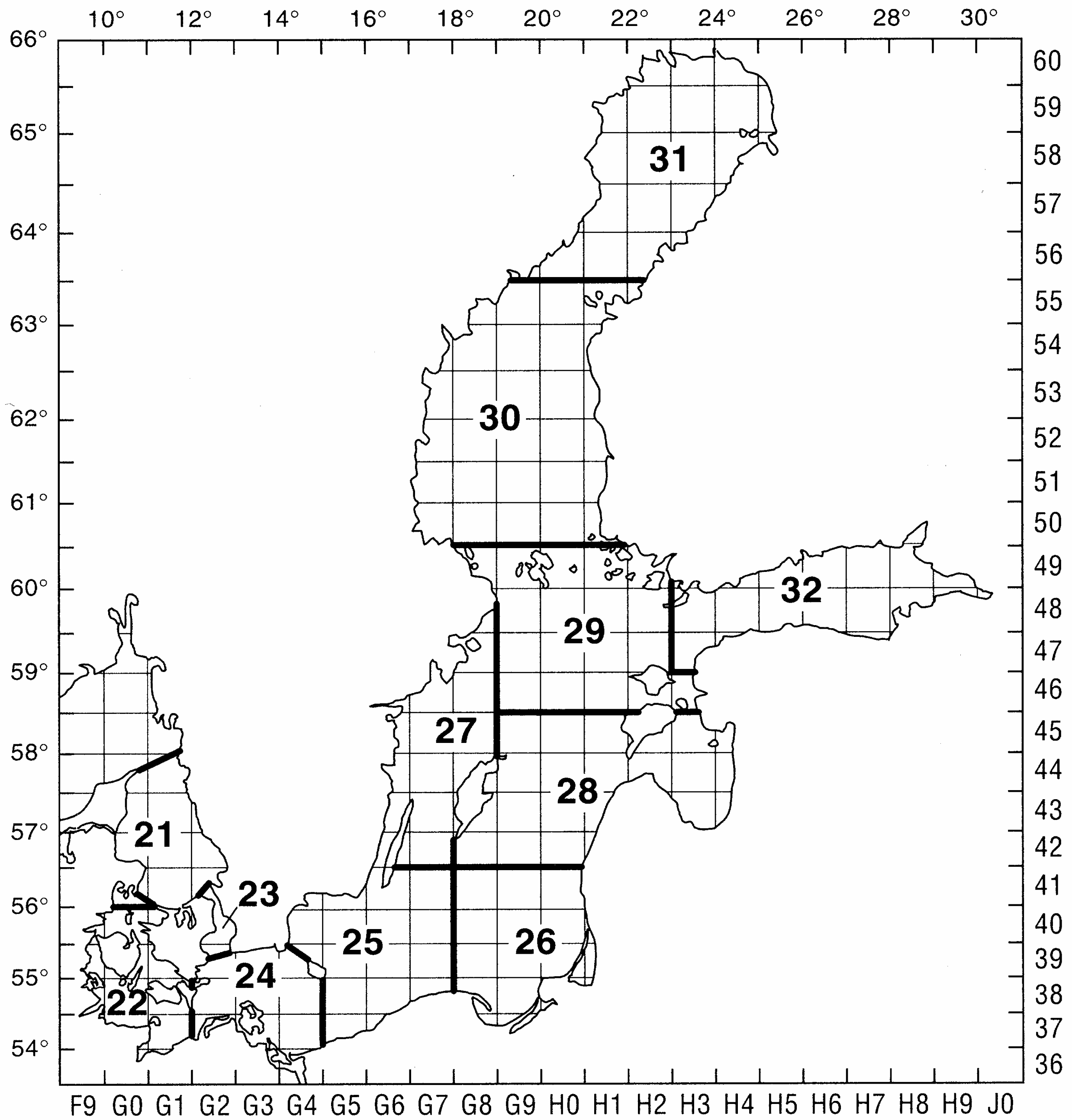
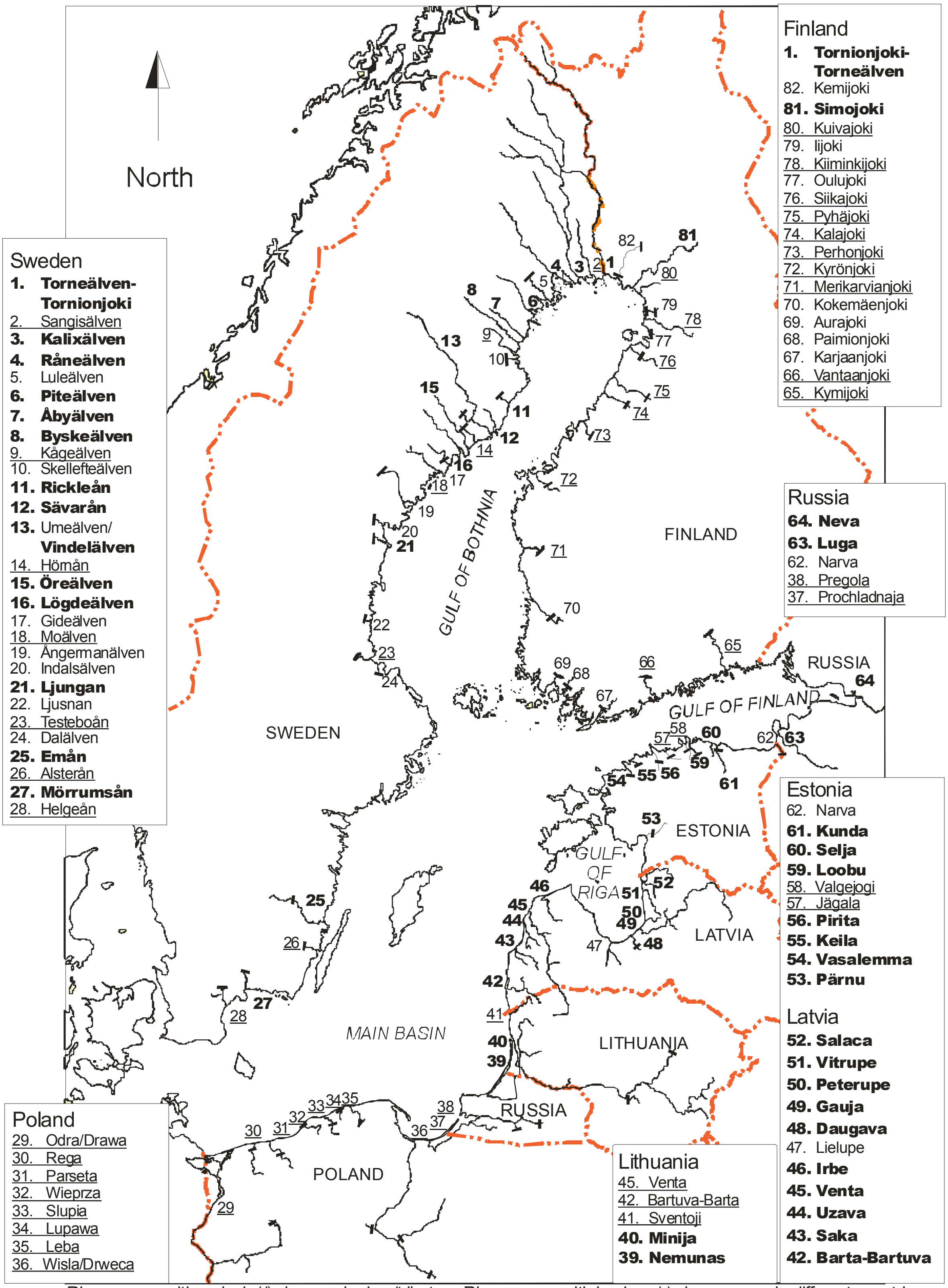


Figure 8.3.2.1 Subdivisions in the Baltic Sea.



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

Figure 8.3.2.2 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.*

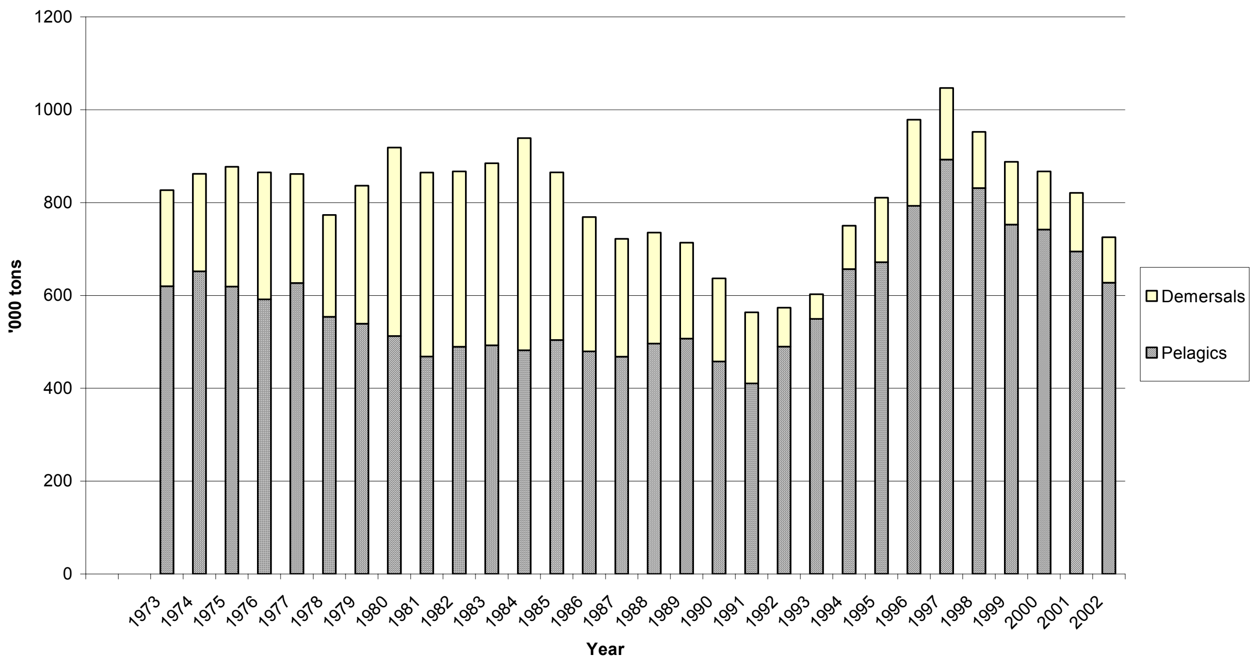


Figure 8.3.2.3 Baltic Sea catches.

Table 8.3.2.1 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 8.3.2.2 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[8]	5,152[8]	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.
[8]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.

Table 8.3.2.3 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 8.3.2.4 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 8.3.2.5 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.

8.3.3 Special Requests

8.3.3.1 Request to 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

A request from HELCOM 2005/1:

"To 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."

Sources of information

ICES. 2005. Report of the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic Sea (SGQAB). ICES CM 2005/ACME:06. 154 pp.

ICES. 2006. Report of the ICES/OSPAR/HELCOM Steering Group on Quality Assurance of Biological measurements (STGQAB). ICES CM 2006/ACME:04. 81 pp.

ICES. 2006. Report of the ICES/HELCOM Steering Group on Quality Assurance of Chemical Measurements in the Baltic Sea (STGQAC). ICES CM 2006/ACME:03. 34 pp.

HELCOM. 2004. Report of HELCOM/BSRP Workshop on monitoring of phytobenthos and productivity in the coastal zone. http://sea.helcom.fi/dps/docs/folders.

ICES. 2006. Report of ICES/BSRP sea-going workshop on fish disease monitoring in the Baltic Sea. ICES CM 2006/BCC:02.

Recommendations and advice

In order to coordinate the quality assurance activities in the Baltic marine area, ICES makes the following recommendations to HELCOM:

1. The HELCOM Phytoplankton Expert Group (PEG) should establish contact with the phytoplankton expert groups working on the EU Water Framework Directive (WFD) intercalibration process, e.g. North East Atlantic Geographical Intercalibration Group. The Phytoplankton Expert Group Chair could be nominated as responsible contact person.
This would help ensure methodological homogeneity.

2. PEG should be requested to continue the work on the consequences of changing the sampling depth for chlorophyll and primary production measurements.

This is necessary because sampling depth unification is needed to ensure data comparability.

3. The HELCOM secretariat should be asked to respond to the PEG's enquiry concerning the possibilities of arranging the regular update and more widespread use of the phytoplankton counting (PhytoWIN) software outside the HELCOM community (e.g. in OSPAR laboratories). Of the options provided by PEG, ICES recommends that the application for funding to maintain the counting software be supported.

This would further ensure methodological homogeneity and ensure that these methods are updated as necessary.

4. To ask PEG to draft the new chapter for the COMBINE manual concerning biovolume estimation and carbon calculation, and to ensure that other relevant updates are completed during the meeting of 2006.

5. To include chapters from the 2006 STGQAB report on bacterioplankton (Annexes 10 and 11) in COMBINE manual part C.

6. To support a general revision of part B of the HELCOM COMBINE Manual performed by members of STGQAB and STGQAC, coordinated by Petra Schilling (Germany). The work should be conducted intersessionally and during the meetings of the steering groups in 2007.

7. To ask for updates of the parts A, C, and D of the HELCOM COMBINE Manual by the STGQAB, STGQAC, and Contracting Parties in order to provide valid information (e.g. list of monitoring stations and sampling frequency).

8. To ensure that the HELCOM MONAS Zooplankton expert network reviews the updated HELCOM Combine Manual Annex C-7 (Zooplankton) and provides a new draft of the HELCOM Combine Manual Annex C-7 (Zooplankton) for the meeting of STGQAB in 2007.

9. To ensure that the chairpersons of HELCOM expert groups and networks participate at STGQAB meetings in order to increase the range of expertise present at those meetings.

10. To support the establishment of a phytobenthos expert/project group, following the HELCOM procedure.

This group is required because there is an urgent need to revise the existing phytobenthos monitoring guidelines and to develop missing quality assurance procedures. The revision of the existing phytobenthos monitoring guidelines is necessary to support EU Water Framework Directive requirements, which require that most of the HELCOM countries increase the number of underwater observations and make wider use of remote methods.

11. To change the status of zooplankton monitoring from optional to mandatory in the HELCOM MONPRO scheme.

Zooplankton plays a central role in the pelagic food web and might be a good indicator of regime shifts and productivity. There are numerous examples underlining the importance of continuation of collecting long-term zooplankton data series, e.g. the breakdown of the *Pseudocalanus spp.* (a major food organism for larval fish, determining their growth and survival (Hinrichsen *et al.,* 2002; Möllmann *et al.,* 2003), but also for adult pelagic planktivorous fish such as sprat and herring (Möllmann and Köster, 1999 and 2002)) and the increase of *Temora longicornis* abundance since the end of the 1980s, as well as regular fluctuations of the *Bosmina spp.* abundance following warm and cold summer periods.

12. To change the status of bacterioplankton biomass and primary production monitoring from voluntary to optional in the HELCOM MONPRO scheme.

This is required because the total biomass of bacterioplankton constitutes an indicator of nutrient status in aquatic environments and is thereby an indicator of eutrophication. As a consequence of their high uptake of organic carbon, bacterioplankton are also responsible for a major part of the oxygen consumption in the water column, and thus provide an indication of the biological oxygen demand. The biomass of bacterioplankton can therefore be used to forecast changes in the oxygen status in the basins of the Baltic Sea. The primary production measurements can be used to calculate the amount of organic material that is formed from light, carbon-dioxide, and nutrients. For this reason primary production is an important indicator of eutrophication and sedimentation and, consequently, the deepwater oxygen concentrations.

13. To review and assess the application of the results of the ICES/BSRP sea-going workshop on fish disease monitoring in the Baltic Sea, which provides updated guidelines for fish disease monitoring.

Advice on planned or ongoing ICES inter-comparison exercises could not be provided as no such exercises are currently planned or ongoing. According to the SGQAB and STGQAB reports, the majority of the international quality assurance-related practical activities have been conducted within the HELCOM area.

14. HELCOM and ICES should consider forming stronger links between STGQAB and the ICES WG's dealing with QA of benthic community analysis and biological effects monitoring (e.g. BEWG and WGBEC) in order to more effectively develop QAC protocols within a wider monitoring context.

15. To follow the developments regarding integrated monitoring within OSPAR so as to take full advantage of these evolving monitoring strategies.

16. With the introduction of the EU Marine Strategy, the EU, OSPAR, and HELCOM should develop consistent AQC procedures for common measurements across the international collaborative and WFD monitoring programmes.

References

ICES. 2005. Report of the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic Sea (SGQAB). ICES CM 2005/ACME:06. 154 pp.

ICES. 2006. Report of the ICES/OSPAR/HELCOM Steering Group on Quality Assurance of Biological measurements (STGQAB). ICES CM 2006/ACME:04. 81 pp.

ICES. 2006. Report of the ICES/HELCOM Steering Group on Quality Assurance of Chemical Measurements in the Baltic Sea (STGQAC). ICES CM 2006/ACME:03. 34 pp.

HELCOM. 2004. Report of HELCOM/BSRP Workshop on monitoring of phytobenthos and productivity in the coastal zone. http://sea.helcom.fi/dps/docs/folders.

ICES. 2006. Report of ICES/BSRP sea-going workshop on fish disease monitoring in the Baltic Sea. ICES CM 2006/BCC:02.

Hinrichsen, H.H., Möllmann, C., Voss, R., Köster, F.W., Kornilovs, G. 2002. Biophysical modeling of larval Baltic cod (*Gadus morhua*) growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 12: 1858-1873.

Möllmann, C., Kornilovs, G., Fetter, M., Köster, F., Hinrichsen, H.H. 2003. The marine copepod, *Pseudocalanus elongatus*, as a mediator between climate variability and fisheries in the Central Baltic Sea. Fisheries Oceanography 12: 360-368.

Möllmann, C., and Köster, F.W. 1999. Food consumption by clupeids in the Central Baltic: evidence for top-down control? ICES Journal of Marine Science 56: 100-113.

Möllmann C, Köster FW. 2002. Population dynamics of calanoid copepods and the implications of their predation by clupeid fish in the Central Baltic Sea. Journal of Plankton Research 24: 959-978

8 Stock Summaries (The Baltic Sea)

8.4.1 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	Fishing mortality in relation to agreed target	Comment
Full reproductive capacity	Not available	Overexploited	Not applicable*	* Not applicable as new multi-annual plan is not yet available.

Based on the most recent estimates of SSB, ICES classifies the stock as having full reproductive capacity, with the spawning stock slightly above $\mathbf{B}_{pa}$. In the absence of defined fishing mortality reference points the state of the stock cannot be fully evaluated. The estimated fishing mortality exceeds the IBSFC fishing mortality reference point (1.0). At this high exploitation rate the stock is highly dependent upon the strength of incoming year classes.

Management objectives

Previously advice was given according to the IBSFC long-term management strategy for cod in the Baltic adopted in 2003 (Resolution XX on the Management Plan for the Cod Stocks in the Baltic Sea). As a consequence of the termination of the IBSFC, the EC is in the process of developing a multi-annual plan for the two cod stocks in the Baltic to be implemented in 2007. These plans target fishing mortalities resulting in a low risk to reproduction and high long-term yields as proposed by ACFM in 2005. The objective of the plans are to ensure sustainable exploitation for both cod stocks in the Baltic by gradually reducing fishing mortalities until sustainable levels are met and to maintain those levels thereafter. The plan includes measures to set catch limits and defines a number of technical measures to reduce fishing effort respectively.

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.

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3–6	Yield/R	SSB/R
Average last 3 years	1.011	0.470	0.479
$\mathbf{F}_{max}$	0.233	0.752	3.152
$\mathbf{F}_{0.1}$	0.151	0.712	4.502
$\mathbf{F}_{med}$	1.192	0.443	0.378

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plan

There is no agreed management plan for this stock. The proposed management plan would imply landings of 21 400 t in 2007, assuming that this includes a 20% reduction in fishing effort. ICES has not evaluated the consistency of this management plan with the Precautionary Approach.

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

ICES has previously recommended target fishing mortalities of 0.3–0.6 which would result in a low risk to reproduction and high long-term yields.

Exploitation boundaries in relation to precautionary limits

Landings of less than or equal to 20 500 t in 2007 are in accordance with reaching in 2008 the Precautionary Approach reference point $\mathbf{B}_{pa}$ of 23 000 t.

Conclusions on exploitation boundaries

In the absence of an agreed management plan that is consistent with the precautionary approach, ICES concludes that the exploitation boundaries for this stock should be based on the precautionary limits. Accordingly, the catch in 2007 should be less than or equal to 20 500 t.

Short-term implications

Outlook for 2007
Basis: F(2006) = $\mathbf{F}_{sq}$ = 1.26; SSB(2007) = 21.6; Landings (2006) = 28.4; Discards= 4.5.
The fishing mortality to be applied in 2007 according to the agreed management plan (F(management plan)) and precautionary limits is:

Rationale	TAC (2007)[1]	Basis	Total F (2007)	Landings F (2007)	Disc F (2007)	landings ('000t)	Discards ('000t)	SSB (2008)	%SSB change [1)]	% TAC change [2)]
Zero catch	0	F = 0	0	0	0	0	0	49.2	+128	-100
Status quo	24.65	$\mathbf{F}_{sq}$	1.26	1.08	0.18	24.65	3.59	18.3	-15	-13
Status quo Precautionary limits	12.85	$\mathbf{F}_{sq}$ * 0.4	0.50	0.43	0.07	12.85	1.80	32.3	+50	-55
	15.31	$\mathbf{F}_{sq}$ * 0.5	0.63	0.54	0.09	15.31	2.16	29.3	+36	-46
	17.55	$\mathbf{F}_{sq}$ * 0.6	0.76	0.65	0.11	17.55	2.49	26.5	+23	-38
	19.58	$\mathbf{F}_{sq}$ * 0.7	0.89	0.76	0.13	19.58	2.80	24.1	+12	-31
	20.51	$\mathbf{F}_{sq}$ * 0.75	0.95	0.81	0.14	20.51	2.94	23.0	+7	-28
	21.43	$\mathbf{F}_{sq}$ * 0.8	1.01	0.87	0.14	21.43	3.08	22.0	+2	-25
	23.11	$\mathbf{F}_{sq}$ * 0.9	1.14	0.98	0.16	23.11	3.34	20.0	-7	-19
	24.65	$\mathbf{F}_{sq}$ * 1.0	1.26	1.08	0.18	24.65	3.59	18.3	-15	-13
	26.06	$\mathbf{F}_{sq}$ * 1.1	1.39	1.19	0.20	26.06	3.82	16.8	-22	-8

Weights in '000 t. Shaded scenarios are not considered consistent with the Precautionary Approach.
[1)] SSB(2008) relative to SSB(2007).
[2)] Calculated landings (2007) relative to TAC 2006 (= 28 400 t).

Management considerations

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

Evaluation of a candidate for a management plan

As a response to a request from the EC in 2005, ICES carried out computer simulations that demonstrated that under the current exploitation pattern target fishing mortalities (all catches) close to 0.3–0.6 (ages 3–6) result in a low risk to reproduction and high long-term yields.

An estimate of $\mathbf{B}_{lim}$ is presently not available for this stock, but the conclusions above are 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.

A new multi-annual plan is under development by EC based on the advice by ICES in 2005, and is expected to be agreed upon in late 2006. This plan incorporates a target fishing mortality and a reduction in fishing effort of 10% by year. The plan is intended to cover both the Eastern and the Western cod stocks.

ICES has not evaluated the management plan that includes gradual reduction in fishing effort.

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 from 15 March to 14 May in 2006 and an additional 30 days of closure, to be allocated individually by the member states.

Scientific basis

Data and methods

The assessment is based on catch data, three commercial cpue indices, and two survey indices.

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.

Information from the fishing industry

Some of the information on misreporting between areas came from industry sources, especially with respect to the introduction of the system with two separate TACs for eastern and western cod stocks. However, it is not possible to quantify the misreporting.

Uncertainties in assessment and forecast

The assessment appears reasonable, but there is some retrospective bias. In addition, the available survey indices 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.

Comparison with previous assessment and advice

The current assessment has revised the value of SSB in 2004 upwards by 14% and the fishing mortality downward by 26%.

Last the year the advice was based on an agreed management plan which was considered to be consistent with the precautionary approach. In the absence of an agreed management plan this year, the advice is now based on precautionary limits. The combination of a low recruitment of the 2005 year class and applying the precautionary limits resulted in an advice reduced from 28,400 t for 2006 to 20,500 t for 2007.

Sources of information

Report of the Baltic Fisheries Assessment Working Group. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

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	22	
2006	Management plan	28.4	28.4		
2007	Keep SSB at $\mathbf{B}_{pa}$	20.5			

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.

