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Report of the ICES Advisory Committee 2012

Book 8
Baltic Sea

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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

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BOOK 8

Section **Page**

8 BALTIC SEA

8.1 Ecosystem overview

This Section has not been updated in 2012. The most recent ecosystem overview is available in ICES Advisory Report 2008, Section 8.1. This overview can also be found on the ICES website: http://www.ices.dk/committe/acom/comwork/report/2008/2008/8%201-8%202%20Baltic%20ecosystem%20overview.pdf.

8.2 Human impacts on the ecosystem

8.2.1 Fishery effects on benthos and fish communities

This Section has not been updated in 2011. The most recent description on Fishery effects on benthos and fish communities is available in ICES Advisory Report 2008, Section 8.2. This description can also be found on the ICES website: http://www.ices.dk/committe/acom/comwork/report/2008/2008/8%201-8%202%20Baltic%20ecosystem%20overview.pdf.

8.3 Assessments and Advice

8.3.1 Assessment and advice regarding protection of biota and habitats

In 2011, ICES has not provided advice regarding protection of biota and habitats for this area.

8.3.2 Assessments and Advice regarding fisheries

Stock status and advice

The state and advice of the individual stocks are presented in the stock sections. The state of stocks and advice (according to the Section 1.2) are summarized in the table below.

Table 8.3.2.1 State of the stock and advice in the Baltic Sea ecoregion

Stock	State of the stock				Outlook options			ICES advice for 2013
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary approach (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary approach (B_{PA}/B_{lim})**	**MSY approach/DLS[1]** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	(in tonnes)
Cod in SD 22–24	Above target	Undefined	Above trigger	Full reproductive capacity	Landings of 12 700 t.	-	TAC of 20 800 t.	Management plan: landings should be 20 800 t.
Cod in SD 25–32	Appropriate	Harvested sustainably	Qualitative evaluation: Above poss. reference points		Landings of 65 900 t.	Landings of 118 000 t.	TAC in 2013 of 65 900 tonnes.	Management plan: landings should be 65 900 t.
Herring in SDs 25–29 (excl GoR) and SD 32	Above target	Harvested unsustainably	Qualitative evaluation: Stable but low biomass		Catches of less than 117 000 t.	Catches of less than 117 000 t.	-	MSY transition: catches should be no more than 117 000 t.
Herring in the Gulf of Riga	Above target	Harvested sustainably	Above trigger	Undefined	Catches of less than 23 200 t.	Catches of less than 25 900 t.	-	MSY approach: approach: catches should be no more than 23 200 t.
Herring in SD 30	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	Catches of no more than 97 000 t.	-	-	MSY approach: catches should be no more than 97 000 t.
Herring in SD 31	Quality evaluation: low to moderate		Quality evaluation: decreasing stock abundance		Catches of no more than 2100 t.		-	DLS approach: catches should be no more than 2100 t.
Sprat in SD 22–32	Above target	Harvested unsustainably	Qualitative evaluation: Stable at average level		Catches of no more than 278 000 t.	Catches of 312 000 t.	-	MSY approach: catches should be no more than 278 000 t.
Flounder in SD 22-32	Unknown	Unknown	Qualitative evaluation Decreasing		Catches of no more than 15 100 t.		-	DLS approach: catches should be no more than 15 100 t.
Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound)	Qualitative evaluation: decreasing, at historic low		Qualitative evaluation: increasing		Catches of no more than 1800 t.		-	DLS approach: catches should be no more than 1800 t.

[1] Data Limited Stock.