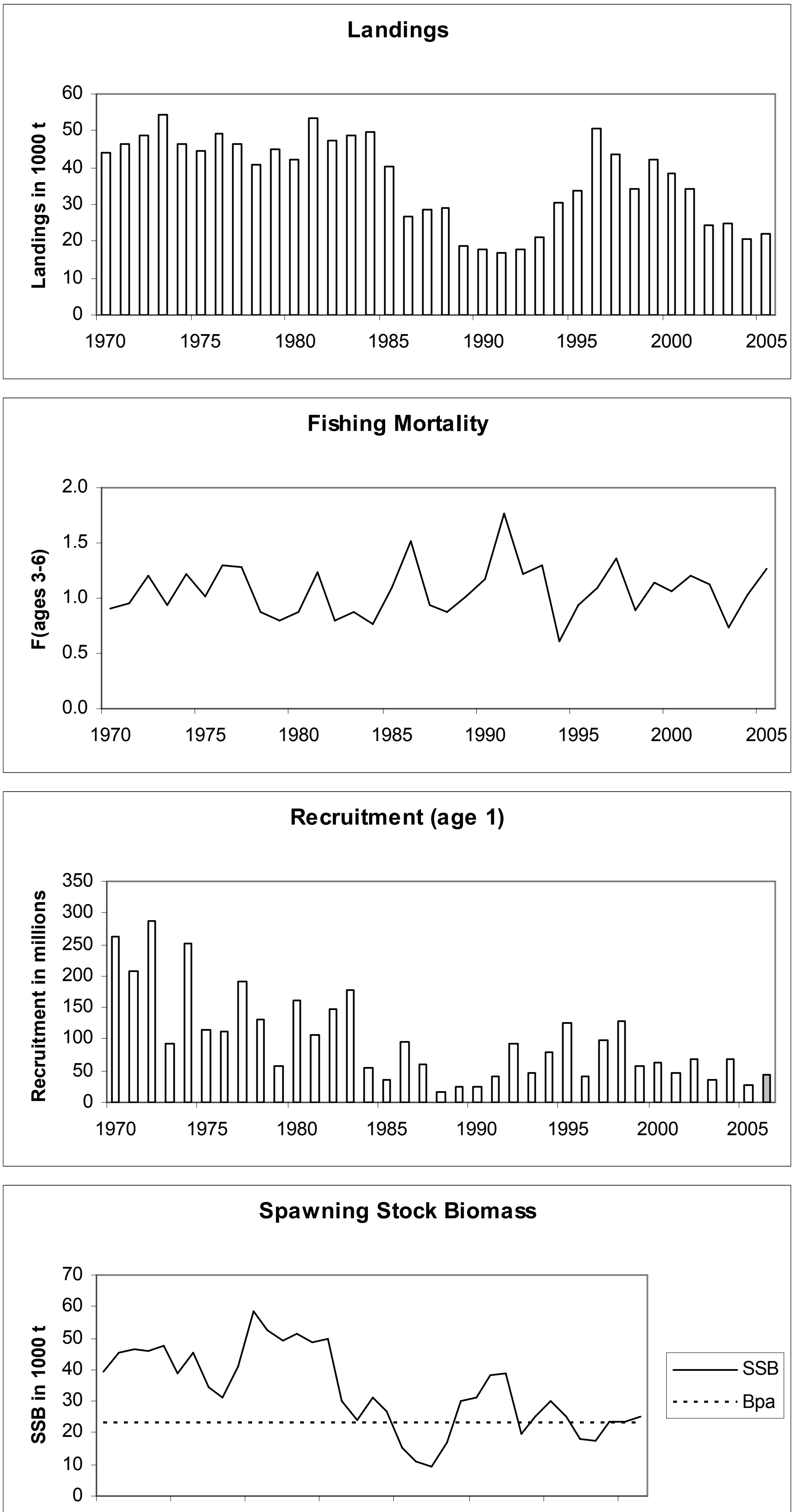


Figure 8.4.1.1 Cod in Subdivisions 22–24. Landings, fishing mortality, recruitment and SSB.

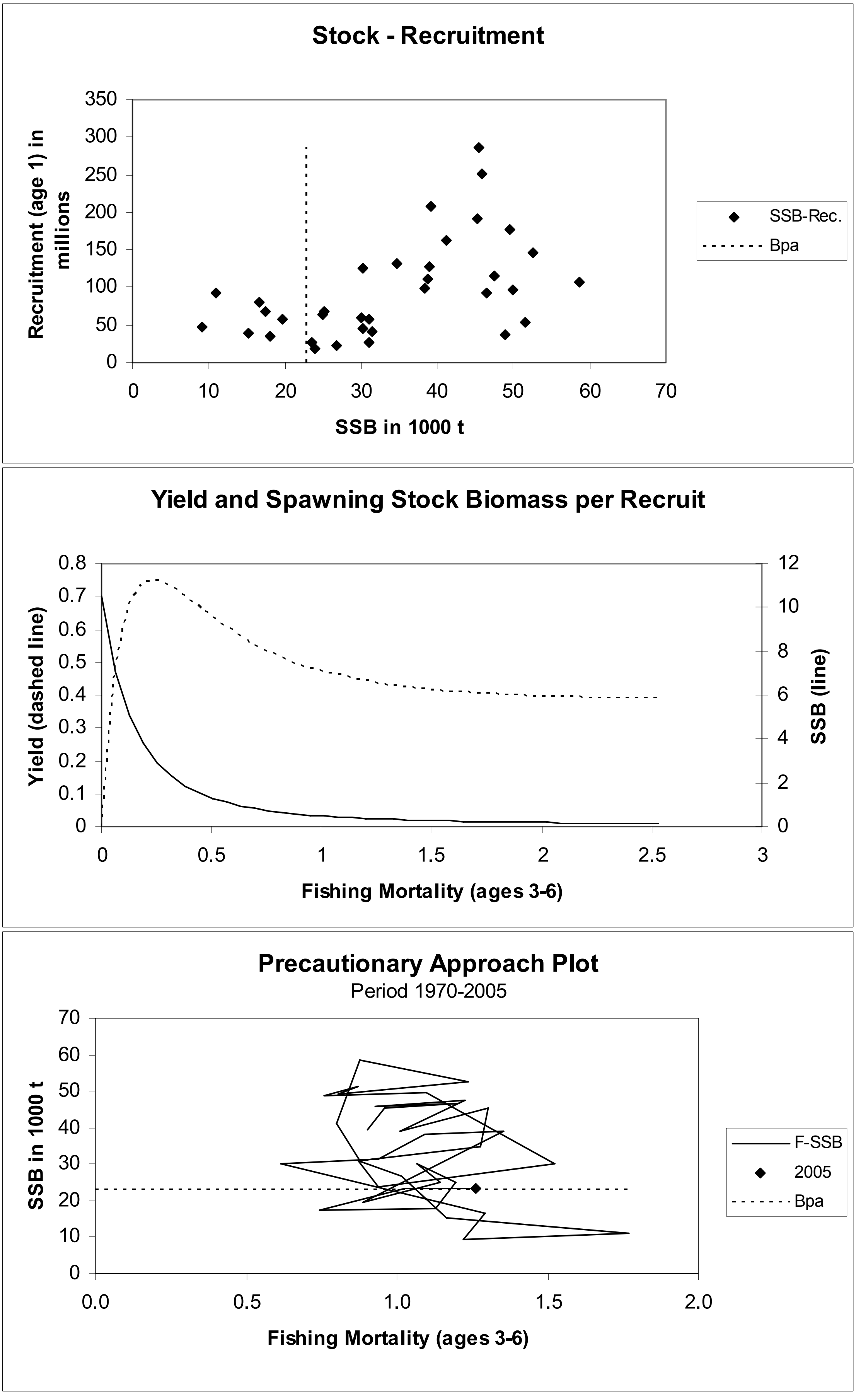


Figure 8.4.1.2 Cod in Subdivisions 22–24. Stock and recruitment; Yield and SSB per recruit.

Table 8.4.1.1 **Cod in SD 22-24. Time series of total landings (tons) of COD in the ICES Sub-divisions 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	22	24	24	24	22	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	1,927	11,386			4,651			221	538		393	1,727	9,091	2,320	9,430	13	18,521	18,534	20,854
2005 [1]	1,902	9,867	2		7,002	72	67	476	1,093	1	719	835	8,729	2,621	10,686	9	19,415	19,424	22,045

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

Table 8.4.1.2 Cod in Subdivisions 22 to 24.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1970	263058	39257	43959	0.9037
1971	207154	45391	46623	0.9573
1972	286660	46555	48900	1.2046
1973	92998	45812	54357	0.9297
1974	251942	47388	46571	1.2236
1975	114659	38840	44367	1.0079
1976	111321	45222	49433	1.3032
1977	191434	34726	46305	1.2765
1978	132120	31040	40612	0.8774
1979	57987	41099	45046	0.7985
1980	162179	58658	41972	0.8761
1981	107078	52600	53646	1.2384
1982	146332	49418	47524	0.8045
1983	176912	51529	48605	0.8737
1984	53791	48853	49495	0.7596
1985	36379	49845	40159	1.0950
1986	95791	29969	26692	1.5207
1987	59192	23943	28566	0.9365
1988	17611	30948	29159	0.8713
1989	25862	26825	18516	1.0149
1990	23626	15170	17780	1.1647
1991	40109	10990	16693	1.7670
1992	93632	9124	17996	1.2196
1993	46977	16736	21228	1.2942
1994	80562	30233	30695	0.6158
1995	126439	31385	33895	0.9384
1996	41669	38346	50845	1.0916
1997	98023	38911	43621	1.3520
1998	127976	19684	34208	0.8852
1999	57926	24949	42149	1.1458
2000	63860	30279	38357	1.0681
2001	46078	25138	34199	1.1969
2002	68703	18015	24158	1.1289
2003	35316	17375	24686	0.7416
2004	68399	23459	20854	1.0266
2005	26167	23317	21907	1.2639
2006	44395*	25133		
Average	99468	33410	36772	1.0659

*Output from RCT3 Analysis.

8.4.2 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*	* Not applicable as new multi-annual plan not yet available

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 year class is strong compared to the last 15 years.

Management objectives

Previously advice was given according to the IBSFC long-term management strategy for cod in the Baltic adopted in 2003 (Resolution XX on the Management Plan for the Cod Stocks in the Baltic Sea). As a consequence of the termination of the IBSFC, the EC is in the process of developing a multi-annual plan for the two cod stocks in the Baltic to be implemented in 2007. These plans target fishing mortalities resulting in a low risk to reproduction and high long-term yields as proposed by ACFM in 2005. The objective of the plans are to ensure sustainable exploitation for both cod stocks in the Baltic by gradually reducing fishing mortalities until sustainable levels are met and to maintain those levels thereafter. The plan includes measures to set catch limits and defines a number of technical measures to reduce fishing effort respectively.

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.

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 $\mathbf{F}_{med}$.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plan

There is no agreed management plan for this stock. The proposed management plan would imply landings of 62 000 t in 2007 assuming that it includes a 20% reduction in fishing effort. ICES has not evaluated the consistency of this management plan with the Precautionary Approach.

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

ICES has previously recommended a target fishing mortality of 0.3 which would result in a low risk to reproduction and high long-term yields.

Exploitation boundaries in relation to precautionary limits

No catch should be taken from this stock in 2007 and a recovery plan should be developed and implemented as a prerequisite to reopening the fishery.

Conclusion on exploitation boundaries

In the absence of an agreed management plan, ICES concludes that the exploitation boundaries for this stock should be based on the precautionary limits. Accordingly, no catch should be taken from this stock in 2007 and a recovery plan should be developed and implemented as a prerequisite to reopening the fishery.

Short-term implications

Outlook for 2007(SSB in tonnes)
Basis: F(2006) = 1.11; SSB(2007) = 80 t; Landings (2006) = 65.5 t.

Rationale	TAC (2007)[1]	Basis	Total F (2007)	Landings F (2007)[1]	Disc F (2007)	landings[1)]	Discards	SSB (2008)	%SSB change [2)]	% TAC change [3)]
Zero catch	0	F = 0	0	0	0	0	0	153	+92	-100
Status quo	72.48	F_{sq}	1.11	1.10	0.007	72.48	2.73	78	-2	+47
Status quo	36.14	F_{sq} * 0.4	0.44	0.44	0.003	36.14	1.2	114	+44	-27
	43.46	F_{sq} * 0.5	0.55	0.55	0.004	43.46	1.47	107	+35	-12
	50.21	F_{sq} * 0.6	0.66	0.66	0.004	50.21	1.74	100	+26	+2
	56.44	F_{sq} * 0.7	0.78	0.77	0.005	56.44	2.00	94	+18	+15
	62.20	F_{sq} * 0.8	0.89	0.88	0.006	62.20	2.25	88	+11	+26
	67.54	F_{sq} * 0.9	1.00	0.99	0.006	67.54	2.49	83	+4	+37
Precautionary limits	13.58	F_{PA} * 0.25	0.15	0.15	0.001	13.58	0.44	138	+74	-72
	25.79	F_{PA} * 0.50	0.30	0.30	0.002	25.79	0.82	125	+58	-48
	36.73	F_{PA} * 0.75	0.45	0.45	0.003	36.73	1.21	114	+43	-25
	46.43	F_{PA}	0.60	0.60	0.004	46.43	1.59	104	+31	-6
	55.20	F_{PA} * 1.25	0.76	0.75	0.005	55.20	1.93	95	+20	+12

Weights in '000 t.
Shaded scenarios are not considered consistent with the Precautionary Approach or the management plan.
[1)] Including possible misreporting.
[2)] SSB(2008) relative to SSB(2007).
[3)] Calculated landings (2007) relative to TAC 2006 (= 49 200 t).

Management considerations

The state of the stock is very low and there are no indications of improvement. However, research survey indicates that the 2003 year class is relatively strong. The fishing mortality has remained high.

Misreporting has been a major problem in this fishery, but there are some actions in progress to enforce control.

ICES has advised low catches or a closure of the fishery for several years. The TAC has been set well above the recommended catches.

Evaluation of a candidate management plan

A new multi-annual plan is under development by EC based on the advice by ICES in 2005, and is expected to be agreed upon in late 2006. This plan incorporates a target fishing mortality and a reduction in fishing effort of 10% by year. The plan is intended to cover both the Eastern and the Western cod stocks.

As a response to a request from the EC in 2005, ICES carried out computer simulations that 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.

ICES has not evaluated the management plan that includes gradual reduction in fishing effort.

Ecosystem considerations

Cod is a major predator on herring and sprat, and the stock size of cod therefore 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. 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. In 2005 the seasonal closure was enforced from May 1 to September 15 for all cod-directed fishery as well as year-round area closures for all fisheries in specific areas of the Bornholm deep, the Gotland basin, and the Gdansk deep with the aim to reduce fishing mortality. In 2006 the area closures are enforced from May 1 to October 31, while the closed period for cod-directed fisheries is scheduled from June 15 to September 14 with 27 days extra closure to be distributed individually by the member states.

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.

The environment

Spawning is confined to the deep basins with water of a sufficiently high oxygen content and salinity for eggs to survive. The amount of water with these characteristics depends on the inflows of high salinity water from the North Sea. The high cod 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 few 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 sp*. 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, which is consistent with the appearance of a relatively strong 2003 year class (compared to the last 15 years) in BITS surveys.

Inflows of high salinity water were noted at the start of 2005 and again during fall-winter 2005–2006, but it is not anticipated that these will have a significant impact on the hydrographic conditions in the spawning basins during the cod spawning seasons 2005 and 2006. 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, the 1st quarter BITS survey and three indices of commercial catch per unit effort. The BITS 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 in the 2005 assessment has made the assessment much less dependent upon the survey indices.

There is information on substantial misreporting in 1993–1996, and this has also been the case since 2000. 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. Although the corrected landings values derived by the ICES are the best possible estimates they are likely to be only minimum values.

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 develops new approaches to age determination for this stock.

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.

Information from the fishing industry

Some of the information on misreporting came from industry sources. A potential new error source has developed with the introduction of the system with two separate TACs for eastern and western cod stocks.

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

Uncertainties in assessment and forecast

Problems with misreporting, age-reading, and a new survey design result in a very uncertain assessment.

Adding yet another year’s data 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 is stronger than any other year class in the past 15 years, but problems with the catch and survey data as well as problems in age determination make it difficult to determine how strong this year class is. This year class should make a major contribution to the catch in 2006 and spawning stock in 2007, so estimates of these quantities are 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 has been at low level for several years. The problems associated with the current assessment were also noted in the previous assessment. The inclusion of commercial cpue data in 2005 has added some stability to the assessment, making it possible to provide short-term forecasts. The present assessment uses additionally the age 2 abundance index from the 1st quarter BITS survey, which has been omitted in recent years as the survey indices have been shifted backwards to reflect the situation at the end of the previous year. This means that only age 3+ indices have been used in the tuning.

Last the year the advice was based on an agreed management plan which was considered to be consistent with the precautionary approach. In the absence of an agreed management plan this year, the advice is now based on precautionary limits. Because the stock is predicted to remain below Blim even in the absence of catches, ICES has recommended a closure of the fishery.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

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	
2005	No fishing	0	42.8	55	
2006	Management plan	14.9	49.2		
2007	No fishing	0			

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.

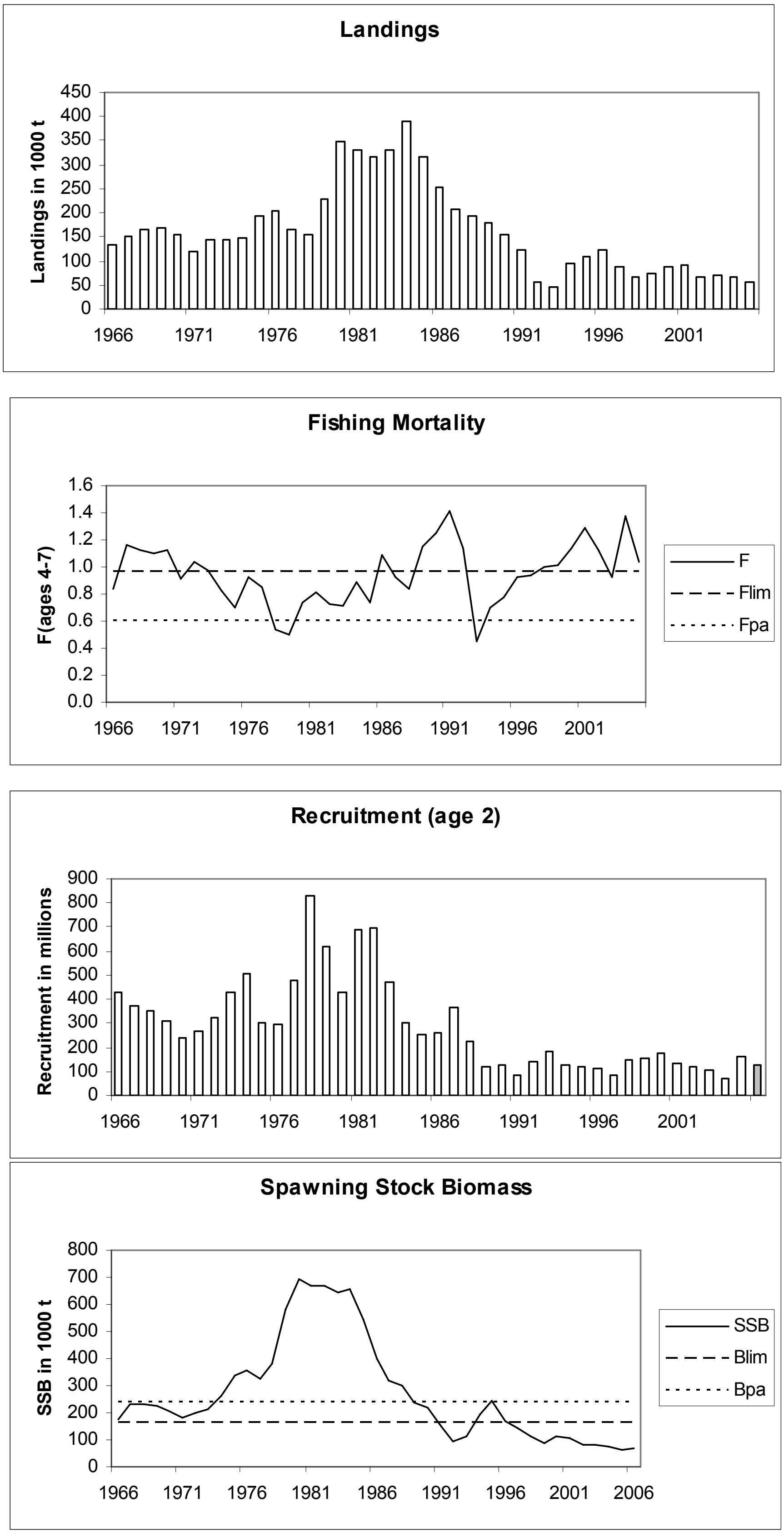
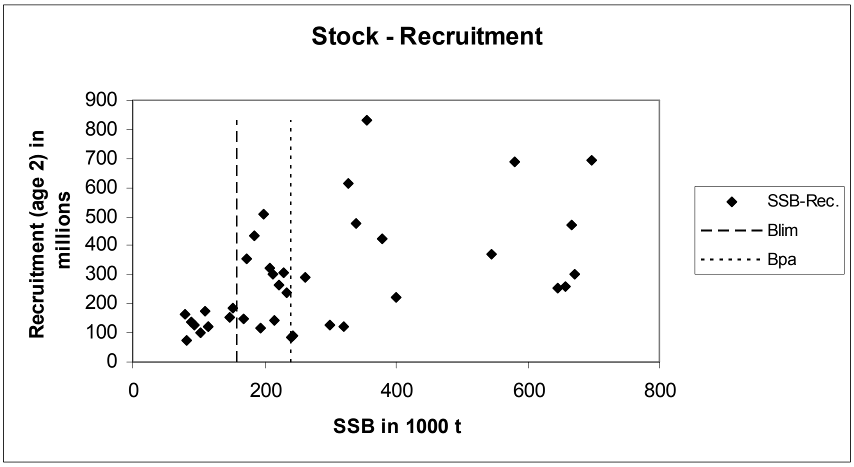
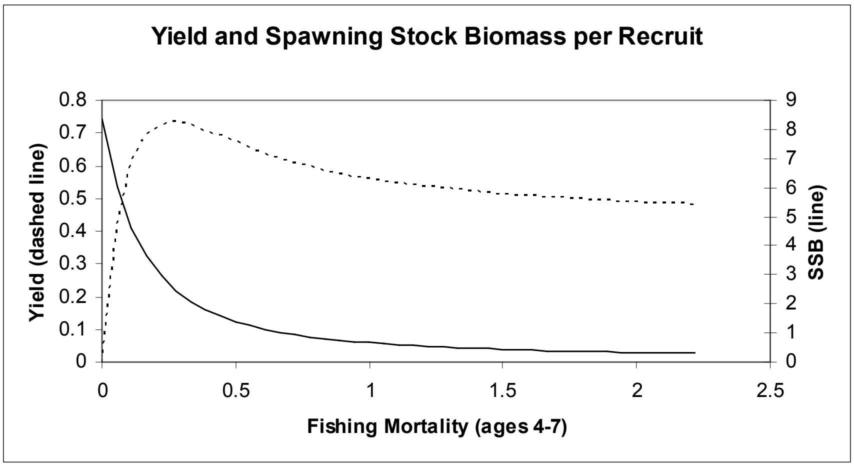


Figure 8.4.2.1 Cod in Subdivisions 25 to 32. Landings, fishing mortality, recruitment and SSB.





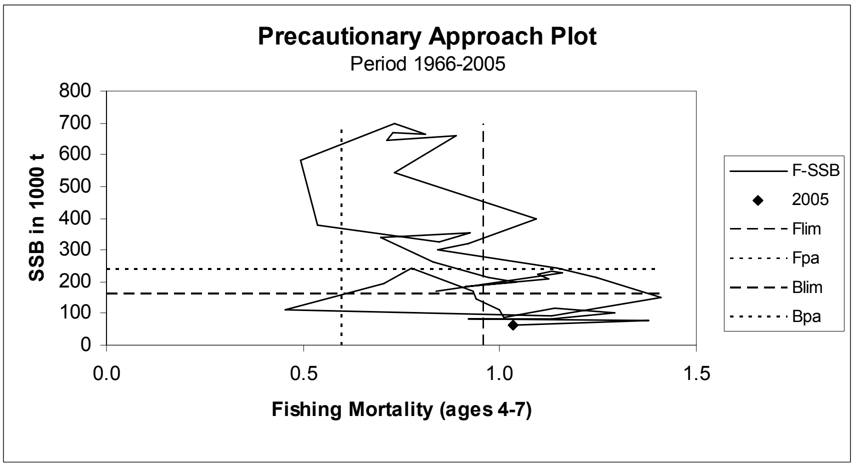


Figure 8.4.2.2 Cod in Subdivisions 25 to 32. Stock and recruitment; Yield and SSB per recruit

Table 8.4.2.1 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	804		1,445	4,796	3,137	15,106	3,793	12,507				17,562	67,018
2003	7,693	591	1,108		1,354	4,510	2,767	15,374	3,707	12,135				22,147	71,386
2004[5]	7,394	1,192	859		2,659	4,835	2,041	14,582	3,410	12,043				19,563	68,578
2005[1]	7,270	833	278		2,339	3,513	2,988	11,669	3,411	7,740				14,991	55,032

[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.

[5] An error in the catch data was discovered at the end of the meeting 2005 (change from 67,768 t to 68,578 t mainly based on changes of the officially reported landings from 48,218 t to 49,015 t). This error was not corrected in 2006. A change of this magnitude would have very little effect on the results of the assessment.

Table 8.4.2.2 Cod in Subdivisions 25 to 32.

	Recruitment Age 2 thousands	SSB tonnes	Landings (incl. misreporting) tonnes	Mean F ages 4-7
1966	430264	172018	134867	0.837
1967	370921	228679	152378	1.1587
1968	354062	233958	164472	1.1303
1969	306727	222659	169909	1.0962
1970	240010	208842	154492	1.1241
1971	264787	184181	118217	0.9133
1972	322278	198995	143833	1.0434
1973	432140	211991	143164	0.9732
1974	506893	262952	147815	0.8311
1975	303683	339545	194649	0.6955
1976	293397	355564	203303	0.9261
1977	479002	326914	164792	0.844
1978	829398	379201	154009	0.5358
1979	615355	579671	227699	0.4952
1980	425886	696743	347619	0.7342
1981	689812	666132	330742	0.8091
1982	693588	670940	316052	0.7301
1983	472372	645257	332148	0.7124
1984	302917	657664	391952	0.8896
1985	253068	544905	315083	0.7334
1986	260185	399361	252558	1.0936
1987	368020	320445	207081	0.9197
1988	224226	299218	194787	0.8402
1989	122080	240171	179178	1.1486
1990	128178	215707	153546	1.2459
1991	83164	151037	122517	1.4086
1992	140320	92473	54882	1.133
1993	182779	113516	45188	0.4545
1994	127081	193795	93380	0.7038
1995	119287	242301	107712	0.7747
1996	115315	168813	121877	0.9304
1997	87797	146437	88600	0.9383
1998	149345	110977	67429	1.0004
1999	152645	89336	72989	1.0098
2000	174984	114682	89168	1.1414
2001	135710	103944	91325	1.2908
2002	121987	82879	67740	1.1306
2003	102133	80533	71386	0.9205
2004	72718	77172	67768	1.3768
2005	162300	65444	55254	1.0329
2006	126638*			
Average	290420	277376	162789	0.9427

* Geometric mean of the period 1989-2004

8.4.3 Herring in Subdivisions 22-24 and Division IIIa (Spring spawners)

Please refer to Volume 6 (North Sea) Section 6.4.17.

8.4.4 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	Harvested sustainably	Unknown	

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

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. 187	0.010	0.056
$\mathbf{F}_{0.1}$	0.201	0.011	0.054
$\mathbf{F}_{med}$	0.235	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 mortality in 2007 should be below $\mathbf{F}_{pa}$ = 0.19, corresponding to landings of at most 164 000 t.

Short-term implications

Outlook for 2007

Basis: F(2006) = $\mathbf{F_{sq}}$ = 0.15; SSB(2006) = 859; catch (2006) = 125.

Rationale	TAC (2007)	F(2007)	Basis	SSB(2007)	SSB(2008)	% SSB change	% TAC change
Zero catch	0	0	F=0	943	1091	16%	-100%
Status quo	133	0.151	$\mathbf{F_{sq}}$	896	913	2%	4%
High long-term yield	Not defined	Not defined	F(long-term yield)		Not defined		
Precautionary limits	18	0.019	$\mathbf{F_{pa}}$ * 0.1	937	1067	14%	-86%
	44	0.048	$\mathbf{F_{pa}}$ * 0.25	928	1031	11%	-66%
	86	0.095	$\mathbf{F_{pa}}$ * 0.5	914	975	7%	-33%
	126	0.143	$\mathbf{F_{pa}}$ * 0.75	899	922	3%	-2%
	149	0.171	$\mathbf{F_{pa}}$ * 0.90	891	892	0%	17%
	164	0.190	$\mathbf{F_{pa}}$	885	872	-1%	28%
	179	0.209	$\mathbf{F_{pa}}$ * 1.1	879	853	-3%	40%
	201	0.238	$\mathbf{F_{pa}}$ * 1.25	870	826	-5%	57%

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 well known, but it is likely that it has influenced 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.

From 2004 management areas were revised to coincide with the stock definition used for assessment.

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.

Uncertainties in assessment and forecast

The assessment is uncertain, due to 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 restrictive herring TAC this problem may have been further exacerbated by species misreporting.

Comparison with previous assessment and advice

The current assessment has revised the value of SSB in 2004 upwards by 16%. The estimate of F in 2004 has been revised downwards by 11%. The basis for the advice is the same as last year.
Source of information

Report of the Baltic Fisheries Assessment Working Group. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

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	**	93*	
2005	$< \mathbf{F}_{pa}$	$< \mathbf{F}_{pa}$	130	130	130[2]	**	92*	
2006	$< \mathbf{F}_{pa}$	$< \mathbf{F}_{pa}$	120	120	128	**		
2007	$< \mathbf{F}_{pa}$	$< \mathbf{F}_{pa}$	164	164				

Weights in '000 t.

[1] TAC is for Subdivisions 22–29S and 32.

[2] This is the EU TAC is for Subdivisions 25–28(1), 29, and 32.

* Excl. GOR (28.2).

** Separate management since 2004.

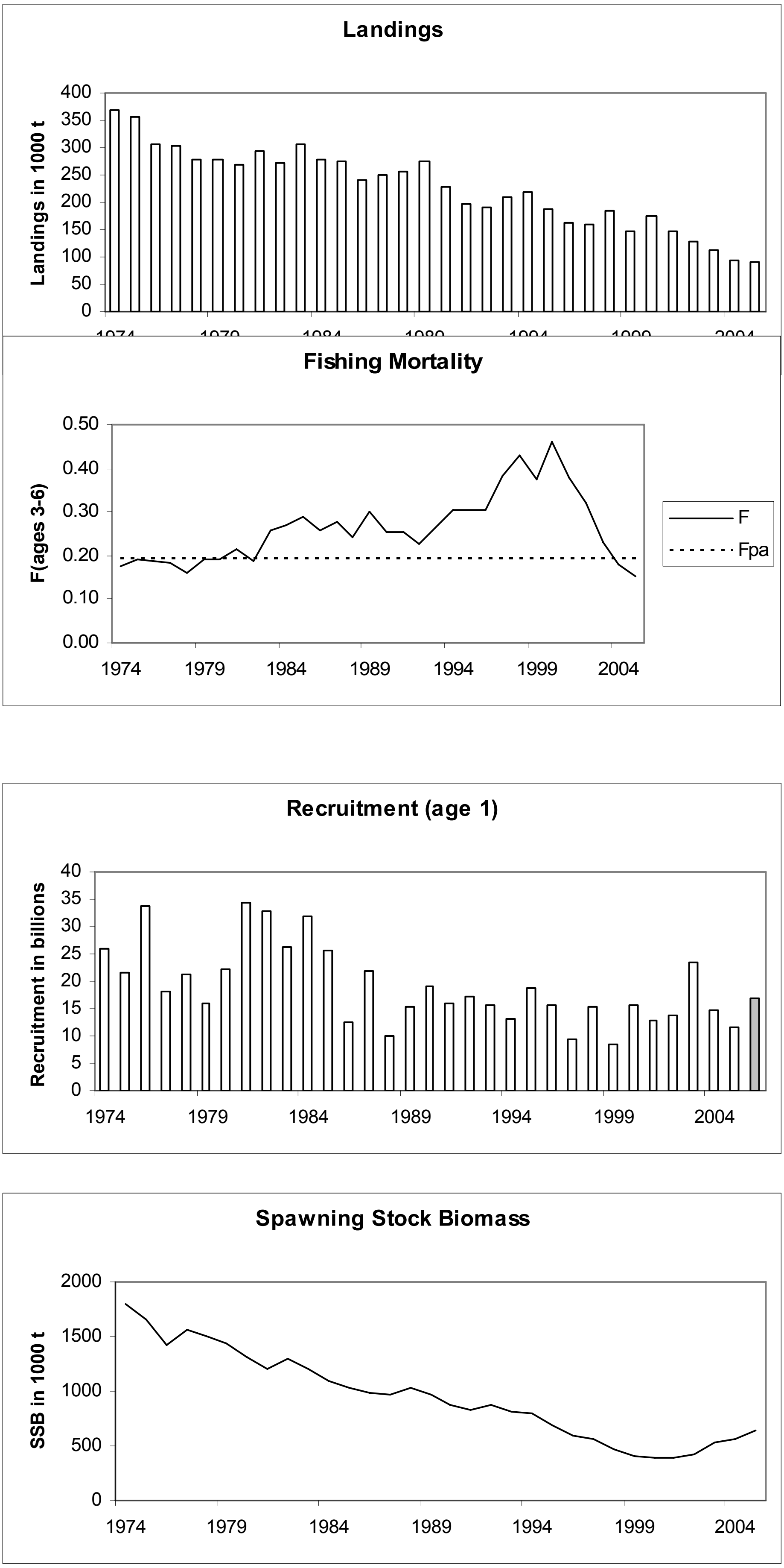


Figure 8.4.4.1 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Landings, fishing mortality, recruitment and SSB

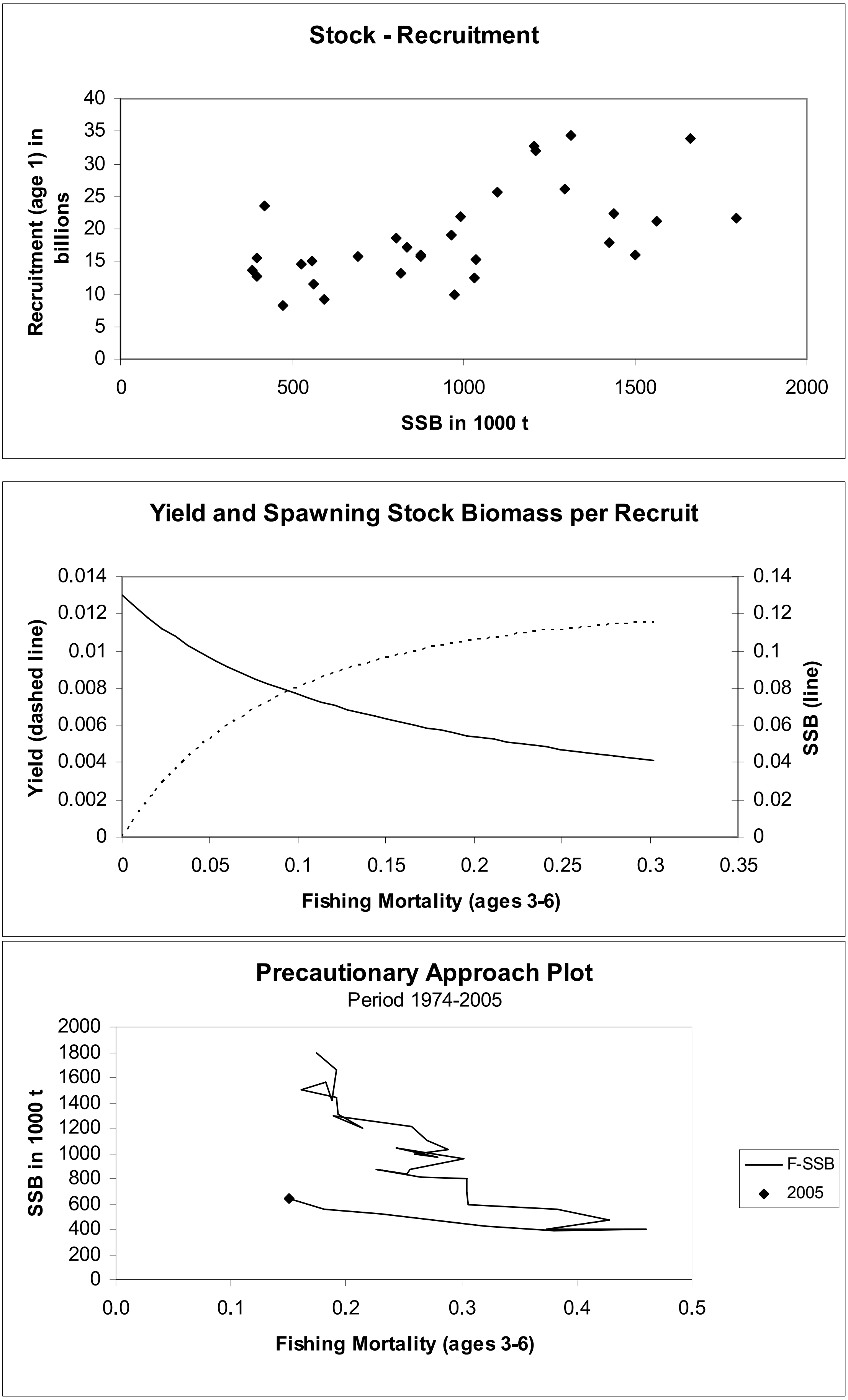


Figure 8.4.4.2 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Stock and recruitment; Yield and SSB per recruit.

Table 8.4.4.1 Herring catches in Subdivisions 25–29 and 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
2005	3,1	10,8	6,4	3,7	2,0	0,7	18,5	7,0	39,4	91,6

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

Table 8.4.4.2 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1974	25942816	1794898	368652	0.1741
1975	21537452	1659199	354851	0.1919
1976	33889504	1422313	305420	0.1871
1977	17971072	1560410	301952	0.1819
1978	21197418	1502023	278966	0.1605
1979	15955841	1439679	278182	0.1918
1980	22304238	1311318	270282	0.1925
1981	34332468	1205256	293615	0.2143
1982	32697184	1293380	273134	0.1892
1983	26114728	1210602	307601	0.2566
1984	31965232	1098575	277926	0.2696
1985	25649928	1031539	275760	0.2883
1986	12557483	992130	240516	0.2593
1987	21798278	975296	248653	0.2791
1988	9864865	1037580	255734	0.2435
1989	15409988	962942	275501	0.3015
1990	18948356	872878	228572	0.2547
1991	15933924	833344	197676	0.2531
1992	17257422	873852	189781	0.2263
1993	15730557	817477	209094	0.2648
1994	13099493	804167	218260	0.3051
1995	18694090	692735	188181	0.3048
1996	15681115	594757	162578	0.3054
1997	9233538	557853	160002	0.3826
1998	15161886	473941	185780	0.4283
1999	8296196	398991	145922	0.3736
2000	15492825	398118	175646	0.4599
2001	12674784	385460	148404	0.3801
2002	13650974	420849	129222	0.3205
2003	23495552	526275	113584	0.2301
2004	14672568	562233	93006	0.1811
2005	11642735	640539	91592	0.1509
2006	16827000*			
Average	18960046	948457	226376	0.2626

* Output from RCT3 analysis.

8.4.5 Herring in the Gulf of Riga

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	Overexploited	

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. Based on high recruitment, SSB increased in the beginning of the 1990s and has remained high thereafter.

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	0.419	0.009	0.026
$\mathbf{F}_{max}$	0.835	0.010	0.014
$\mathbf{F}_{0.1}$	0.264	0.009	0.036
$\mathbf{F}_{med}$	0.297	0.009	0.033

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 of at most 33 900 t in 2007.

Short-term implications

Outlook for 2007

Basis: F(2006) = $\mathbf{F}_{sq}$ = 0.42; Landings(2006) = 39.5; SSB(2006) = 106.4.

Rationale	TAC (2007)	F (2007)	Basis	SSB (2007)	SSB (2008)	%SSB change	%TAC change
Zero catch	0	0.0	F=0	106.4	132.1	24%	-100%
Status quo	35.4	0.42	$\mathbf{F}_{sq}$	98.7	89.7	-9%	-12%
Precautionary limits	3.9	0.04	$\mathbf{F}_{pa}$* 0.1	105.6	127.2	20%	-90%
	9.6	0.10	$\mathbf{F}_{pa}$* 0.25	104.5	120.3	15%	-76%
	18.4	0.20	$\mathbf{F}_{pa}$* 0.5	102.6	109.6	7%	-54%
	26.0	0.30	$\mathbf{F}_{pa}$* 0.75	100.8	100.0	-1%	-34%
	31.1	0.36	$\mathbf{F}_{pa}$* 0.9	99.8	94.7	-5%	-22%
	34.0	0.40	$\mathbf{F}_{pa}$	99.0	91.3	-8%	-15%
	36.8	0.44	$\mathbf{F}_{pa}$* 1.1	98.3	88.1	-10%	-8%
	40.9	0.50	$\mathbf{F}_{pa}$* 1.25	97.3	83.5	-14%	2%

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

Management considerations

The assessment is based on 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 to 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

The 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. The bycatch of sprat in this fishery has recently been about 10% of the total catch. 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).

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. Recruitment predictions are based on average water temperature in April, when the spawning starts and the abundance of zooplankton in May, when the hatching of larvae begins. The period since the end of the 1980s, when the majority of winters have been 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 2004 downwards by 9% and fishing mortality in 2004 upwards by 14%.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Rostock, 18 – 27 April 2006, ICES CM 2006/ACFM:24.

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	32.2
2006	$F=\mathbf{F}_{pa}$	39.9	40.0	
2007	$F=F_{pa}$	33.9		

Weights in ‘000 t. * The possible catch of open-sea herring is not included. ** The possible catch of open-sea herring is included.

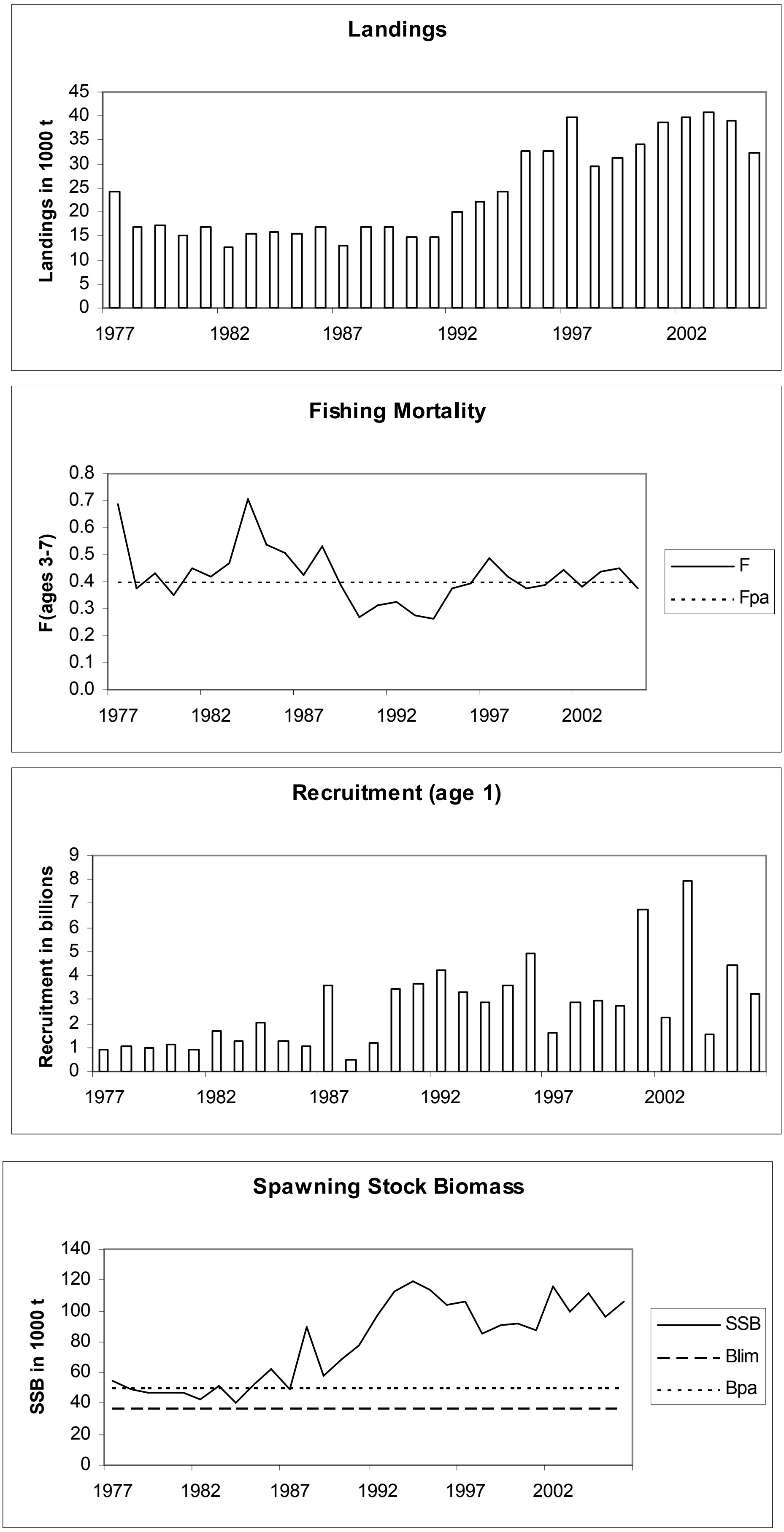
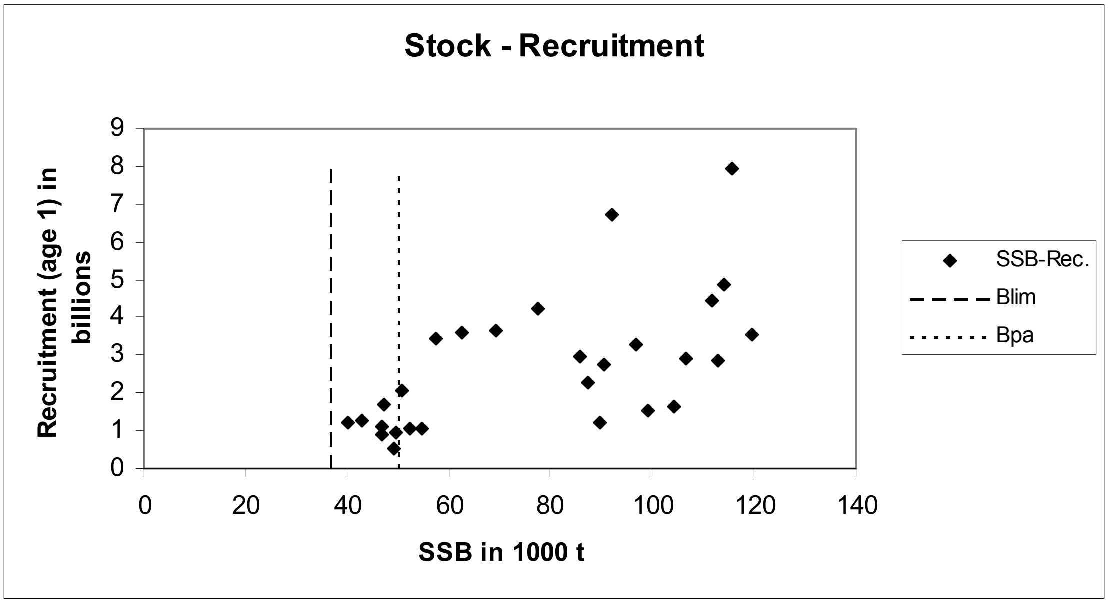
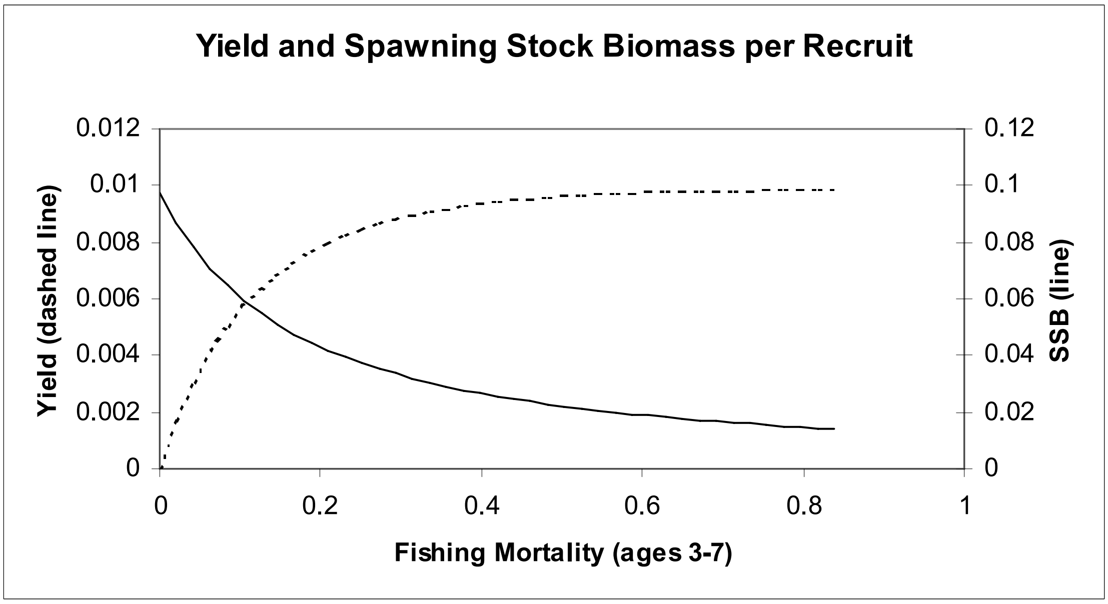


Figure 8.4.5.1 Gulf of Riga herring. Stock development. Landings, fishing mortality, recruitment and SSB.