Stock	State of the stock				Outlook options			ICES advice for 2013
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary approach (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary approach (B_{PA}/B_{lim})**	**MSY approach/DLS**[1] (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	(in tonnes)
Plaice in Subdivisions 24-32 (Baltic Sea)	Unknown	Unknown	Qualitative evaluation: increasing		Catches should be no more than 900 t.		-	DLS approach: catches should be no more than 900 t.
Dab in SDs 22–32	Unknown	Unknown	Qualitative evaluation: increasing		Catches should be no more than 1400 t.		-	DLS approach: catches should be no more than 1400 t.
Turbot in SDs 22–32	Unknown	Unknown	Qualitative evaluation: decreasing		Catches should be no more than 220 t.		-	DLS approach : catches should be no more than 220 t.
Brill in SDs 22–32	Unknown	Unknown	Qualitative evaluation: increasing		Catches should be no more than 68 t.		-	DLS approach: catches should be no more than 68 t.
Salmon in SD 22-31 (Main Basin and Gulf of Bothnia)	Qualitative evaluation: Fishing mortality low in a historically perspective, but have increased slightly in recent years		Qualitative evaluation: Stable spawning stocks sizes, generally below reference points, and for some rivers far below.		TAC of not more than 54 000 salmon for 2012. Mis- and un-reported was estimated to be about 30% in 2011. Reducing these unaccounted removals would allow a higher TAC recommendation.	-	-	MSY approach: TAC of not more than 54 000 salmon. Mis- and un-reported was estimated to be about 30% in 2011. Reducing these unaccounted removals would allow a higher TAC recommendation.
Salmon in SD 32 (Gulf of Finland)	Qualitative evaluation: Fishing mortality low in a historically perspective.		Qualitative evaluation: the current stock status is most likely well below the MSY levels		-	Catches of wild salmon should be kept to a minimum.	-	Precautionary considerations: catches of wild salmon should be kept to a minimum.
Sea trout in the Baltic	Qualitative evaluation: Likely overfished in most areas, except in the southern areas.		Qualitative evaluation: likely below MSY except in the southern areas.		-	Exploitation should be reduced.	-	Precautionary considerations: exploitation rates in SD 30 and 31 should be reduced.

Table 8.3.2.2 Summary of the stock categories in the Baltic Sea ecoregion (see section 1.2 for categories definitions).

Total Number of stock in the ecoregion	16
Data rich stocks	6
Data-limited stocks	7
Anadromous and catadromous fish stocks	3

Table 8.3.2.3 Status of data rich stocks (n=6) for Baltic Sea Ecoregion relative to MSY and PA reference points for Fishing Mortality (F) and Spawning Stock Biomass (SSB). Table shows percentage of stocks per stock status. Valuesin brackets denote the number of data rich stocks per stock status.

MSY Approach	Spawning Stock Biomass… is at or above MSY $B_{trigger}$ $SSB_{2012} \geq$ MSY $B_{trigger}$	is below MSY $B_{trigger}$ $SSB_{2012} <$ MSY $B_{trigger}$	is not defined
Fishing Mortality…			
is at or below MSY ($F_{2011} \leq F_{MSY}$)	17 % (1)	-	33% (2)
is above MSY ($F_{2011} > F_{MSY}$)	33% (2)	-	33% (2)
is not defined	-	-	-

Precautionary Approach	is at or above PA $SSB_{2012} \geq B_{pa}$	is at increased risk $B_{pa} > SSB_{2012} > B_{lim}$	is below limit $SSB_{2012} < B_{lim}$	is not defined
Fishing Mortality…				
is at or below PA ($F_{2011} \leq F_{pa}$)	-	-	-	50% (3)
is at increased risk ($F_{lim} > F > F_{pa}$)	-	-	-	
is above PA ($F_{2011} > F_{pa}$)	-	-	-	17% (1)
is not defined	17 % (1)	-	-	17% (1)

Table 8.3.2.4 Summary of the catch advice of Data Limited Stocks (n=10) in relation to recent catch, as an indicator of the stock status. Table shows percentage of stocks within each DLS category for which the advice corresponds to an increase or decrease in relation to recent catch. Values in brackets denote the number of stocks.

DLS Category[2]	Catch Advice Increase	Catch Advice Decrease
3	57% (4)	43% (3)

[2] Detailed categories are available under section 1.2.

[1]8.3.3 Multispecies considerations for the central Baltic stocks: cod in Subdivisions 25–32, herring in Subdivisions 25–29 and 32, and sprat in Subdivisions 22–32

ICES intends to provide multispecies advice on fisheries for some ecosystems (see Section 1.2) and encourages managers to apply such an approach to the central Baltic Sea. The present section may serve as a starting point for a dialogue between ICES and managers to foster the development of a multispecies management system for the Baltic. This text uses implicit management objectives and risk tolerance that need to be validated by managers. If managers decide to adopt a multispecies management approach a transition period from the present management will be required. As this work is mostly illustrative, ICES focuses on the most obvious interactions between commercially exploited fish stocks in the area and does not attempt to provide a full foodweb model.