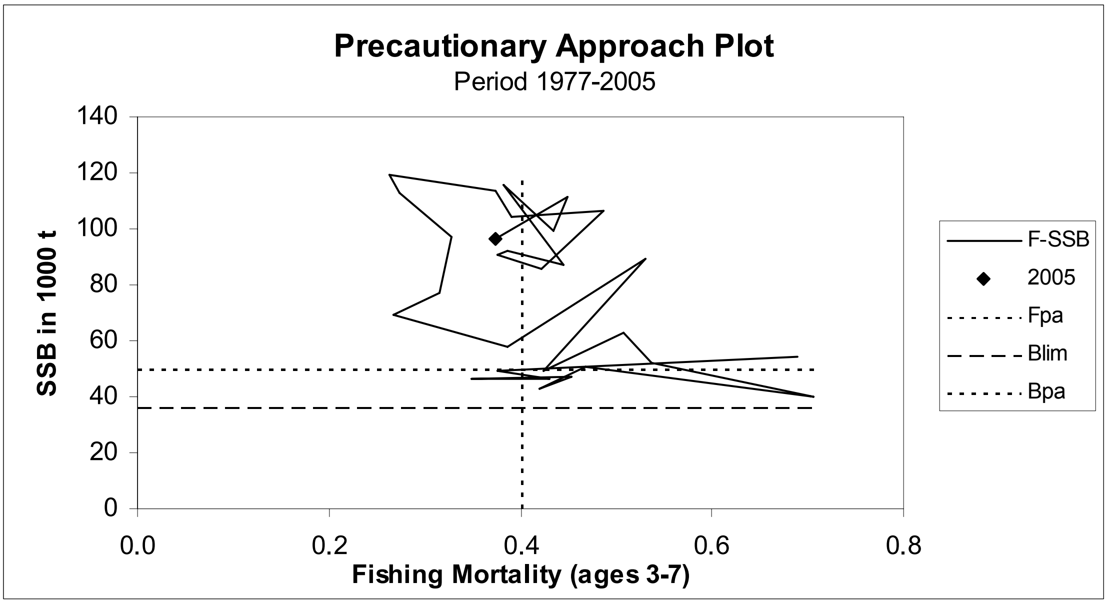


Figure 8.4.5.2. Gulf of Riga herring. Stock development. Stock and recruitment; Yield and SSB per recruit.

Table 8.4.5.1 Herring catches in the Gulf of Riga by country.

Year	Estonia	Latvia	Unallocated landings	Total
1991	7420	13481	-	20901
1992	9742	14204	-	23946
1993	9537	13554	3446	26537
1994	9636	14050	3512	27198
1995	16008	17016	3401	36425
1996	11788	17362	3473	32623
1997	15819	21116	4223	41158
1998	11313	16125	3225	30663
1999	10245	20511	3077	33833
2000	12514	21624	3244	37382
2001	14311	22775	3416	40502
2002	16962	22441	3366	42769
2003	19647	21780	3267	44694
2004	18218	20903	3136	42257
2005	11213	19741	2961	33915

Table 8.4.5.2 Herring in the Gulf of Riga.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1977	943316	54524	24186	0.6902
1978	1076601	49359	16728	0.3751
1979	977120	46743	17142	0.4309
1980	1110553	46720	14998	0.3498
1981	909000	47232	16769	0.4524
1982	1690925	42776	12777	0.4196
1983	1253087	50902	15541	0.4675
1984	2049739	39946	15843	0.7058
1985	1235975	52247	15575	0.5370
1986	1038622	62517	16927	0.5071
1987	3605778	49094	12884	0.4243
1988	525759	89607	16791	0.5298
1989	1230387	57524	16783	0.3867
1990	3428267	69320	14931	0.2677
1991	3650100	77418	14791	0.3148
1992	4253070	96815	20000	0.3274
1993	3277176	112923	22200	0.2732
1994	2875114	119547	24300	0.2631
1995	3556283	113921	32656	0.3729
1996	4891918	104359	32584	0.3908
1997	1627463	106453	39843	0.4867
1998	2895800	85704	29443	0.4210
1999	2973446	90529	31403	0.3767
2000	2752461	92029	34069	0.3861
2001	6749079	87416	38785	0.4457
2002	2266018	115788	39701	0.3822
2003	7924983	99107	40803	0.4355
2004	1532340	111549	39115	0.4490
2005	4422505	96707	32225	0.3733
2006*	3213330			
Average	2664541	79170	24131	0.4221

* RCT3 estimate.

8.4.6 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	Appropriate	

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. The spawning stock biomass has been high since the late 1980s and seems to have increased in recent years. It is presently well above $\mathbf{B}_{pa}$. The fishing mortality decreased since 1999 and has been below $\mathbf{F}_{pa}$ since 2001, hovering around F=0.15.

Recruitment has been high since 1989 and the 2002 year class appears exceptional. Estimation of year class 2003 is among the lowest since 1988, whereas year class 2004 is average.

Management objectives

There are no explicit management objectives for this stock. Herring management for Subdivisions 30 and 31 is 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	0.149	0.009	0.058
$\mathbf{F}_{max}$	0.468	0.011	0.026
$\mathbf{F}_{0.1}$	0.171	0.010	0.054
$\mathbf{F}_{med}$	0.115	0.008	0.066

Technical basis

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

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Assuming a fishery in 2006 at *status quo* $\mathbf{F}_{sq}$ = 0.15, fishing below $\mathbf{F}_{pa}$ in 2007 corresponds to landings of less than 83 400 t.

Short-term implications

Outlook for 2007.

Basis: F(2006) = $\mathbf{F}_{sq}$ = 0.15; Landings (2006) = 60; SSB(2006) = 411.

Rationale	TAC (2007)	F(2007)	Basis	SSB(2007)	SSB(2008)	%SSB change	%TAC change
Zero catch	0	0	**F**=0	402	442	10%	-100%
Status quo	60.9	0.15	$\mathbf{F}_{sq}$	393	376	-4%	-34%
High long-term yield	Not defined	Not defined	F(long-term yield)				
Precautionary limits	9.1	0.02	$\mathbf{F}_{pa}$ * 0.1	401	432	8%	-90%
	22.5	0.05	$\mathbf{F}_{pa}$ * 0.25	399	418	5%	-75%
	43.8	0.10	$\mathbf{F}_{pa}$ * 0.5	394	394	0%	-52%
	64.1	0.16	$\mathbf{F}_{pa}$ * 0.75	393	372	-5%	-30%
	75.8	0.19	$\mathbf{F}_{pa}$ * 0.90	391	360	-8%	-17%
	83.4	0.21	$\mathbf{F}_{pa}$	390	352	-10%	-9%
	90.8	0.23	$\mathbf{F}_{pa}$ * 1.1	388	344	-11%	-1%
	101.6	0.26	$\mathbf{F}_{pa}$ * 1.25	386	332	-14%	11%

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

Management considerations

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

Most herring is taken in herring trawl fisheries. The sprat bycatches in herring fisheries are low in ICES Subdivisions 30 and 31.

SSB is presently at a very high level due to the strong 2002 year class. Fishing at the current level is not expected to reduce SSB close to $\mathbf{B}_{pa}$ in the short term.

Ecosystem considerations

Stock trends in Bothnian Sea herring have since the 1990s been driven mainly by good recruitment and by 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 may be 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 low exploitation level it is expected that the dioxin concentration in the fish caught will increase, as the amount of older herring (which have higher accumulated amounts of dioxin) will increase in the stock and in the catch.

Factors affecting the fisheries and the stock

Most of the Baltic herring catch 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.

The EU has given Finland and Sweden a dispensation up to the end of the year 2006 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.

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.

The environment

Herring weight-at-age has shown a declining trend since the late 1980s which may be caused by limited food supply due to changes in zooplankton species composition.

Scientific basis

Data and methods

The assessment is based on catch data with revised ageing for the years 2002–2005 in Finnish samples, and two commercial cpue series.

As the reported fishing effort data (trawling hours) is not considered to reflect fishing mortalities correctly, correction coefficients have been used for trawl fishing effort data in 1980–2005.

Uncertainties in assessment and forecast

There are high uncertainties in the estimates of SSB and F in recent years as visible in the retrospective pattern, showing an underestimation of SSB and overestimation of F.

No fishery-independent information is available. The commercial cpue time-series showed a residual pattern. This may be caused by changes in catchability of the trapnet fishery and potentially by the effort estimation procedure for the pelagic trawl fleet. 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. Predation by grey seals was analysed and found to be insignificant for the current assessment. However, due to the rapid increase in the grey seal population, this conclusion should be re-evaluated in future assessments.

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 2004 downwards by about 9%. The estimate of F has similarly been revised upwards by about 10%.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

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	58
2006	F below $\mathbf{F}_{pa}$	88/93	91.6	
2007	F below $\mathbf{F}_{pa}$	83.4		

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

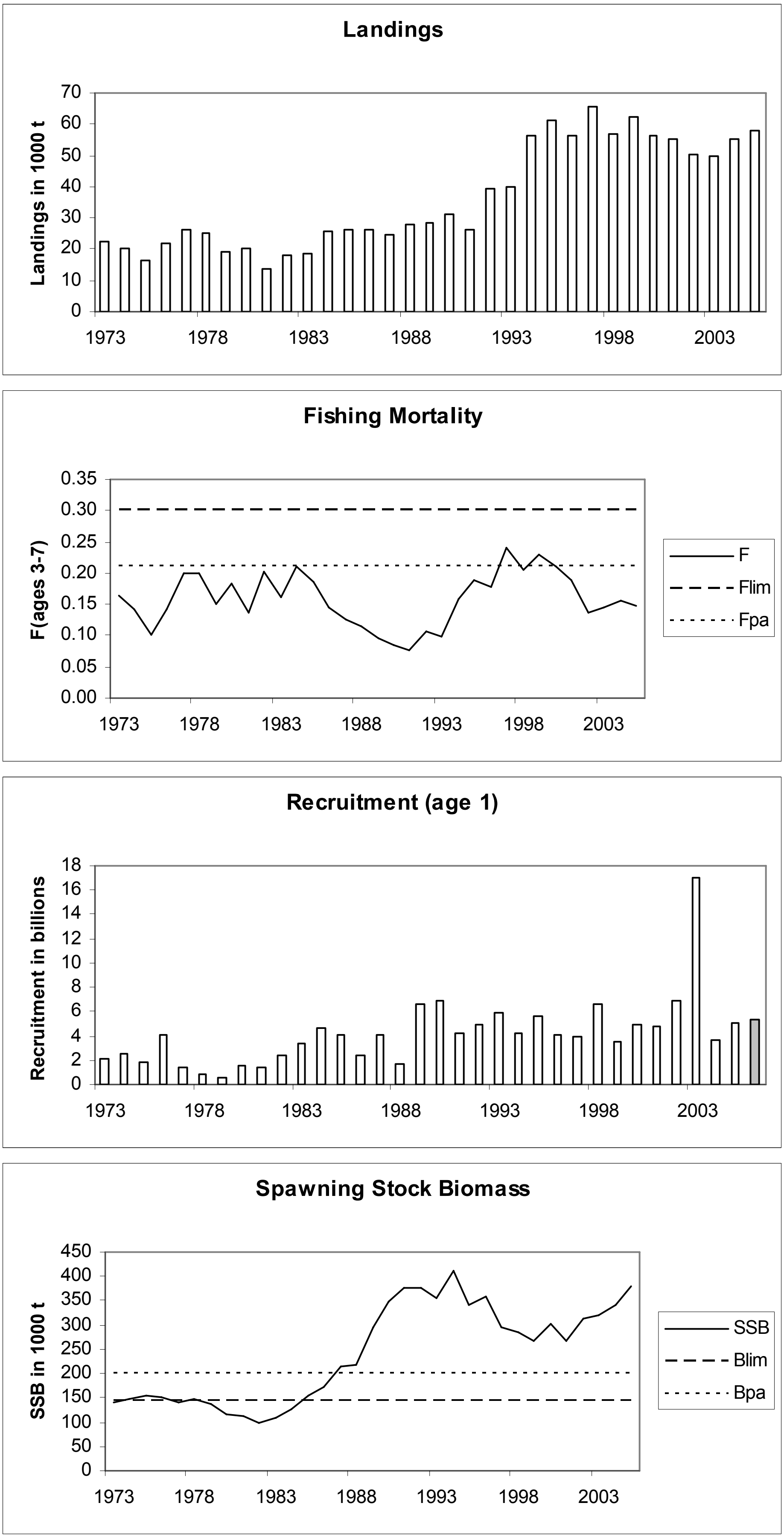


Figure 8.4.6.1 Herring in Subdivision 30, Bothnian Sea. Landings, fishing mortality, recruitment and SSB.

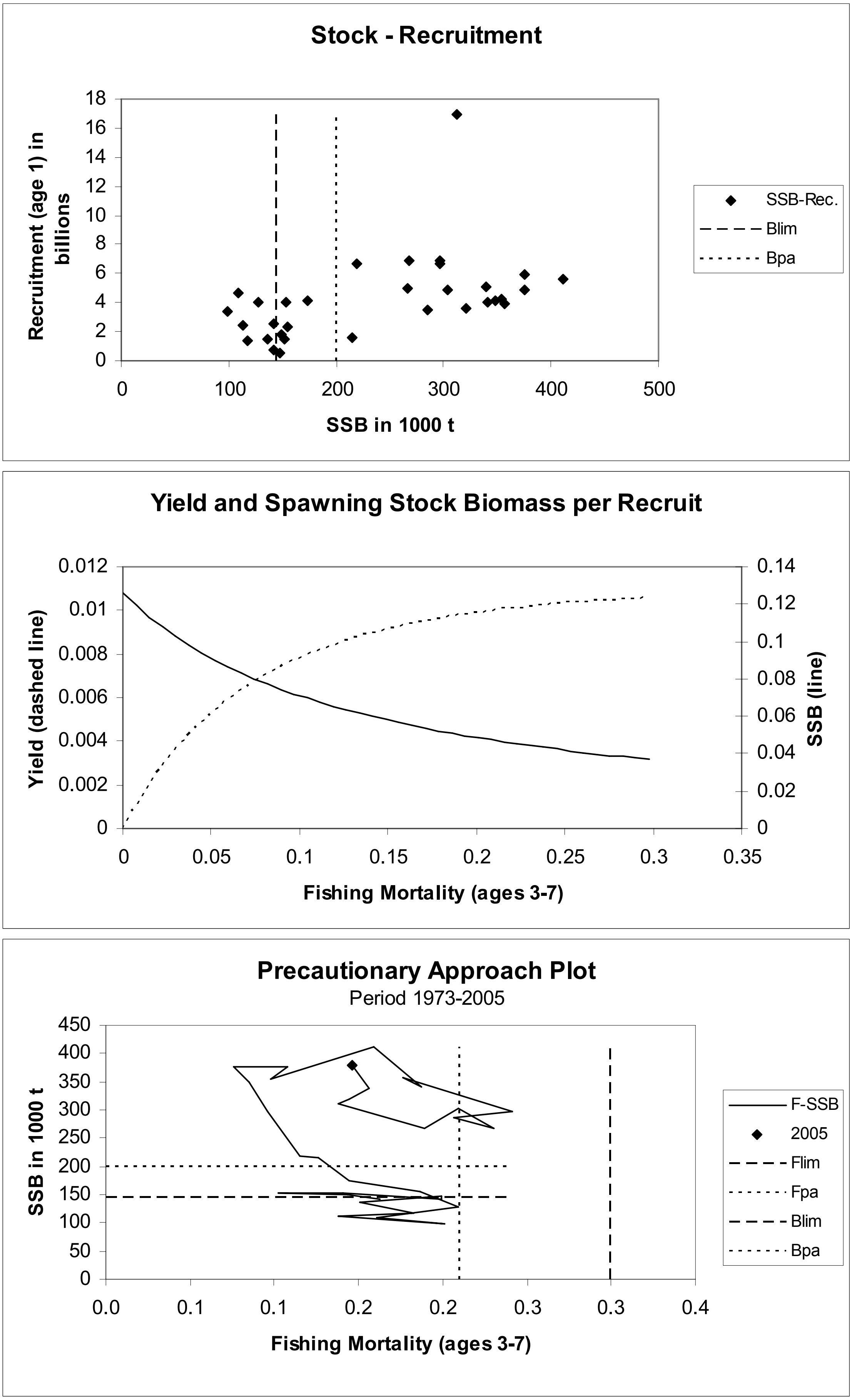


Figure 8.4.6.2 Herring in Subdivision 30, Bothnian Sea. Stock and recruitment; Yield and SSB per recruit.

Table 8.4.6.1 Catches in Subdivision 30 by country.

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
2005*	55422	2520	57942

* preliminary.

Table 8.4.6.2 Herring in Subdivision 30, Bothnian Sea.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1973	2067880	141118	22531	0.1627
1974	2558233	148791	20294	0.1433
1975	1841885	153738	16264	0.1023
1976	4061176	151645	22012	0.1410
1977	1455730	141536	26304	0.1988
1978	773628	147866	25105	0.1995
1979	502116	135730	19049	0.1509
1980	1489769	116862	20150	0.1828
1981	1426553	112840	13700	0.1380
1982	2421698	99434	17847	0.2013
1983	3399000	108761	18501	0.1604
1984	4675569	126998	25629	0.2097
1985	4054612	154192	26120	0.1868
1986	2321268	173184	26489	0.1442
1987	4120262	215201	24520	0.1262
1988	1636805	219300	27650	0.1147
1989	6623998	296420	28658	0.0955
1990	6895701	348323	31282	0.0849
1991	4177973	375551	26219	0.0756
1992	4855035	375554	39310	0.1075
1993	5915147	353609	40179	0.0975
1994	4236729	410945	56380	0.1586
1995	5660958	340494	61086	0.1877
1996	4048586	356984	56109	0.1768
1997	3892422	296610	65527	0.2417
1998	6618758	285365	56892	0.2061
1999	3537625	266127	62345	0.2299
2000	4942687	304063	56261	0.2095
2001	4825632	268241	54984	0.1896
2002	6904006	311979	50218	0.1378
2003	16959712	320380	49638	0.1442
2004	3623751	339323	55450	0.1559
2005	5119298	378944	57941	0.1463
2006	5378788			
Average	4206559	241700	36383	0.1578

8.4.7 Herring in Subdivision 31, Bothnian Bay

State of the stock

In the absence of analytical assessment and defined reference points the state of the stock cannot be fully evaluated.

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 2000 SSB has increased and is now near the long-term average due to large year classes in 1999, 2001, and 2002.

Management objectives

There are no explicit management objectives for this stock. Herring management for Subdivisions 30 and 31 is 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	0.309	0.014	0.049
$\mathbf{F}_{max}$	0.395	0.014	0.039
$\mathbf{F}_{0.1}$	0.165	0.012	0.077
$\mathbf{F}_{med}$	0.208	0.013	0.066

Short-term implications

Due to uncertainties in the state of the stock, catches at recent (2002–2005) average levels of 4 700 t should not be exceeded.

Management considerations

This stock is a minor part of the TAC set for the Management Unit consisting of ICES Subdivisions 30 and 31.

Most herring is taken in herring trawl fisheries. The sprat bycatches in herring fisheries are low in ICES Subdivisions 30 and 31.

Factors affecting the fisheries and the stock

The environment

The main part of the total catch is taken by trawl fishery. Fluctuations in total trawl catches and the length of the fishing season depends on the onset of winter and the 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

Due to inconsistencies in tuning fleet indices and retrospective bias the analytical assessment was not accepted and no short-term forecast was produced.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 18–27 April 2006 (ICES CM 2006/ACFM:24).

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	5.0
2006	Less than average catches (2002–2004)	4.6	91.6	
2007	Less than average catches (2002–2005)	4.7		

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

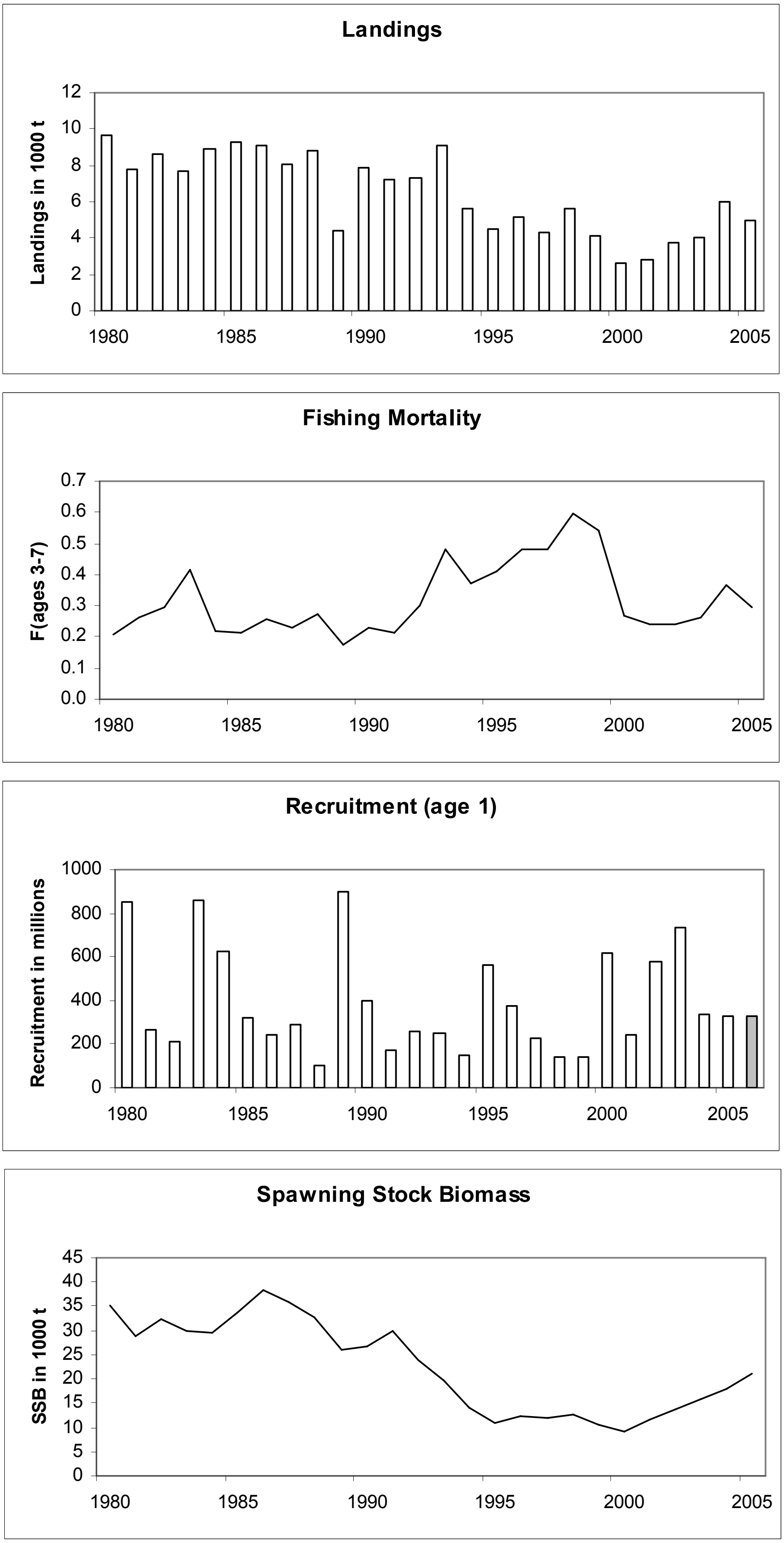


Figure 8.4.7.1 Herring in Subdivision 31, Bothnian Bay. Landings, fishing mortality, recruitment and SSB.

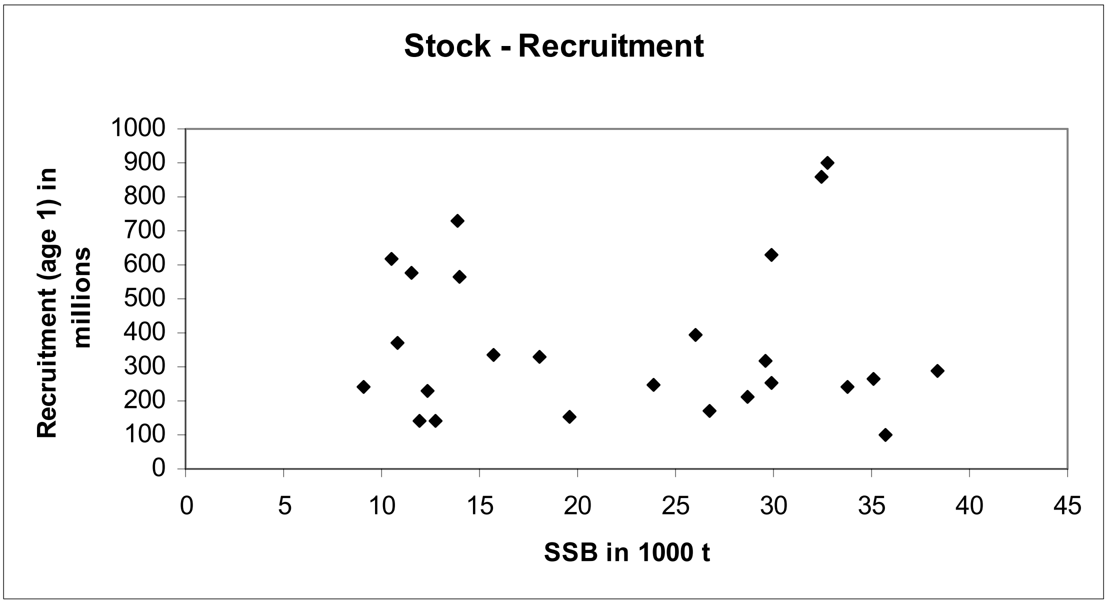


Figure 8.4.7.2 Herring in Subdivision 31, Bothnian Bay. Stock Recruitment

Table 8.4.7.1 Herring catches in Subdivision 31 by country.

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	5 194
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
2005*	4 800	169	4 970

* Preliminary

8.4.8 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 as being harvested sustainably.

Management objectives

The IBSFC long-term management plan for the sprat stock was terminated in 2006. The present advice was now given in relation to precautionary limits.

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	0.386	0.004	0.012
$\mathbf{F}_{max}$	N/A		
$\mathbf{F}_{0.1}$	0.399	0.004	0.012
$\mathbf{F}_{med}$	0.364	0.004	0.012

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 high long term yield, low risk of depletion of production potential and considering ecosystem effects

The current fishing mortality, estimated at 0.32, is below fishing mortalities that would lead to high long-term yields (in the range of 0.36 – 0.40).

Exploitation boundaries in relation to precautionary limits

Fishing mortality in 2007 should be below $\mathbf{F}_{pa}$ = 0.40 corresponding to landings of less than 477 000 t.

Short-term implications

Outlook for 2007

Basis: F(2006) = 0.32 (*status quo* assumption); Landings (2006) = 370; SSB(2006) = 1430.

Rationale	TAC (2007)	F(2007)	Basis	SSB(2007)	SSB(2008)	%SSB change	%TAC change
Zero catch	0	0	F=0	1600	1850	16%	-100%
Status quo	389	0.32	$\mathbf{F}_{sq}$	1450	1350	-7%	-17%
Precautionary approach	55	0.04	Fpa * 0.1	1600	1800	13%	-88%
	135	0.10	Fpa * 0.25	1550	1700	10%	-71%
	259	0.20	Fpa * 0.50	1500	1500	0%	-45%
	373	0.30	Fpa * 0.75	1450	1400	-3%	-20%
	437	0.36	Fpa * 0.90	1400	1300	-7%	-7%
	477	0.40	Fpa	1400	1250	-11%	2%
	517	0.44	Fpa * 1.1	1400	1200	-14%	10%
	574	0.50	Fpa * 1.25	1350	1150	-15%	23%

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

Management considerations

A catch in 2007 of 477 000 tonnes is expected to decrease the SSB to 1.25 million t in 2008. The strong year classes of 2002–2003 contribute 54% to the yield in 2007. The 2004 year class is estimated to be weak, while the 2005 year class is predicted to be above average.

The current level of SSB is very high and is well above $\mathbf{B}_{pa}$. In 2007–2008 the stock and the catch opportunities will still be good due to the strong year classes 2002 and 2003, and the above-average year class of 2005. The prospect of the sprat fishery in the coming years will to a great extent depend on the 2006 and 2007 year classes. In the presented projections they were assumed as the long-term average, in which case they constitute 33% of the SSB predicted for 2008. However, available environmental data (NAO index) suggest that the 2006 year class may be weak, which would only slightly affect the 2007 catches, but would lead to 17% lower SSB in 2008 than the one predicted in present forecast.

The highest 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 recovers.

Fishing at $\mathbf{F}_{sq}$ in the medium term will lead to about 15% decline in biomass and catches. However, all of these levels of exploitation show a high probability of the stock remaining above $\mathbf{B}_{pa}$.

The catch possibilities can vary considerably from year to year because of the recruitment pattern with the occasional large year classes.

Factors affecting the fisheries and the stock

Sprat are taken in mixed fisheries together with herring to an extent that depends on season and area. This means that the fishing options for sprat should take account of the state of Baltic herring stocks, especially the central stock, as they overlap in distribution and fishing area. Management of the pelagic species therefore requires effective monitoring of catches by species.

Regulations and their effects

The mesh size (minimum of 16-mm mesh opening) and TAC are the main regulatory measures adopted for the Baltic sprat fishery.

The environment

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 unusually high state of the North Atlantic Oscillation (NAO), associated with unusually high temperature conditions.

Sprat in the Baltic Sea are located near the northern limit of the species' geographic distribution. Low temperatures can therefore be expected to be detrimental to production and survival in the Baltic Sea. Laboratory experiments have shown that cold water prevents hatching of sprat eggs from the Baltic Sea. 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. Another way 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.

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 fisheries are likely to be imprecise.

Environment conditions

The NAO index was used in the present assessment to predict the 2005 year class.

Comparison with previous assessment

Updated natural mortalities were used in the assessment. The current and last year's assessments gave almost identical estimates of SSB in 2004. The estimate of F in 2004 has been revised upwards by 26%.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

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	614	550	405
2006	Agreed Management Plan	Management plan F	439	439	468	
2007	< $\mathbf{F}_{pa}$	< $\mathbf{F}_{pa}$	<477	<477		

Weights in '000 t.

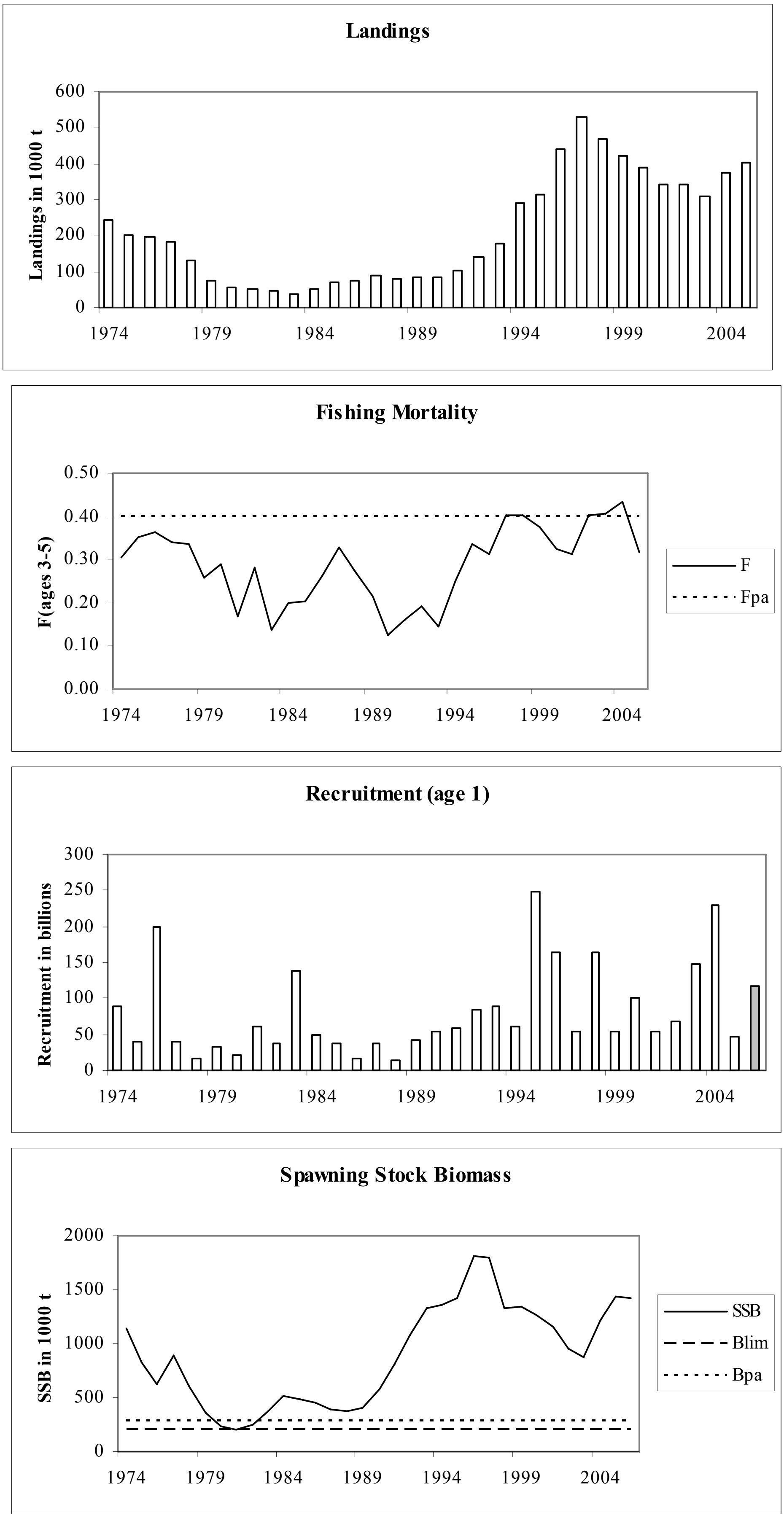
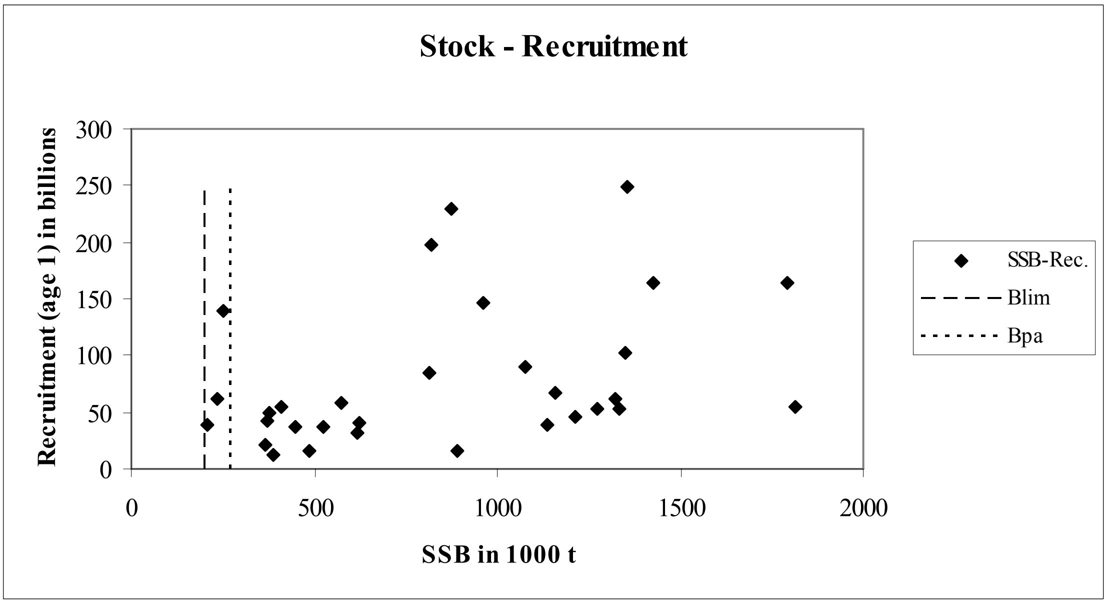


Figure 8.4.8.1 Sprat in Subdivisions 22–32. Landings, fishing mortality, recruitment and SSB.



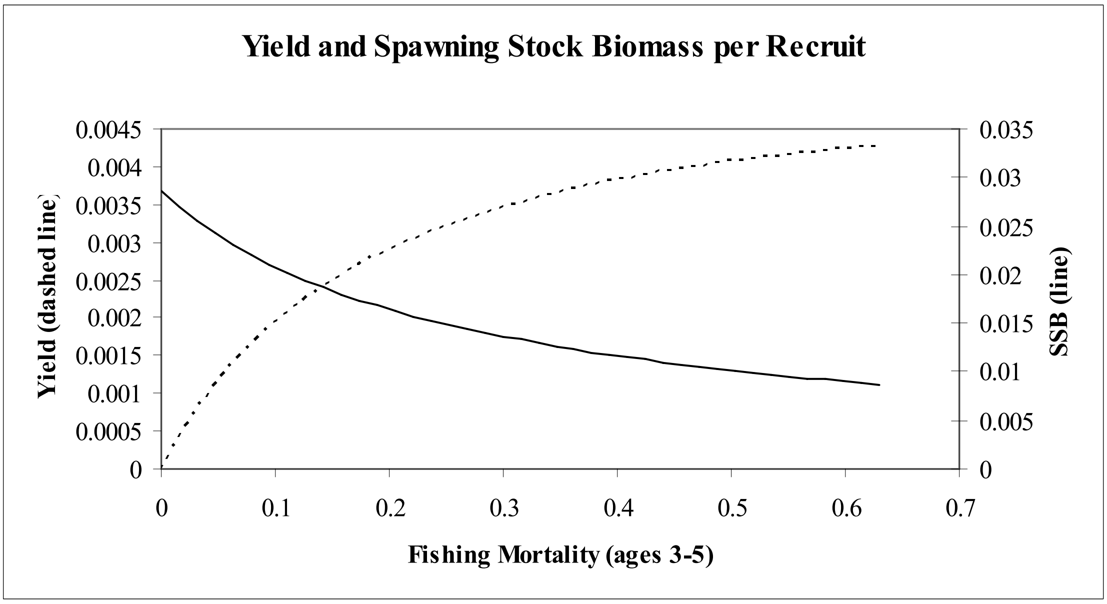


Figure 8.4.8.2 Sprat in Subdivisions 22–32. Stock and recruitment; Yield and SSB per recruit

Table 8.4.8.1 **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
2005	46.5	49.8	17.9	29.0	64.7	8.6	71.4	29.7	87.8	405.2

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

Table 8.4.8.2 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**

Year 2005

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**46.5**	17.6	2.1	11.1	5.4	0.3	10.0	-	-	-	-
Estonia	**49.8**	-	-	-	-	-	7.1	16.6	-	-	26.0
Finland	**17.9**	-	0.1	0.6	0.6	0.1	0.3	9.0	3.2	0.0	4.0
Germany	**29.0**	1.2	0.1	0.4	4.3	10.2	6.8	6.1	-	-	-
Latvia	**64.7**	-	-	1.2	7.3	0.4	55.8	-	-	-	-
Lithuania	**8.6**	-	-	-	8.6	-	-	-	-	-	-
Poland	**71.4**	-	2.0	23.5	45.6	0.2	0.1	-	-	-	-
Russia	**29.7**	-	-	-	29.7	-	-	-	-	-	0.1
Sweden	**87.8**	-	0.7	11.1	10.3	25.1	24.5	16.2	-	-	-
Total	**405.2**	**18.8**	**5.0**	**47.9**	**111.7**	**36.2**	**104.5**	**47.9**	**3.2**	**0.005**	**30.2**

Table 8.4.8.3 Sprat in Subdivisions 22 to 32.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-5
1974	88776312	1137055	241700	0.3046
1975	38876604	820807	201434	0.3507
1976	198313968	623149	194775	0.3642
1977	40265340	888294	180800	0.3385
1978	16189915	614834	132360	0.3341
1979	32357310	365488	77100	0.2567
1980	21775124	233092	58100	0.2881
1981	61433612	205419	49300	0.1695
1982	38347768	253692	48700	0.2803
1983	138819632	376163	37320	0.1371
1984	49881212	522499	52560	0.1979
1985	37756908	484763	69497	0.2045
1986	15672043	449606	75800	0.2624
1987	36607488	386365	88276	0.3291
1988	13180027	372741	80300	0.2705
1989	42911756	410941	85817	0.2131
1990	53830324	575545	85578	0.1234
1991	57577968	811913	103200	0.1587
1992	84115808	1073910	142195	0.1910
1993	89887376	1322805	178100	0.1442
1994	60971996	1355575	288700	0.2507
1995	248944080	1424727	313000	0.3363
1996	164075184	1816839	441100	0.3134
1997	54056748	1794631	529400	0.4023
1998	164114336	1331148	470770	0.4041
1999	53224024	1347128	421397	0.3736
2000	101540040	1271422	389140	0.3224
2001	52866440	1158569	342200	0.3126
2002	67030936	960543	343191	0.4019
2003	146869088	876464	308260	0.4068
2004	229709584	1212783	373675	0.4353
2005	45809204	1437246	405250	0.3150
2006*	118290000			
Average	80729641	889217	212781	0.2881

* Output from recruitment prediction model (RCT3) using NAO index and acoustic surveys

8.4.9 Flounder in Subdivisions 22–32

State of the stock

The size of most Baltic flounder stocks is unknown. There are indications from surveys for an above average recruitment in recent years. Landings have increased since the late 1990s.

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 a 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. An average of about 50% of the Baltic flounder landings are reported for Subdivisions 24 + 25, followed by Subdivision 26 (20%) and Subdivision 22 (15%). Total landings varied between about 8400 t and 19 640 t. Peaks occurred in 2002 and 2005. During the mid-1990s flounder landings were misreported (over-reported) from the cod trawl fishery, mainly for Subdivisions 24 and 25. Total landings in 2005 amounted to 19 640 t.

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.

The implementation of the IBSFC Fishery Rule to use only the BACOMA net in the cod trawl fishery is expected to increase flounder discard rates.

Scientific basis

Data and methods

Until now, the assessment was considered exploratory. It is based on long-term catch data and two BITS surveys (1st and 4th quarter). In the surveys as well as in the landings subsequent age groups of the same year class appear poorly correlated. Therefore, the BFAS Working Group proposed to postpone age-based assessments for that stock until remarkable improvement in the basic data quality can be demonstrated.

Main problems are age-reading and discards both in cod and directed fisheries. An age-reading Workshop in March 2006 in Rostock identified some of the ageing problems and initiated a comparative reading around the Baltic. Sweden will host the next age-reading Workshop on flounder in 2007. In early October 2006 a Workshop on assessment strategies for Baltic flounder will be held in Öregrund/Sweden.

Comparison with previous assessment and advice

No analytical assessment was presented this year.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

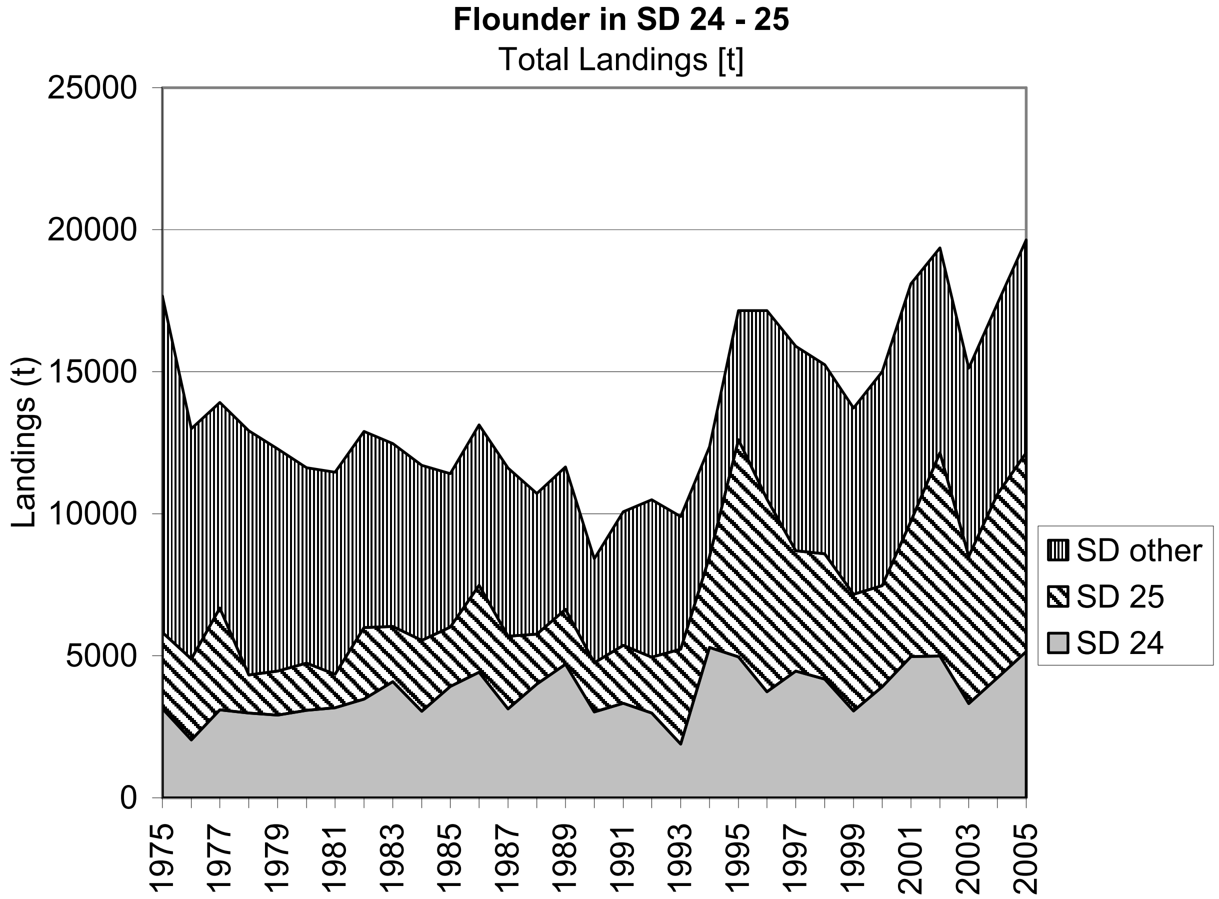


Figure 8.4.9.1 Landings of flounder in the Baltic.

Table 8.4.9.1 Total landings (tonnes) of flounder in 1981–1988 by Subdivision and country.

Year	Country*	SD 22	SD 23	SD 24	SD 25	SD 26	SD 27	SD 28	SD 29	SD 30	SD 31	SD 32	Total
1981	Denmark	1,964		548									2,512
	Finland								227	56		135	418
	Gem. Dem. Rep.	271		2,595									2,866
	Gem. Fed. Rep.	351		1									352
	Poland				1,151	1,541							2,692
	Sweden			21	30		21	194	34				300
	USSR					58		742	445			1,078	2,323
	Total	2,586	0	3,165	1,181	1,599	21	936	706	56	0	1,213	11,463
1982	Denmark	1,563	104	257									1,924
	Finland								219	58		144	421
	Gem. Dem. Rep.	263		3,202									3,465
	Gem. Fed. Rep.	248		1									249
	Poland				2,484	1,623							4,107
	Sweden			22	33		65	16	3				139
	USSR					195		665	615			1,121	2,596
	Total	2,074	104	3,482	2,517	1,818	65	681	837	58	0	1,265	12,901
1983	Denmark	1,714	115	450									2,279
	Finland								181	67		120	368
	Gem. Dem. Rep.	280		3,572									3,852
	Gem. Fed. Rep.	418		1									419
	Poland				1,828	905							2,733
	Sweden			72	108		212	52	9				453
	USSR					209		551	497			1,114	2,371
	Total	2,412	115	4,095	1,936	1,114	212	603	687	67	0	1,234	12,475
1984	Denmark	1,733	85	306									2,124
	Finland								174	108		135	417
	Gem. Dem. Rep.	349		2,719									3,068
	Gem. Fed. Rep.	371		1									372
	Poland				2,471	1,288							3,759
	Sweden			18	27		53	13	2				113
	USSR					145		202	286			1,226	1,859
	Total	2,453	85	3,044	2,498	1,433	53	215	462	108	0	1,361	11,712
1985	Denmark	1,561	130	649									2,340
	Finland								157	97		137	391
	Gem. Dem. Rep.	236		3,253									3,489
	Gem. Fed. Rep.	199		4									203
	Poland				2,063	1,302							3,365
	Sweden			16	24		47	12	2				101
	USSR					268		189	265			806	1,528
	Total	1,996	130	3,922	2,087	1,570	47	201	424	97	0	943	11,417
1986	Denmark	1,525	65	1,558									3,148
	Finland								199	128		181	508
	Gem. Dem. Rep.	127		2,838									2,965
	Gem. Fed. Rep.	125		10									135
	Poland				3,030	1,784							4,814
	Sweden			20	31		60	15	3				129
	USSR					442		159	281			556	1,438
	Total	1,777	65	4,426	3,061	2,226	60	174	483	128	0	737	13,137
1987	Denmark	1,208	122	1,007									2,337
	Finland								159	106		143	408
	Gem. Dem. Rep.	71		2,096									2,167
	Gem. Fed. Rep.	114		11									125
	Poland				2,530	1,745							4,275
	Sweden			17	26		51	13	2				109
	USSR					1,315		203	279			397	2,194
	Total	1,393	122	3,131	2,556	3,060	51	216	440	106	0	540	11,615
1988	Denmark	1,162	125	990									2,277
	Finland								177	118		159	454
	Gem. Dem. Rep.	92		2,981									3,073
	Gem. Fed. Rep.	133		5									138
	Poland				1,728	1,292							3,020
	Sweden			23	35		68	17	3				146
	USSR					578		439	257			331	1,605
	Total	1,387	125	3,999	1,763	1,870	68	456	437	118	0	490	10,713

* Denmark: Catches 1981 of SD 23 are included in SD 22 & catches of SDs 28&29 are included in SD 27
Finland: Catches of SDs 27&28 are included in SD 29 & catches of SD 31 are included in SD 30
Gem. Dem. Rep. Catches of SD 26 are included in SD 25
Gem. Fed. Rep. Catches of SD 25 are included in SD 24
Poland Catches of SD 24 are included in SD 25

Table 8.4.9.2 Total landings (tonnes) of flounder in 1989–1995 by Subdivision and country.

Year	Country*	SD 22	SD 23	SD 24	SD 25	SD 26	SD 27	SD 28	SD 29	SD 30	SD 31	SD 32	Total
1989	Denmark	1,321	83	1,062									2,466
	Finland								175	122		163	460
	Gem. Dem. Rep.	126		3,616									3,742
	Gem. Fed. Rep.	122		2									124
	Poland				1,896	1,089							2,985
	Sweden			22	34		66	16	3				141
	USSR					783		512	214			214	1,723
	Total	1,569	83	4,702	1,930	1,872	66	528	392	122	0	377	11,641
1990	Denmark	941		1,389									2,330
	Finland								219	81		161	461
	Gem. Dem. Rep.	52		1,622									1,674
	Gem. Fed. Rep.	183		10									193
	Poland				1,617	599							2,216
	Sweden				120								120
	USSR					752		390	144			141	1,427
	Total	1,176	0	3,021	1,737	1,351	0	390	363	81	0	302	8,421
1991	Denmark	925		1,497									2,422
	Finland								236	81		167	484
	Germany	246		1,814									2,060
	Poland				2,008	1,905							3,913
	Sweden			24	31		88	20					163
	Estonia					49		1	135			51	236
	Latvia					123		323					446
	Lithuania					125							125
	Russia					216		10					226
	Total	1,171	0	3,335	2,039	2,418	88	354	371	81	0	218	10,075
1992	Denmark	713	185	975									1,873
	Finland								405	40		627	1,072
	Germany	227		1,972									2,199
	Poland				1,877	1,869							3,746
	Sweden			41	88	3	86	11	3				232
	Estonia							47	47			46	140
	Latvia					26		664					690
	Lithuania					399							399
	Russia					146							146
	Total	940	185	2,988	1,965	2,443	86	722	455	40	0	673	10,497
1993	Denmark	649	194	635									1,478
	Finland								438	57		683	1,178
	Germany	235		1,230									1,465
	Poland				3,276	1,229							4,505
	Sweden		26	27	63	1	83	10					210
	Estonia							52	86			55	193
	Latvia					99		389					488
	Lithuania					155							155
	Russia					225							225
	Total	884	220	1,892	3,339	1,709	83	451	524	57	0	738	9,897
1994	Denmark	882	181	1,016									2,079
	Finland								445	33		87	565
	Germany	44		4,262		2		3					4,311
	Poland				3,177	1,266							4,443
	Sweden		84	20	18	37	33	55	10				257
	Estonia								3			4	7
	Latvia					31		276					307
	Lithuania					218							218
	Russia					167							167
	Total	926	265	5,298	3,195	1,721	33	334	458	33	0	91	12,354
1995	Denmark	859	231	2,110									3,200
	Finland								398	28		131	557
	Germany	286		2,825		4		40					3,155
	Poland				7,437	1,482							8,919
	Sweden		58	28	186	7	81	18					378
	Estonia				8			16	52			35	111
	Latvia					39		322					361
	Lithuania				8	187							195
	Russia					271							271
	Total	1,145	289	4,963	7,639	1,990	81	396	450	28	0	166	17,147

* Finland: Catches of SDs 27&28 are included in SD 29 & catches of SD 31 are included in SD 30
Denmark: Catches of SDs 28&29 are included in SD 27
Gem. Dem. Rep. Catches of SD 26 are included in SD 25
Gem. Fed. Rep. Catches of SD 25 are included in SD 24
Germany Catches of SD 25 are included in SD 24
Poland/Latvia Catches of SD 24 are included in SD 25

Table 8.4.9.3 Total landings (tonnes) of flounder in 1996–2001 by Subdivision and country.

Year	Country*	SD 22	SD 23	SD 24	SD 25	SD 26	SD 27	SD 28	SD 29	SD 30	SD 31	SD 32	Total
1996	Denmark	1,041	227	2,306									3,574
	Finland				1				365	78		271	715
	Germany	189		1,322		10		9					1,530
	Poland				6,069	2,556							8,625
	Sweden	2	58	101	718	48	114	31					1,072
	Estonia							44	99			145	288
	Latvia					74		215					289
	Lithuania					316							316
	Russia					740							740
	Total	1,232	285	3,729	6,788	3,744	114	299	464	78	0	416	17,149
1997	Denmark	1,356		2,421	31	10							3,818
	Finland				1				283	69		299	652
	Germany	655		1,982		12		4					2,653
	Poland				3,877	1,730							5,607
	Sweden		42	62	308	31	105	370					918
	Estonia				15			101	96			125	337
	Latvia					78		284					362
	Lithuania					554							554
	Russia					1,001							1,001
	Total	2,011	42	4,465	4,232	3,416	105	759	379	69	0	424	15,902
1998	Denmark	1,372		2,393									3,765
	Finland				4				284	59		297	644
	Germany	411		1,729		2							2,142
	Poland				4,215	1,370							5,585
	Sweden		61	49	187	18	70	117					502
	Estonia				10			146	79			87	322
	Latvia				2	88		274					364
	Lithuania					737							737
	Russia					1,188							1,188
	Total	1,783	61	4,171	4,418	3,403	70	537	363	59	0	384	15,249
1999	Denmark	1,473		1,206									2,679
	Finland				1				286	57		276	620
	Germany	510		1,825									2,335
	Poland				4,015	1,435							5,450
	Sweden		37	24	87	47	15						210
	Estonia				8			92	150			164	414
	Latvia					140		365					505
	Lithuania					547							547
	Russia					964							964
	Total	1,983	37	3,055	4,111	3,133	15	457	436	57	0	440	13,724
2000	Denmark	1,896		1,757									3,653
	Finland			15	6				276	43		275	615
	Germany	660		2,089									2,749
	Poland				3,423	1,668							5,091
	Sweden		41	49	122	0	73	28					313
	Estonia				2	1		65	150			126	344
	Latvia				3	113		302					418
	Lithuania					575							575
	Russia					1,236							1,236
	Total	2,556	41	3,910	3,556	3,593	73	395	426	43	0	401	14,994
2001	Denmark	2,030		3,048									5,078
	Finland			9	69				224	28		267	597
	Germany	458		1,886									2,344
	Poland				4,608	1,433							6,041
	Sweden		52	31	96	3	90	178			3		453
	Estonia							100	161			221	482
	Latvia					201		412					613
	Lithuania					1,127							1,127
	Russia					1,355							1,355
	Total	2,488	52	4,974	4,773	4,119	90	690	385	28	3	488	18,090

* Finland: Catches of SDs 27&28 are included in SD 29 & catches of SD 31 are included in SD 30

Poland/Latvia: Catches of SD 24 are included in SD 25

Germany: Catches of SD 25 are included in SD 24

Table 8.4.9.4 Total landings (tonnes) of flounder in 2002–2005 by Subdivision and country.

Year	Country*	SD 22	SD 23	SD 24	SD 25	SD 26	SD 27	SD 28	SD 29	SD 30	SD 31	SD 32	Total
2002	Denmark	1,490		2,883	2								4,375
	Finland			9	69				109	77		21	285
	Germany	317		2,066									2,383
	Poland				6,979	1,512							8,491
	Sweden		42	30	111	4	90	48		5			330
	Estonia							91	199			226	516
	Latvia					221		375					596
	Lithuania					1,077							1,077
	Russia					1,314							1,314
	Total	1,807	42	4,988	7,161	4,128	90	514	308	82	0	247	19,367
2003	Denmark	1,063		1,786	1	1							2,851
	Finland			2	7				103	69		22	203
	Germany	241		1,490									1,731
	Poland				5,068	1,425							6,493
	Sweden		33	45	105		57	17					257
	Estonia							122	192			128	442
	Latvia					281		392					673
	Lithuania					1,066							1,066
	Russia					1,402							1,402
	Total	1,304	33	3,323	5,181	4,175	57	531	295	69	0	150	15,118
2004	Denmark	952		2,615									3,567
	Finland				1				85	65		24	175
	Germany	315		1,591									1,906
	Poland				6,364	1,900							8,264
	Sweden		31	19	86		45	18					199
	Estonia							89	144			167	400
	Latvia				7	169		600					776
	Lithuania					834							834
	Russia					1,277							1,277
	Total	1,267	31	4,225	6,458	4,180	45	707	229	65	0	191	17,398
2005**	Denmark	725	184	2,159	144								3,212
	Finland								59	40	0	13	112
	Germany	94		883	43								1,020
	Poland			2,072	6,762	1,714							10,548
	Sweden	+	38	26	58	+	47	124	2	+			296
	Estonia							133	144			114	391
	Latvia			2		383		1,333					1,718
	Lithuania					949							949
	Russia					1,393							1,393
	Total	819	223	5,142	7,007	4,439	47	1,590	206	40	0	127	19,639

* Finland: Catches of SDs 27&28 are included in SD 29 & catches of SD 31 are included in SD 30

Poland/Latvia Catches of SD 24 are included in SD 25

Germany Catches of SD 25 are included in SD 24

** provisional

8.4.10 Plaice in Subdivisions 22–32

State of the stock

The only information available for this stock is landing statistics.

Management objectives

No management objectives have been defined for this stock.

Reference points

No reference points are defined for this stock.

Factors affecting the fisheries and the stock

The highest total landings were taken in the late 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. The landings in 2005 amounted to 2220 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. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

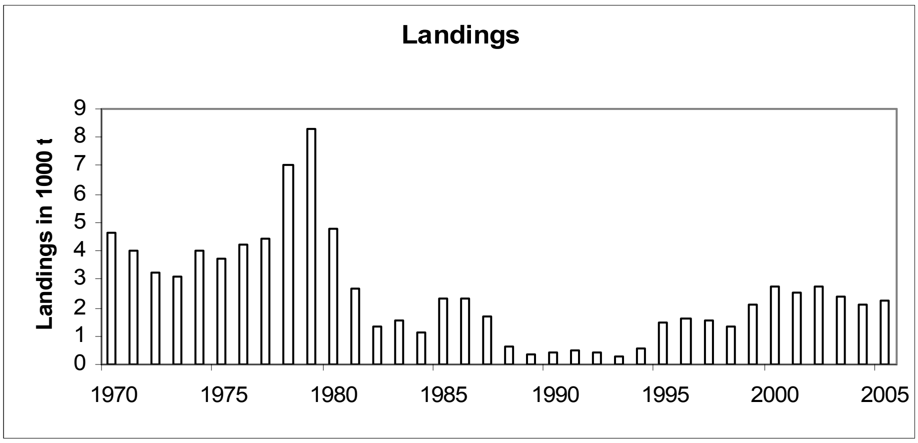


Table 8.4.10.1 Plaice in the Baltic Sea: Total landings (tonnes) by ICES Subdivision and country.

(There are some gaps in the information, therefore "Total" is preliminary)

	Denmark					Germ. Dem. Rep.[1]		Germany, FRG			Poland		Sweden[2]								Total by SD								Total
Year/SD	22	23	24(+25)	25	26+27	22	24	22	24(+25)	28	25(+24)	26	22	23	24	25	26	27	28	29	22	23	24[3]	25	26	27	28	29	SD 22-29
1970	3,757		494					202	16						149						3,959	0	659	0	0	0	0	0	4,618
1971	3,435		314					160	2						107						3,595	0	423	0	0	0	0	0	4,018
1972	2,726		290					154	2						78						2,880	0	370	0	0	0	0	0	3,250
1973	2,399		203			2	44	163	1		174	30			75						2,564	0	323	174	30	0	0	0	3,091
1974	3,440		126			36	10	166	2		114	86			60						3,642	0	198	114	86	0	0	0	4,040
1975	2,814		184			11	67	302	1		158	142			45						3,127	0	297	158	142	0	0	0	3,724
1976	3,328		178			11	82	302	3		164	76			44						3,641	0	307	164	76	0	0	0	4,188
1977	3,452		221			5	36	348	2		265	26			41						3,805	0	300	265	26	0	0	0	4,396
1978	3,848		681			33	1,198	346	3		633	290			32						4,227	0	1,914	633	290	0	0	0	7,064
1979	3,554		2,027			10	1,604	195	7		555	224			113						3,759	0	3,751	555	224	0	0	0	8,289
1980	2,216		1,652			5	303	84	5		383	53			113						2,305	0	2,073	383	53	0	0	0	4,814
1981	1,193		937			6	52	74	31		239	27			118						1,273	0	1,138	239	27	0	0	0	2,677
1982	716		393			6	25	39	6		43	64			40	6		7	1		761	0	464	49	64	0	0	0	1,346
1983	901		297			5	12	37	14		64	12			133	20		24	2		943	0	456	84	12	0	0	0	1,521
1984	803		166			7	2	23	8		106				23	3		4	1		833	0	199	109	0	0	0	0	1,146
1985	648		771			68	593	26	40		119	49			25	4		5	1		742	0	1,429	123	49	0	0	0	2,349
1986	570		1,019			34	372	25	7		171	59			48	7		9	1		629	0	1,446	178	59	0	0	0	2,322
1987	414		794			4	142	14	16		188	5			68	10		12	1		432	0	1,020	198	5	0	0	0	1,668
1988	234		323			3	16	7	1		9	1			49	7		9	1		244	0	389	16	1	0	0	0	660
1989	167		149				5	7			10				34	5		6	1		174	0	188	15	0	0	0	0	384
1990	236		100				1	9	1		6				50						245	0	152	6	0	0	0	0	403
1991	328		112					15	9		2	1			5	2		2			343	0	126	4	1	0	0	0	476
1992	316		74					11	4		6				3	1		1			327	0	81	7	0	0	0	0	416
1993	171		66					16	6		4			2	4						187	2	76	4	0	0	0	0	269
1994	355		159					1			43	4		6	4	7					356	6	163	50	4	0	0	0	579
1995	601	64	343					75	91	1	233	2		12	13	10	1				676	76	447	243	3	0	0	0	1,446
1996	859	81	263					43	77		183	5	1	13	28	23	10	1			903	94	368	206	15	0	0	0	1,587
1997	902		201					51	56		308	3		13	7	8		1			953	13	264	316	3	0	0	0	1,550
1998	642		278					213	41		101	14		13	6	17		1			855	13	325	118	14	0	0	0	1,326
1999	1,456		183					244	46		145	1	1	13	5	10					1,701	13	234	155	1	0	0	0	2,104
2000	1,932		161					140	37		408	3		26	9	12					2,072	26	207	420	3	0	0	0	2,728
2001	1,627		173					58	43		549	3		39	9	13					1,685	39	225	562	3	0	0	0	2,514
2002	1,759		153	159	0			46	146		429	3		42	10	15					1,805	42	309	603	3	0	0	0	2,763
2003	1024		326	299	2			35	96		480	10	0	26	16	51		0	0		1,059	26	438	830	13	0	0	0	2,366
2004	911		167	239				60	65		292	8		35	6	37					971	35	289	781	11	0	0	0	2,087
2005[4]	908	145	164	241				51	108		511	11		35	16	28		0	0		959	180	289	781	11	0	0	0	2,220

[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

8.4.11 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 about 1900 t in 2004 to 1500 t in 2005. The species is mostly discarded, mainly in the cod fishery. The level of discarding has not yet been evaluated.

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. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

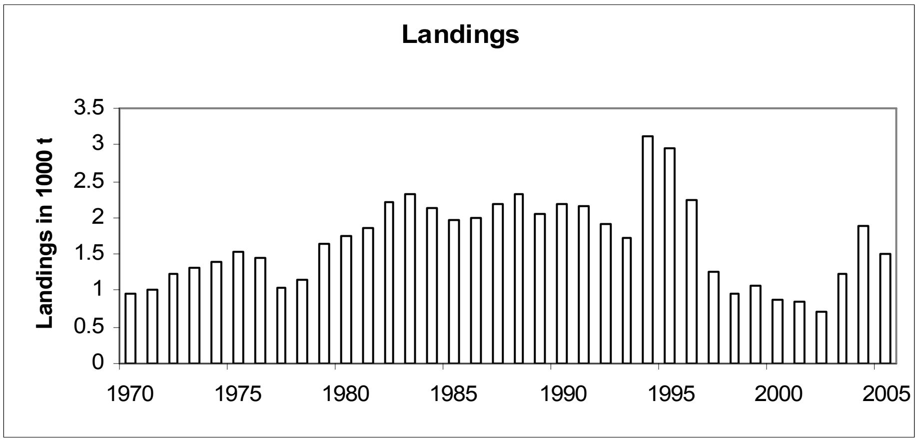


Table 8.4.11.1 Dab in the Baltic Sea: Total landings (tons) of by Subdivision and country.

(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						1053	1	179	0						1,233
2004	953		185				745	10	0			1	1	0					1698	1	196	0						1,894
2005[4]	752	34	163	16			474	45	9			1	1	0					1226	35	209	25						1,495

[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] In 1995 Danish landings of Sub-divisions 25-28 are included.

8.4.12 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. Rostock, 18–27 April 2006, ICES CM 2006/ACFM:24.

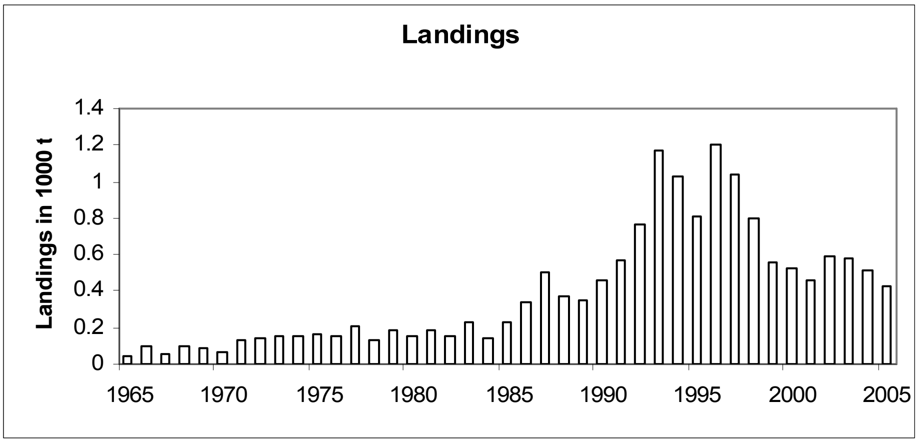


Table 8.4.12.1 Turbot in the Baltic Sea: Total landings (tonnes) by ICES Subdivision and country.

(There are some gaps in the information, therefore "Total" is preliminary)

	Denmark					Germ. Dem.Rep.		Germany, FRG				Poland		Sweden[2]							Latvia		Lithuania	Russia	Total by SD							Total
Year/SD	22	23	24(+25)	25	26+27	22	24	22	24	25	27	25(+24)	26	22	23	24	25	26	27	28(+29)	26	28	26	26	22	23	243	25	26	27	28(+29)	SD 22-28(+29)
1965						3	39																		3	0	39	0	0	0	0	42
1966	16		21			5	53																		21	0	74	0	0	0	0	95
1967	14		20			7	10																		21	0	30	0	0	0	0	51
1968	14		18			3	67																		17	0	85	0	0	0	0	102
1969	13		13			4	57																		17	0	70	0	0	0	0	87
1970	11		13			5	40									2									16	0	55	0	0	0	0	71
1971	11		26			4	86									2									15	0	114	0	0	0	0	129
1972	10		26			3	100									3									13	0	129	0	0	0	0	142
1973	11		30			3	33					58	13			5									14	0	68	58	13	0	0	153
1974	14		40			2	23					34	36			6									16	0	69	34	36	0	0	155
1975	27		48			3	38	15				23	6			7									45	0	93	23	6	0	0	167
1976	29		24				52	11				14	12			7									40	0	83	14	12	0	0	149
1977	32		37				55	9				12	55			8									41	0	100	12	55	0	0	208
1978	33		37			2	27	9				7	3			10									44	0	74	7	3	0	0	128
1979	23		38			3	39	6				29	34			12									32	0	89	29	34	0	0	184
1980	28		38				30	9				12	20			15									37	0	83	12	20	0	0	152
1981	28		62			1	46	8				10	19			7									37	0	115	10	19	0	0	181
1982	31		51			1	27	7				2	17			3	4		4	3					39	0	81	6	17	4	3	150
1983	33		40			3	9	8				5	4			31	41		35	24					44	0	80	46	4	35	24	233
1984	41		45			4	8	12				13	2			3	4		3	2					57	0	56	17	2	3	2	137
1985	56		34			5	22	15				67	15			4	5		4	3					76	0	60	72	15	4	3	230
1986	99		81			6	32	25				32	37			6	8		7	5					130	0	119	40	37	7	5	338
1987	134		93			4	34	30				155	21			8	11		9	6					168	0	135	166	21	9	6	505
1988	117		117			3	28	34				7	10			12	16		14	9					154	0	157	23	10	14	9	367
1989	135		109			7	22	20					11			11	15		13	9					162	0	142	15	11	13	9	352
1990	178		181			4	2	26				24	25			14									208	0	197	24	25	0	0	454
1991	228		137					44	39			73	20			2	12		16						272	0	178	85	20	16	0	571
1992	267		127					55	68			80	55			12	12		21	36				30	322	0	207	92	85	21	36	763
1993	159	29	152					74	56			520	72		2	4	14		13	38				34	233	31	212	534	106	13	38	1,167
1994	211	18	166					52	57	10		380	30		2	3	18	1	17	44				15	263	20	226	408	46	17	44	1,024
1995	257	11	94					65	53	4		30	15		2	3	54	9	31	83	34	27	15	20	322	13	150	88	93	31	110	807
1996	207	12	95					36	47	4	1	288	92	1	3	15	100	5	54	104	42	3	72	25	244	15	157	392	236	55	107	1,206
1997	151		68					60	52	3		290	70		2	6	70	1	53	86	33	14	59	25	211	2	126	363	188	53	100	1,043
1998	138		80					44	55	1		66	68		2	4	58	1	18	69	12	24	62	96	182	2	139	125	239	18	93	798
1999	106		59					23	48			18	15		2	4	41	3	17	60	20	34	58	48	129	2	111	59	144	17	94	556
2000	97		58					23	54			90	12		2	3	39		16	39	7	9	23	53	120	2	115	129	95	16	48	525
2001	76		53					19	31			121	10		2	5	16		9	29	5	1	18	69	95	2	89	137	102	9	30	464
2002	73		22	4	0			20	32	2		245	65		5	2	15		7	21	2	8	18	50	93	5	56	266	135	7	29	591
2003	48		28	5	0			10	39	1		184	178		1	2	18		3	14	7	2	13	28	58	1	69	208	225	3	16	579
2004	61		27	7				12	27	1		225	96		1	1	8		3	14	3	8	7	15	73	1	55	241	121	3	22	516
2005[4]	57	5	36	12				14	35	1		123	57		1	3	6		5	21	1	6	18	28	72	5	74	143	104	5	27	429

[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

8.4.13 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. Rostock, 18–27 April 2006 (ICES CM 2006/ACFM:24).

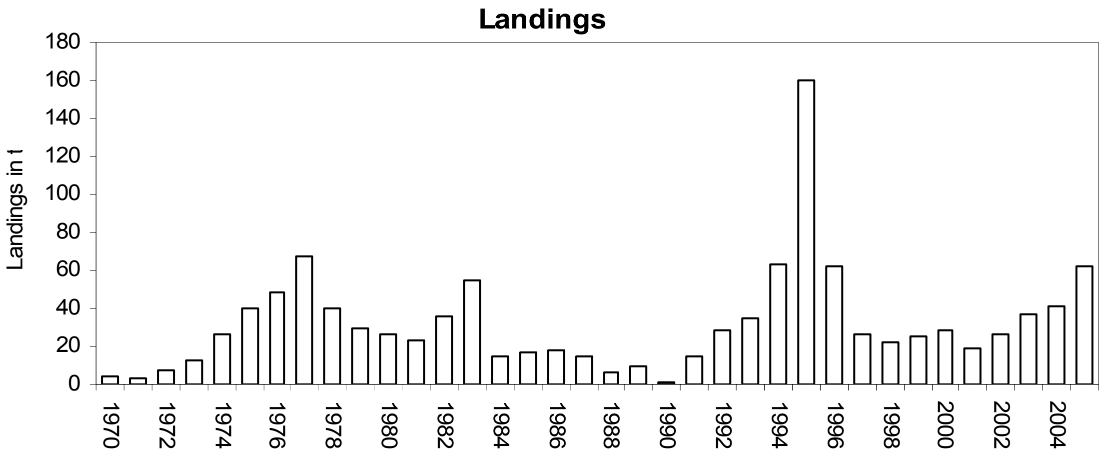


Table 8.4.13.1 Total landings (tonnes) of BRILL in the Baltic Sea by Subdivision and country (There are some gaps in the information, therefore "Total" is preliminary).

	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.

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

In order to better support the management of wild salmon stocks, ICES has established five assessment units for the Baltic Main Basin and Gulf of Bothnia (see Figure 8.4.14.1). The division of stocks into units is based on management objectives and biological and 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 measures it might be possible 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 contain a relatively high proportion of the 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

To evaluate the state of the stock ICES uses the current smolt production relative to the 50% level of the natural production capacity on a river-by-river basis. This objective is likely to be met for several large rivers in the Northern Baltic Sea area while the status of less productive wild stocks, especially in the Southern Baltic Sea area is poor, and even a negative trend in smolt production has been observed within these rivers (Figure 8.4.14.2).

The total wild smolt production has increased about fourfold since the Salmon Action plan was adopted in 1997 and is now estimated to be around two thirds of the potential smolt production (Tables 8.4.14.1 and 8.4.14.2). However, this increase in smolt production is not uniform among rivers and is particularly low in the 'potential' rivers, i.e. rivers where salmon were extirpated and are now being reintroduced.

The stocks of **unit 1** are very likely to reach 50% of the smolt production capacity in 2010, and the rivers Tornionjoki and Kalixälven are very likely to even reach 75% of the smolt production capacity in 2010. For the rivers Tornionjoki and Kalixälven it is respectively uncertain and unlikely that they will reach 100% of the smolt production capacity in 2010. It is uncertain and unlikely that Simojoki and Råneälven will reach 75% and 100% of the smolt production capacity in 2010, respectively (Figure 8.4.14.3 and Table 8.4.14.3)

All stocks in assessment **unit 2** show a similar trend in smolt production, but the actual status of the stocks differs, with most stocks being likely or very likely to reach the target of 50% of the potential smolt production in 2010. The exceptions are the River Öreälven and River Rickleån, where the smolt production capacities are uncertain. In general, the recovery of the assessment unit 2 stocks seems to be delayed in comparison with the stocks in assessment unit 1. The probability of reaching 75% and 100% of the smolt production capacity in 2010 for stocks of assessment unit 2 is lower than for stocks of assessment unit 1, which can partly be explained by the higher uncertainty in the smolt production and smolt production capacity estimates for stocks of this unit compared to stocks of unit 1.

The stock in the river Ljungan (**unit 3**) is likely to reach 50% of the smolt production capacity in 2010, but it is uncertain and unlikely whether it will reach 75% and 100% of the potential level, respectively.

Within **unit 4**, Mörrumsån and Emån differ significantly in their status. While it is very likely that Mörrumsån will reach 50% of the smolt production capacity in 2010 and most likely 75%, Emån is unlikely to reach the 50% target.

Unit 5 consists of a diverse range of stocks with some stocks, such as the River Pärnu and the River Nemunas being heavily depleted while others, such as the rivers Salaca, Vitrupe, Irbe, Venta, Uzava, and Barta are likely to reach 50% of the smolt production capacity by 2010. One factor influencing the negative trend in the abundance of the stocks in unit 5 is the increased post-smolt mortality during the past decade. It should, however, be stated that the smolt production estimates for unit 5 are very uncertain and, due to a shorter life cycle in these stocks, the smolt production estimates can vary more widely from year to year.

Figure 8.4.14.3 summarises the status on a river basis, relative to the potential smolt capacity estimates.

The total nominal salmon catch in the Baltic Sea has declined, starting in 1990 from 5636 tonnes and decreasing to 1740 tonnes in 2005. The nominal catch in the offshore fisheries decreased by 29% from 247 455 salmon in 2004 to 174 959 salmon in 2005; in the coastal fisheries the decrease was 20% and the number of salmon caught by the river fisheries increased by 22%. The TAC of 460 000 salmon in the Main Basin and the Gulf of Bothnia was utilised to 64% only. There has been an increase in the total proportion of wild salmon in catches, relative to reared salmon, which reflects the increased abundance of the wild salmon stocks.

Management objectives

The objective of the Salmon Action Plan (SAP), as adopted in 1997 by the former IBSFC, 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 level as high as possible. In addition, objectives state that the genetic diversity of the stocks should be maintained.

Catch options for 2007 do mainly influence the smolt year classes beyond year 2010. No update of objectives has been set by the EU Commission replacing the IBSFC Salmon Action Plan (SAP).

Reference points

To evaluate the state of the stock ICES uses the current smolt production relative to the 50% level of the natural production capacity on a river-by-river basis. Furthermore, ICES has calculated the probability of attaining 50%, 75%, and 100% of the natural production capacity for the period 2011–2015.

Single-stock exploitation boundaries

ICES recommends that catches should not increase. The current exploitation pressure will not impair the possibility of the larger stocks attaining the management objective. For the smaller stocks long-term benefits 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.

The present TAC (460 000) is not fully utilised; the catches in 2005 were 324 000. Other factors have limited the fishery. These include: 1) technical measures such as opening time of fishery and closed areas, 2) restrictions on driftnets, 3) large salmon cannot be marketed due to the dioxin level, and 4) increased seal damage to catches and gear. As ICES suggests that catches should not increase, it is recommended that the technical regulations are continued.

For the rivers Emån and Rickleån, which are unlikely to reach 50% of the smolt production capacity within 2010, it is recommended that special stock rebuilding measures are taken, including habitat restoration and removal of physical barriers. River catches are negligible in these rivers. Furthermore, it is recommended for the stocks of unit 5 to implement additional measures to decrease the exploition of these stocks by fisheries intercepting them during migration. ICES has not been able to identify differences in migrating routes or timing which could be used to distinguish fisheries of these fish (Emån, Rickleån, and Unit 5 fish) from the general exploitation.

Management considerations

Because the catch in 2007 will not start to affect the smolt abundances until 2011 and smolt production prior to 2011 is the result of management decisions made in the past, ICES evaluates the current status of the salmon stock by looking at the estimated smolt production up to 2010 and comparing these smolt production estimates to the natural smolt production capacity (Tables 8.4.14.1 and 8.4.14.2).

The prevalence of M74 has been decreasing since the mid-1990s to a low level in the recent years. The factors influencing the development of M74 are poorly understood and future mortality rates due to M74 can therefore not 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. The present advice assumes that M74 will continue at a low level. However, if it is assumed that future M74 levels might rise again to previous levels, catches should be reduced.

Recent efforts to re-establish self-sustaining salmon stocks in ‘potential’ rivers, where salmon stocks existed in the past, but have now 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 is likely to be lower than average. 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.

The recovery of the assessment unit 2 stocks seems to be delayed in comparison with the stocks in assessment unit 1. One possible explanation might be the fact that many of these stocks were severely depleted in the past, i.e. they may require more time for recovery.

The estimated population parameters for rivers in the southern Baltic suggest a low productivity, which means that they can not support as high harvest rates as the other stocks.

Due to the increase in post-smolt mortality rates for reared salmon during recent years, the decrease in exploitation rates has not resulted in similar increases in non-exploited reared salmon.

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 may 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.

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.

More than 80% of the salmon catch in the Gulf of Bothnia is taken by trapnets. If adipose fin-clipping of reared fish were introduced, it may be possible to retain fin clipped fish, while wild fish could be released. In Sweden, all salmon and sea trout smolt released to the Baltic Sea from 2005 and forward have been, respectively will be, adipose fin-clipped. However, the impacts of large-scale releases of wild salmon from fish traps are difficult to predict.

Factors affecting the fisheries and the stock

Regulations and their effects

The increased fishing period in longlining will increase the exploitation of salmon by longlining, especially from 2008 when drift netting will be totally banned. The previous rule of a maximum number of hooks per vessel is no longer in effect after adopting the new EC Council regulation. Together these measures are likely to increase fishing effort in longlining, which is likely to increase harvesting of undersized salmons in this fishery in the future. Together with rather high discard percentages due to seal damage in coastal waters, this means an increase in discards.

When the new and lower EU content limit for dioxin (including dioxin-like PCBs) is introduced in November 2006, it will be impossible to sell salmon above approx. 2.0 kg in Denmark. The 2 kg weight limit is also very close to the minimum landing size of 60 cm. If new laboratory tests on salmon dioxin levels to be performed in early summer 2006 do not change compared to previous tests, the conclusion of this will probably be that only a very low share of the Danish TAC will be utilized in the future.

The total ban on drift netting, the problems with seal-damaged salmon, the new lower EU content limit for dioxin and the resulting economical problems for the fishers, are likely to be the most dominating limiting factors in the salmon fishery in the near future. The low price level for salmon, together with the new restrictions mentioned above has tightened and will even further tighten up the economical situation for the salmon fishery.

The use of the TAC in the Baltic Main Basin and the Gulf of Bothnia was in 2005 at a historical low level of only 64%, and it seems very likely that the use of the TAC in the future will also be at a low level because of the above-mentioned limiting factors. At the same time the non-commercial catches were higher than ever, and as these catches in numbers were close to 22% of the total commercial catches, and have been growing for some years, it is predictable that the non-commercial catches will increasingly influence the fishery in the coming years.

The overall TAC is effective in safeguarding wild salmon as a whole only in the Main Basin, allowing them to survive until 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 normally the largest. In most countries there are fishery closures near the mouths of salmon rivers.

The environment

Environmental conditions have a marked effect on the status of salmon stocks, particularly freshwater conditions where river damming and habitat deterioration have 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 or removing 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.

Fishers change their fishing strategy to minimise the costs imposed on their fishery by seals.

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, albeit with major uncertainty, see *ICES Cooperative Research Report No. 255* (2002). The indirect effects can only be estimated very crudely 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 size of the seal population together with information on their diet.

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 prior knowledge (from previous studies, literature, and/or expert opinions) 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 update expert information on the smolt production capacities for the different rivers based on a full life history model of all stocks.

The Old Point Estimates (OPE) of smolt production capacity have been estimated prior to 1997 and have previously been used for the management advice. These estimates are now replaced by new estimates which are based on expert knowledge and the available spawner/smolt estimates.

Uncertainties in assessment and forecast

The Bayesian approach used to assess Baltic salmon incorporates new information annually and thus updates both smolt production historically as well as the smolt capacity for each river. Additional new information has therefore caused a change in the perception of these two estimates. This is also likely to happen in the future; however, the change in perception from year to year is expected to decrease.

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. 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 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 and 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 allow ICES to apply the same assessment methods across all rivers within the Baltic Sea.

The Bayesian approach is based on a number of assumptions; the effect of changing these assumptions on the resulting production and capacity estimates has not yet been fully explored.

Comparison with previous assessment and advice

The main changes in the assessment procedure are:

1. A full life history model with the updated stock-recruit information is applied to all assessment units (1 to 5) compared to last year, where it was only applied to assessment unit 1.
2. The inherent correlation between river-specific carrying capacity priors (expert opinions) has been taken into account, i.e. the more the opinion of an expert agrees with the information provided by data from data-rich rivers, the more the opinion of that expert will become weighted in other rivers with less informative data.
3. Mean discharge (flow) of the river is used as an explanatory variable for the model in each Gulf of Bothnian river when estimating the smolt production.

Because the current assessment relies on estimates of the number of spawners and smolt to estimate the natural smolt production capacity for each river, new information to update the smolt production capacity estimates will be available in each assessment year as data accumulate. The amount of annual change in the capacity estimates can be expected to be highest in the first assessment year when data from multiple years are brought in simultaneously. Subsequent updates are expected to be smaller. The estimated smolt production capacity has stabilized in the current assessment compared to smolt production capacity estimates obtained in 2005. The decreased uncertainty in this year's estimates is partly due to the increased number of stocks (unit 1 to 5 instead of only unit 1) which provide their information through the full life history model and the inherent correlation between the prior distributions for the smolt production capacity of different rivers. At the moment there are no further data available that could further decrease this uncertainty.

Source of information

Report of the Baltic Salmon and Trout Assessment Working Group, 28 March–6 April (ICES CM 2006/ACFM:21).

Year	ICES Advice	Catch corresp. to advice '000 tonnes	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.	-	-		
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.		-		460
2007	ICES recommends that catches should not increase.		324		

[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	35	0.77	168	1.73	366	2.50	534	2.71	570
1997	0.28	45	0.80	149	1.50	282	2.31	431	2.59	476
1998	0.19	30	0.59	104	1.52	314	2.11	418	2.30	449
1999	0.17	30	0.59	104	1.23	256	1.82	360	1.99	391
2000	0.18	30	0.52	100	1.45	313	1.97	413	2.15	442
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	0.12	28	0.43	113	1.00	235	1.43	348	1.56	376
2004	0.13	25	0.77	147	1.11	247	1.88	394	2.01	420
2005[3]	0.17	31	0.61	118	0.86	175	1.47	293	1.64	324

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

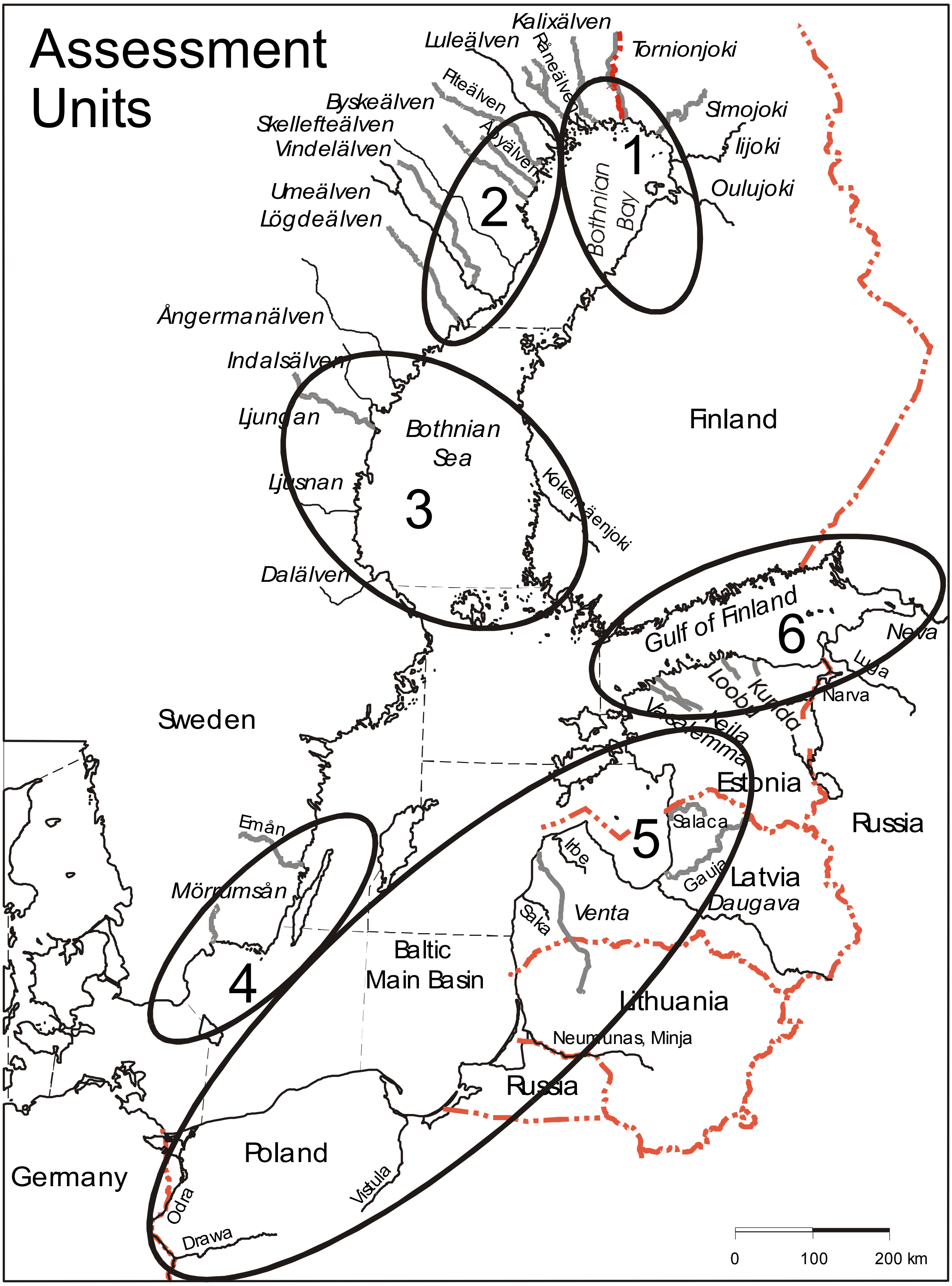


Figure 8.4.14.1 Grouping of salmon stocks in 6 assessment units in the Baltic Sea (assessment units 1–5 included in the assessment of salmon in Subdivisions 22-31, and assessment unit 6 in the assessment of salmon in the Gulf of Finland). The genetic variability between stocks of an assessment unit is smaller than the genetic variability between stocks of different units. In addition, the stocks of a particular unit exhibit similar migration patterns.

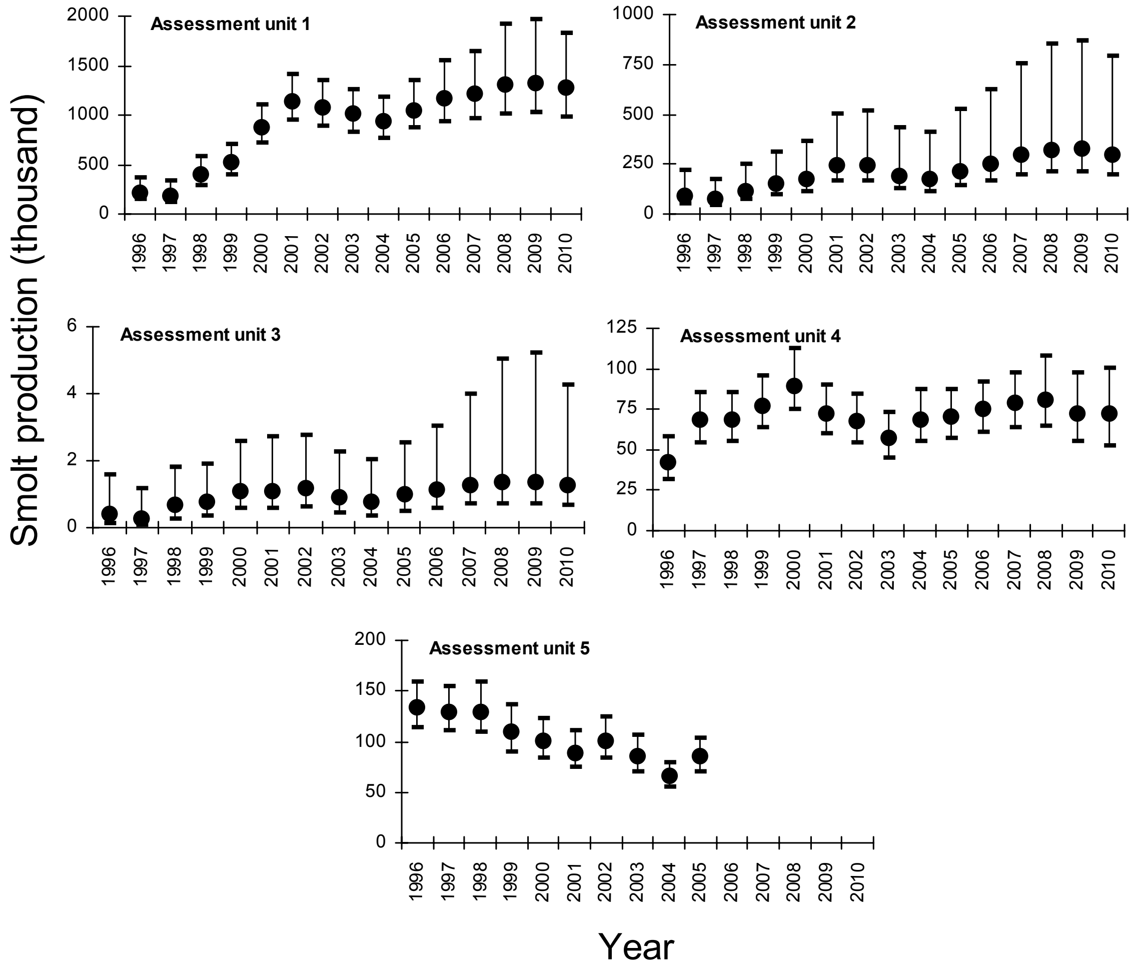


Figure 8.4.14.2 Posterior probability distribution (mode and 95% PI) of the total smolt production within units 1 to 5. The smolt production of unit 5 is shown until the year 2005.

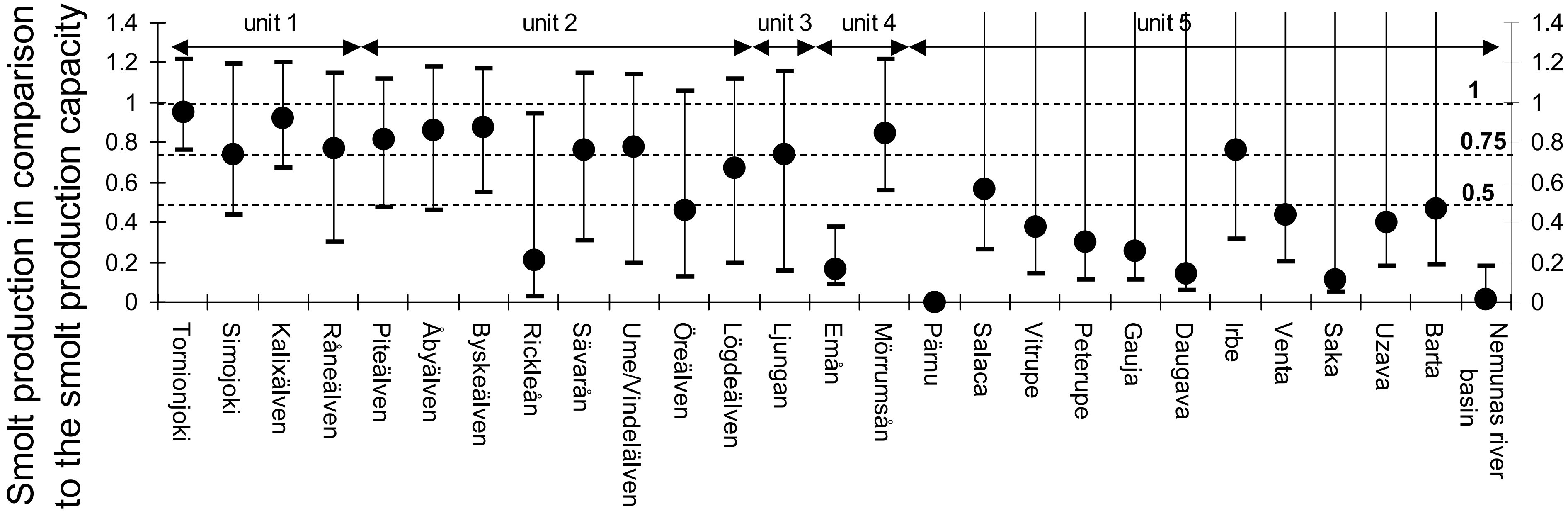


Figure 8.4.14.3 Smolt production in 2010 in comparison to the natural smolt production capacity for Gulf of Bothnia and Main Basin stocks (mode and 95% probability interval).

Table 8.4.14.1 Salmon smolt production in Baltic rivers with natural reproduction of salmon grouped by assessment units. Most probable number (x 1000) of smolts from natural reproduction with the associated uncertainty (95% Probability interval).

Assessment unit, sub-division, country	Cat	Reprod. area (ha)	Potential (*1000)	Wild smolt production (x 1000) 1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Pred 2006	Pred 2007	Pred 2008	Pred 2009	Pred 2010	Method of estimation Pot. prod.	Pres. prod.
Gulf of Bothnia, Sub-div. 30-31																				
Finland																				
Simojoki	wild	254	65	3	5	9	12	26	49	52	54	41	39	48	50	62	64	55	1	1
95% PI		218-299	47-144	1-4	3-8	5-13	8-17	19-37	38-64	41-68	41-70	31-54	30-51	37-63	38-70	44-96	45-104	40-84		
Finland/Sweden																				
Tornionjoki;Torneälven	wild	4997	643	100	71	152	201	452	605	546	542	509	535	580	593	634	644	622	1	1
95% PI		3877-6695	530-845	72-144	50-104	115-206	158-260	373-555	513-743	462-641	453-652	427-614	453-655	478-709	476-752	488-866	500-883	483-840		
Sweden																				
Kalixälven	wild	2570	525	98	94	212	272	361	435	440	375	355	434	486	510	530	534	520	1	1
95% PI		2062-3295	363-1348	48-237	43-241	120-387	169-456	239-580	297-691	300-709	246-607	227-588	293-717	318-850	333-932	339-1115	339-1136	333-1054		
Råneälven	wild	384	23	8	7	16	19	20	22	21	17	15	20	22	23	25	25	22	1	1
95% PI		325-462	16-125	2-25	2-24	7-39	9-43	11-44	13-48	12-45	8-36	7-33	11-44	13-52	13-56	14-71	14-75	13-64		
Assessment unit 1, total			**1330**	**221**	**189**	**405**	**519**	**879**	**1136**	**1081**	**1008**	**939**	**1051**	**1166**	**1211**	**1310**	**1328**	**1271**		
95% PI			1078-2216	152-367	125-336	293-580	398-706	720-1112	951-1420	897-1361	837-1255	773-1189	870-1349	943-1551	968-1645	1012-1927	1025-1962	984-1838		
Piteälven	wild	425	23	3	3	4	4	6	16	17	12	12	14	20	30	35	36	32	1	1
95% PI		359-511	17-92	1.5-4	1.9-5	2-6	2-6	3-10	11-23	11-24	7-18	7-18	8-21	15-28	22-41	25-51	26-53	23-47		
Åbyälven	wild	84	10	5	4	5	7	8	10	9	8	7	7	8	9	10	10	9	1	1
95% PI		67-108	5-31	2-15	1-13	2-14	3-16	4-21	5-24	5-23	4-20	3-17	3-18	4-20	4-23	4-26	5-26	4-24		
Byskeälven	wild	560	122	37	29	55	70	85	108	107	88	82	99	111	120	124	125	118	1	1
95% PI		473-673	79-370	16-101	12-86	27-113	38-139	51-161	69-201	68-196	54-165	49-156	61-192	69-221	73-261	75-297	75-300	73-271		
Rickleån	wild	15	2	0.1	0.1	0.1	0.1	0.1	0.3	0.6	0.4	0.3	0.3	0.3	0.7	1.3	1.3	1	1	1
95% PI		9.2-29	0.9-31	0-0.8	0-0.4	0-0.4	0-0.4	0-0.6	0-1.7	0-2	0-1.4	0-1.1	0-1.2	0-1.5	0-2.9	0-5.5	0-6	0-4		
Sävarån	wild	21	4	2	1	2	2	2	3	3	3	3	4	4	4	4	4	3	1	1
95% PI		13-40	3-17	0.6-4	0.4-3	1-4	1-4	1-4	1-6	2-6	1-5	1-4	2-4	2-6	2-8	2-10	2-10	2-9		
Ume/Vindelälven	wild	1242	94	22	19	30	41	45	69	64	46	38	54	64	75	84	83	73	1	1
95% PI		917-1778	37-893	8-143	6-113	11-157	16-196	18-227	28-320	27-343	17-285	12-278	18-363	23-428	29-511	32-583	32-595	28-554		
Öreälven	wild	105	12	1.0	0.7	1.3	1.3	2	3	3	2	2	3	3	5	6	6	5	1	1
95% PI		84-135	3-34	0.4-3	0.2-2	0.5-4	0.5-4	0.6-5	1.3-7	1.4-8	1-6	0.9-6	1.2-8	1.6-10	2.3-14	2.8-18	2.9-19	2.4-17		
Lögdeälven	wild	104	13	2	1	3	4	5	8	8	6	5	8	10	12	13	13	11	1	1
95% PI		82-136	7-95	0.5-7	0.4-6	1-9	1-12	2-15	4-20	4-19	2-15	2-14	3-20	5-25	6-35	6-44	6-45	5-38		
Assessment unit 2, total			**366**	**89**	**75**	**118**	**150**	**178**	**246**	**241**	**190**	**172**	**215**	**252**	**294**	**323**	**326**	**298**		
95% PI			247-1119	51-219	42-177	74-251	96-313	117-363	169-505	167-517	130-436	116-412	145-529	171-625	195-756	212-856	214-870	199-790		
Ljungan	mixed	17	1	0.39	0.28	0.68	0.76	1.08	1.11	1.17	0.93	0.79	1.01	1.13	1.29	1.36	1.36	1.26	1	1
95% PI		9.8-37	0.7-13	0.11-1	0.09-1	0.2-1	0.3-1	0.5-2	0.5-2	0.6-2	0.4-2	0.3-2	0.5-2	0.5-3	0.7-4	0.7-5	0.7-5	0.6-4		
Assessment unit 3, total			**1**	**0.39**	**0.28**	**0.68**	**0.76**	**1.08**	**1.11**	**1.17**	**0.93**	**0.79**	**1.01**	**1.13**	**1.29**	**1.36**	**1.36**	**1.26**		
95% PI			0.7-13	0.11-1	0.09-1	0.2-1	0.3-1	0.5-2	0.5-2	0.6-2	0.4-2	0.3-2	0.5-2	0.5-3	0.7-4	0.7-5	0.7-5	0.6-4		
Total Gulf of B., Sub-divs.30-31			**1786**	**329**	**280**	**543**	**690**	**1082**	**1415**	**1355**	**1230**	**1144**	**1310**	**1468**	**1559**	**1694**	**1721**	**1632**		
95% PI			1384-3021	234-518	194-454	408-751	543-929	894-1375	1188-1792	1131-1748	1025-1572	941-1482	1076-1727	1185-1992	1241-2206	1311-2547	1329-2607	1269-2401		

Table 8.4.14.2 Salmon smolt production in Baltic rivers with natural reproduction of salmon grouped by assessment units. Most probable number (x 1000) of smolts from natural reproduction with the associated uncertainty (95% Probability interval).

Assessment unit, sub-division, country	Cat.	Reprod. area (ha)	Potential (*1000)	Wild smolt production (x 1000) 1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Pred 2006	Pred 2007	Pred 2008	Pred 2009	Pred 2010	Method of estimation Pot. prod.	Pres. prod.
Total Main B., Sub-divs. 22-29																				
Sweden																				
Emån	wild	21.7	14	2	4	4	4	6	3	3	2	2	3	3	4	4	2	2	1	1
95% PI			9-19	1-3	3-5	2-5	3-5	4-6	2-4	2-3	1-3	1-3	2-4	2-4	2-4	2-5	1-3	1-4		
Mörrumsån	wild	44	80	40	64	64	73	84	69	64	55	66	67	71	75	77	70	69	1	1
95% PI			63-110	29-55	50-81	51-81	59-92	70-106	56-86	51-81	42-70	53-84	53-83	58-89	60-94	61-104	53-94	50-96		
Assessment unit 4, total			**95**	**43**	**69**	**69**	**77**	**90**	**73**	**67**	**57**	**69**	**71**	**75**	**79**	**81**	**72**	**72**		
95% PI			77-124	32-58	54-85	55-85	63-95	75-112	59-89	54-84	44-72	55-87	56-86	61-92	64-97	64-108	55-97	52-100		
Estonia																				
Pärnu	wild	3	3.5	3.2	3.3	0.6	0.3	0.07	0.3	0.3	0.01	0.009	0.005	0.02	0.005	0.001	0.001	0.001	2	3, 4
95% PI				1.4-13	1.5-13	0.2-2	0.1-1	0.03-0.2	0.11-0.8	0.12-1	0-0.04	0-0.03	0-0.01	0-0.41	0-0.48	0-0.01	0-0.01	0-0.02		
Latvia																				
Salaca	wild		30	23	23	36	32	23	32	31	28	12	28	23	20	17	12	18	3	2
95% PI			26-35	15-38	15-38	23-59	21-54	15-38	21-51	21-50	19-44	8-19	19-44	9-217	8-163	6-147	4-97	7-163		
Vitrupe	wild		4	6	6	5	5	5	3	3	3	3	3	1	2	1	1	2	3	5
95% PI			2.6-7.2	3.1-13	3.1-13	2.5-10	2.5-11	2.5-11	1.5-5	1.5-5	1.5-5	1.5-5	1.5-5	0.6-15	0.6-14	0.5-14	0.6-14	0.5-14		
Peterupe	wild		5	6	6	5	5	5	3	3	3	3	3	2	2	2	2	1	3	2, 5
95% PI			3.2-9	3-13	3-13	2-10	2-10	2-10	1-5	1-5	1.5-5	1.5-5	1.5-5	0.6-16	0.6-15	0.5-15	0.6-15	0.5-17		
Gauja	mixed		28	16	16	15	15	14	13	16	16	11	12	10	11	10	9	9	3	2, 5
95% PI			18-51	10-25	10-26	9-24	9-24	9-24	9-21	11-26	11-26	7-18	7-18	4-105	4-99	4-98	3-76	3-87		
Daugava***	mixed		10	5	6	6	6	5	3	6	3	3	3	1	3	1	1	2	3	5, 6
95% PI			6-18	3-12	3-14	3-12	3-13	3-12	1-5	3-12	1-5	1-6	1-6	0.7-20	1.1-29	0.6-18	0.6-19	0.5-19		
Irbe	wild		4	9	9	9	9	9	6	6	6	5	5	3	3	3	3	3	3	5
95% PI			2.6-7.2	4-20	4-20	4-21	4-22	4-22	3-12	3-12	3-12	3-11	3-10	1-31	1-29	1-29	1-26	1-26		
Venta	mixed		15****	17	14	14	14	14	12	13	11	12	12	8	9	7	8	8	3	2, 5
95% PI			10-27	10-30	8-24	8-24	8-25	8-25	7-19	8-23	7-19	7-19	7-20	3-85	3-71	3-69	3-66	3-74		
Saka	wild		8	11	9	7	7	7	2	7	2	2	2	1	3	1	1	1	3	5
95% PI			5-14	6-19	5-16	4-13	4-13	4-13	1-4	4-12	1-4	1-4	1-4	0.6-16	1.1-28	0.4-14	0.4-14	0.4-15		
Uzava	wild		4	2	2	1	2	2	2	1	2	3	3	1	1	2	2	2	3	5
95% PI			2.6-7.2	1.3-5.3	1.1-4.8	0.6-2.7	1.3-5.4	1.3-5.3	1.4-5.1	0.8-2.9	1.3-4.6	1.4-5.2	1.4-5.4	0.6-18	0.4-11	0.6-16	0.7-17	0.7-18		
Barta	wild		4	2	2	1	1	1	3	1	2	2	2	2	1	2	2	2	3	5
95% PI			2.6-7.2	1.3-5.2	1.1-4.6	0.6-2.7	0.6-2.7	0.6-2.6	1.4-5.3	0.82-3	1.29-4.6	1.35-4.9	1.4-5	0.8-19	0.5-13	0.7-17	0.7-18	0.7-20		
Lithuania																				
Nemunas river basin	wild		150	20	20	20	2	5	4	4	3	4	7	2	2	1	2	2	3	3, 4
95% PI			96-269	16-24	16-24	16-24	1-2	4-6	3-5	3-5	2-4	3-5	5-8	0.7-18	0.6-17	0.5-14	0.7-19	1-27		
Assessment unit 5, total			**279**	**134**	**129**	**130**	**110**	**101**	**89**	**101**	**85**	**66**	**85**	**111**	**107**	**96**	**87**	**101**		
95% PI			218-395	114-159	110-154	110-159	90-136	84-123	74-111	83-124	71-106	55-79	71-104	68-399	62-320	53-302	46-251	57-318		
Total Main B., Sub-divs. 22-29			**385**	**177**	**198**	**199**	**188**	**192**	**163**	**168**	**144**	**135**	**156**	**195**	**190**	**183**	**164**	**178**		
95% PI			311-500	153-207	175-229	174-230	163-219	169-222	142-189	147-197	124-168	118-158	136-181	144-442	140-401	134-387	117-325	128-395		
Gulf of B.+Main B., Sub-divs. 22-31			**2196**	**513**	**486**	**747**	**883**	**1277**	**1581**	**1528**	**1377**	**1283**	**1470**	**1708**	**1789**	**1918**	**1918**	**1853**		
95% PI			1758-3416	410-698	391-655	605-954	729-1121	1086-1571	1350-1958	1301-1918	1168-1721	1075-1620	1233-1885	1394-2258	1446-2458	1513-2772	1507-2804	1467-2652		

Table 8.4.14.3 Overview of the status of the Gulf of Bothnia and Main Basin stocks in terms of their probability to reach 50, 75 and 100% of the smolt production capacity in 2010. Stocks are considered very likely to reach this objective in case the probability is more than 90%. They are likely to reach the objective in case the probability is between 70 and 90% and unlikely in case the probability is less than 30%. When the probability of reaching the objective lies between 30 and 70%, it is considered uncertain if they will reach the objective in 2010.

	Probability to reach 50%				Probability to reach 75%				Probability to reach 100%			
	Very Likely	Likely	Un-certain	Un-likely	Very Likely	Likely	Un-certain	Un-likely	Very Likely	Likely	Un-certain	Un-likely
Unit 1												
Tornionjoki	X				X						X	
Simojoki	X						X					X
Kalixälven	X				X							X
Råneälven	X						X					X
Unit 2												
Piteälven	X					X						X
Åbyälven	X					X						X
Byskeälven	X					X						X
Rickleån			X					X				X
Sävarån		X					X					X
Ume/Vindelälven		X					X					X
Öreälven			X					X				X
Lögdeälven		X					X					X
Unit 3												
Ljungan		X					X					X
Unit 4												
Emån				X				X				X
Mörrumsån	X					X						X
Unit 5												
Pärnu				X				X				X
Salaca		X				X					X	
Vitrupe		X					X				X	
Peterupe			X				X				X	
Gauja			X				X					X
Daugava			X					X				X
Irbe	X					X				X		
Venta		X					X				X	
Saka			X					X				X
Uzava		X					X				X	
Barta		X					X				X	
Nemunas				X				X			X	

Table 8.4.14.4 Production of wild and reared smolts (in millions) in the Baltic Sea, excluding the Gulf of Finland. Estimates of wild smolts are based on the assessment model. Time-series of wild smolt production estimates are updated annually based on electrofishing and smolt trapping data.

Salmon	Wild	Reared	Total
1996	0.51	4.47	4.98
1997	0.49	4.94	5.43
1998	0.75	5.20	5.95
1999	0.88	5.02	5.90
2000	1.28	5.25	6.53
2001	1.58	4.99	6.57
2002	1.53	4.73	6.26
2003	1.38	4.70	6.08
2004	1.28	4.48	5.76
2005	1.47	4.45	5.92

8.4.15 Salmon in the Gulf of Finland (Subdivision 32)

State of the stock

The condition of the wild stocks is poor. Although the estimates of smolt production as well as the potential production capacity of the extant wild salmon rivers are uncertain the status of these populations is considered to be precarious. Parr densities in 2005 suggest increased recruitment in most rivers.

Catches of salmon in the area remained low despite increased smolt releases. Although commercial effort is low there is substantial (but poorly quantified) effort and catches by recreational fishers. The total catches in 2005 in the Gulf of Finland were 17 658 salmon or 99 tonnes, about 5500 salmon more than in 2004. This is one of the lowest recorded catches since 1981 and represents about 15% of the maximum recorded catch of salmon in the area (in 1991). Catch samples indicate that Gulf of Bothnia salmon contribute occasionally to the catches of Gulf of Finland, particularly during the early summer fishing.

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[3]	561	584
1996	23[3]	665	688
1997	25[3]	526	551
1998	23[3]	552	575
1999	19[3]	705	724
2000	23[3]	668	691
2001	19[3]	886	905
2002	27	705	732
2003	20	650	670
2004	11	820	831
2005	11	856	867

[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 all fish released as 1-year-olds were counted as smolts, although some of these fish stayed in the river as parr.
[3]Data on wild production in Russia reported for 1995–2001: 11 000 smolts annually. Not included in table.
Na = Not available.

Wild stocks: The only remaining native salmon populations of the area exist in three Estonian rivers. In one of these rivers (Kunda) the estimated smolt production has been less than 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 2004–2005 no smolts came out from these rivers. The wild salmon populations are genetically distinctive from each other, which indicate that there are still original salmon stocks left, but there is also 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. Some year classes have occasionally been lacking in Estonian rivers during the last 30 years. One of the main reasons preventing the recovery of these small Estonian populations is poaching for salmon in the rivers.

Mixed stocks: There have been wild salmon populations in 9 Estonian rivers in the Gulf of Finland. However, six of these populations (Selja, Loobu, Valgejõgi, Jägala, Pirita, Vääna) have been supported by smolt releases of the river Narva strain in the last few years. Despite enhancement releases some of these rivers may still support fractions of the original wild salmon populations, and a recovery programme should therefore be considered for these rivers.

Wild salmon production was lost in rivers on the Finnish side of the Gulf of Finland by the 1950s due to pollution and damming of rivers. There is a suitable habitat in the lowest part of the River Kymijoki, and natural reproduction has been observed by returning spawning salmon, released as smolts.

Surveys also indicate that some natural reproduction occurs in the river Luga in Russia. This population is supported by long-term releases. However, there are no national plans to attain self-sustainable populations in this river.

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 to 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 objective of the Salmon Action Plan (SAP), as adopted by the former IBSFC, 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 level as high as possible. In addition, objectives state that the genetic diversity of the stocks should be maintained.

The management objective concerned has expired in practice because catch options for 2007 mainly influence smolt year classes beyond year 2010. No update of objectives has been set by the EU Commission after the former IBSFC Salmon Action Plan (SAP).

Management advice for 2007

ICES recommends that catches should not increase.

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.

In addition actions should be taken to stop poaching in Estonian rivers still carrying native wild salmon.

Management considerations

At present wild salmon populations exist in 3 Estonian rivers. Although the estimates on smolt production as well as the potential production capacity of these rivers are uncertain the status of these populations are considered to be precarious. These populations are at risk of extinction or at least loss of genetic variability. In addition the potential smolt production of these rivers is small compared to the most of other wild salmon populations in the Baltic Sea. The spawning and rearing habitats of these rivers are in total about 4 hectares and their potential smolt production is estimated to be about 7000 smolts. A rough estimate of the spawning population in full production state for these rivers would be in the order of a few hundred spawners in total. At present the abundances of these populations are much lower. Genetic analysis has shown that the wild Estonian stocks are genetically separate stocks.

The building of fish ladders would increase substantially the size of the reproduction areas of these rivers, which could increase productivity and create more buffer for stocks to maintain the variability. Unlike the Gulf of Bothnia rivers there are no positive signs of increasing parr densities in these Estonian rivers. 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 harvest rates in sea fisheries in the entire migration area must be retained at 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 these 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 17 000 fish. Though the TAC is not fully utilized (67% in 2005, commercial catch) it is, however, now so low that it may restrict harvest already in the near future. 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 need coordinated management.

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 the outer archipelago to areas closer to the coast and river mouths. Trapnets with modifications to prevent seal entering the trap are in use in some parts of the coastal fishery and are under development in other parts.

The environment

For a short discussion, see Section 8.4.14 on the Main Basin salmon. At least 1741 salmon were discarded in the Gulf of Finland in 2005 due to damages caused by seals.

Scientific basis

Data and methods

No analytic assessment was done in 2006. 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

The cohort analysis was not run this year because the catch predictions were not sufficient to generate a trajectory of the actual catches from 1998 onwards when the catches were low. The following factors created the main uncertainty to the analysis: low catches, low number of tag returns, large uncertainty in recreational catch estimates, mixing of the stocks during the migrations between the Gulf of Finland, Main Basin, and Gulf of Bothnia.

Source of information

Report of the Baltic Salmon and Trout Assessment Working Group, 28 March–6 April 2006 (ICES CM 2006/ACFM:21).

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	-		17
2007	Retain sea fishery low. Special stock rebuilding measures for Estonian wild salmon rivers.	-		

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

Landings.

Year	River	Coast	Offshore	Coastal and offshore[2]		Total[3]	
	t	t	t	t	'000 fish	t	'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	57	3	60	11	69	13
2004	11	62	2	64	10	75	12
2005[1]	17	79	3	82	14	99	18

[1]Preliminary. Table revised because of additional data.
[2] For comparison with TAC.
[3] Total catch includes catches from recreational fisheries, estimated to be 6000 fish in 2005.

8.4.16 Sea Trout in the Baltic

State of the stock

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 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, mainly because of poor quality of the freshwater habitat (Table 8.4.16.1).

In the Gulf of Bothnia, a large number of the natural sea trout stocks have died out due to a combination of loss or decreased quality of freshwater habitat and recruitment overfishing in the last 40 years. The status of the remaining populations is very weak (Table 8.4.16.1). In most of the rivers, both on 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.

In the Gulf of Finland the situation of many sea trout populations is similar to the Gulf of Bothnia (Table 8.4.16.1). 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 total sea trout catch from the Baltic Sea was 855 tonnes in year 2005, which is 190 tonnes less than in 2004 (Table 8.4.16.2).

Management considerations

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

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 is considered for the sea trout stocks. 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. As sea trout and salmon have many similarities concerning their ecological demands, life cycle, and fishing exploitation, the sound management of salmon fishery could also be beneficial for the recovery of the sea trout.

In the Gulf of Bothnia and Gulf of Finland there is mainly no particular sea trout fisheries, but the sea trout are caught as a bycatch in fisheries for other species like whitefish, pikeperch, and perch. Therefore, the potential stock rebuilding measures for sea trout concerns especially the fisheries for these other species. The optional measures, however, are not contradictory in terms of sustainable and rational utilisation of concerned species resources, but would be potentially beneficial for all target species in these fisheries.

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

Factors affecting stocks and fisheries

Most of the sea trout is caught as bycatch, either in offshore fisheries for salmon or in coastal fisheries for salmon, whitefish, and pikeperch. 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 by bottom gillnets for other species.

For the Bothnian Bay a large proportion—often the majority—of the sea trout are caught during the first two years in the sea as bycatch in the fisheries for other species before reaching sexual maturity. In the Gulf of Bothnia, sea trout become mature mainly at the age of 3SW (>55 cm). According to the tagging data less than 5% of the catch has been 3SW or older fish in the last 15 years. Particularly on the Finnish side of the Gulf, the bottom gillnet fishing effort has remained high in the last 10 years. In addition, the development of the net materials has improved the catchability of gillnets, especially for the youngest age groups.

In the Gulf of Finland the fishery is to a large extent a bottom gillnet fishery for other species 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, but this proportion is currently only about 15%.

Many sea trout populations in the Baltic Sea are dependent on stocking (Table 8.4.16.3). 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. As there is an incentive to misreport salmon catches in this mixed fishery, further improvement of control measures should be carried out in order to prevent such misreporting in offshore fishery.

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.

Source of information

Report of the Baltic Salmon and Trout Assessment Working Group, 28 March–6 April 2006 (ICES CM 2006/ACFM:21).

Table 8.4.16.1 Status of monitored wild and mixed sea trout populations in 2005.

	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	9	3	2	5	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	6	2	6	16	30
Danmark (Sub-div 22-25)	122	90	27		239
Russia	2			5	7
Total	**240**	**162**	**73**	**68**	**543**

Table 8.4.16.2 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						Total Gulf of Bothnia	Gulf of Finland				Total Gulf of Finland	Grand Total
																		Finland[2]			Sweden				Estonia	Finland[2]				
	S + C	C	S	S + C	R	C	S + C	R	C	R	S[9]	S + C	R	S[6]	C[6]	R		S	C	R	S[6]	C[6]	R		C	S	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	46	3	1	35	0	12	7		1		606	122	36	9	2	3	883	1	62	11	0	18	29	120	7	0	33	2	43	1,045
2005[5]	14	4	1	38	0	15	7	1	1	0	480	86	20	5	2	2	676	0	71	10	0	22	31	133	6	0	37	3	46	855

[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 8.4.16.3 Sea trout smolt releases (x1000) to the Baltic by country and Sub-division.

Sub-div	Country	age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Main	DK	1yr	5	1	4	4	4	19	17	177	177	177	196	196	19	751	634	614	562	562
Basin		2yr															30	30	30	30
22-29	EE	1yr	50	5		5														
		2yr			5	6	10	10	16	28	30	32	30	32	30	32	30	23	25	2
	FI	1yr		25	11	33	66	54	1	57	106	131	181	199	148	255	131	125	151	93
		2yr		133	169	166	123	103	170	144	181	153	182	168	258	197	131	138	244	303
		3yr		35	16	0		26	1	8	0	13	18	25	35	34	24	9	16	16
	LT	1yr						5	5	4	4	10								
		2yr								3										
	LV	1yr	1	1	6	26	44	26	24	20	1	1	7	25	18	114	160	170		74
		2yr	1	4	6	7	5	2					11	29	74	2	10	67		116
	PL	1yr	51	85	102	2	148	140	266	483	298	492	330	138	151	211	30	16	46	322
		2yr	857	847	498	248	376	845	523	642	821	1028	1001	924	845	733	739	804	765	843
	SE	1yr	13	9	8	19	41	18	6		4	23	19	90	7	10	108	10	116	11
		2yr	32	51	78	61	44	46	84	90	60	95	87	76	100	93	40	48	103	44
Main Basin Total			1010	1196	903	577	861	1293	1113	1657	1683	2156	2061	1903	1685	2277	2066	2053	2057	2415
Gulf of	FI	1yr		7	13	22	38	26	33	8	37	7		421	49	67	1	27	7	5
Bothnia		2yr		288	526	586	564	455	451	451	578	527	382	462	393	365	434	301	239	273
30-31		3yr		99	27	7	18	30	9	0	28	12	5	11	11	5	27	11	15	6
	SE	1yr			19	7				6			1							
		2yr	445	392	406	406	413	376	460	642	554	429	407	372	405	424	380	428	361	413
GOB Total			445	786	989	1028	1033	887	953	1107	1196	975	794	1265	858	862	842	767	622	697
Gulf of	EE	1yr			1															
Finland		2yr	17															14	6	8
32	FI	1yr		19	3	33	10	11	4	33	28	18	51	112	43	95	1	37	14	4
		2yr		192	260	244	306	323	284	342	128	228	278	386	355	372	367	290	281	190
		3yr			0		24	6		1	33	92	40	7	24	18	6	16		
	RU	1yr																4	3	
		2yr																1		0
GOF Total			17	210	265	277	340	341	287	376	189	337	369	504	422	484	373	363	305	202
Grand Total			**1472**	**2191**	**2157**	**1881**	**2233**	**2521**	**2353**	**3139**	**3068**	**3467**	**3224**	**3672**	**2966**	**3622**	**3281**	**3182**	**2983**	**3314**