The main result of the present preliminary quantitative multispecies analysis for the central Baltic Sea (Subdivisions 25–29 and 32 excl. Gulf of Riga) is that, compared to the present single-species approach, it could be possible to increase the sum of the sustainable yields in tonnes of the three species combined; the growth of individual fish would be improved if multispecies interactions were taken into account when setting target Fs. However, cod yields will remain about the same, whereas the probability of low cod spawning-stock biomass (SSB) will increase. Multispecies considerations indicate a multitude of solutions, all being biologically sustainable. The societal choice between these must be based on social and economic considerations and informed by social and economic impact assessments.

These results are derived assuming that there is full spatial overlap for all three stocks. The geographical overlap of cod and clupeid stocks is currently small, with cod found mainly in the south (Subdivision 25) and clupeids in the north (Subdivisions 28–29 and 32).

The current difference in distribution of cod and clupeids implies that:

- an increase in F on cod will not necessarily result in increasing Baltic-wide clupeid stock sizes (and hence will not increase clupeid yields);
- a reduction of clupeid F in Subdivision 25 is likely to improve growth and condition of cod as well as reduce cannibalism;
- an increase in clupeid F in northern areas (Subdivisions 27–32) is unlikely to negatively affect the major cod stock component distributed in southern areas (Subdivisions 25–26);
- an increase in sprat F in northern areas (Subdivisions 27–32) is likely to improve the growth rates of the clupeid stocks; and
- an increase in cod F may imply higher probability of low cod SSB.

Background

Extensive multispecies and ecosystem research has been performed in the Baltic in the past 30 years. ICES, together with several institutes around the Baltic, has invested substantially in the research on multispecies interactions, ecosystem functioning, and integrated assessment. Currently, several multispecies and ecosystem models exist for the Baltic Sea (for an overview cf. ICES, 2009a). One of them, the stochastic multispecies model (SMS), was chosen for a more detailed scrutiny in 2012 by ICES in cooperation with the EU STECF (2012a, 2012b; STECF, 2012).

The three stocks considered are cod in Subdivisions 25–32, herring in Subdivisions 25–29 and 32 (excl. Gulf of Riga), and sprat in Subdivisions 22–32. Cod is a predator on herring, sprat, and juvenile cod (Figure 8.3.3.1). This predation by cod forms the main interactions among these stocks and is the only type of interaction considered in the quantitative analysis below. Note that the cod growth responses to changes in herring and sprat stock sizes are not modelled.

[1] As this Section has been omitted in the printed version of the Advice, it has been included in the Web version but with different page numbering, so as not to confuse the original setup.

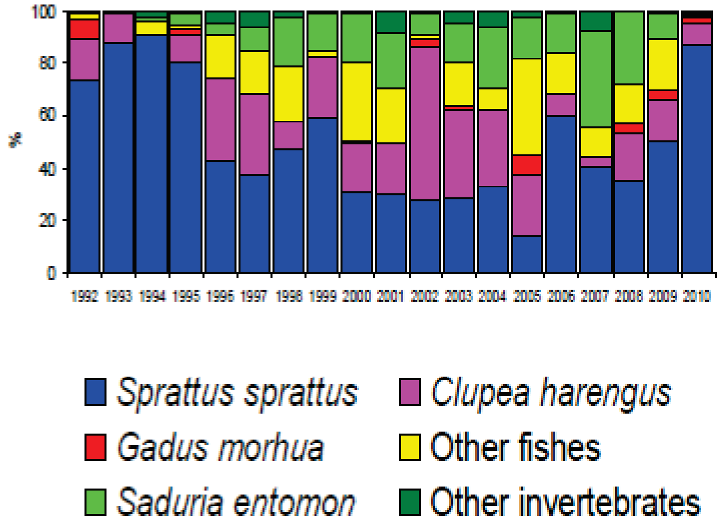

Figure 8.3.3.1 Cod stomach content, by prey item, of cod caught in Subdivision 26 in March 1992–2010 (from Patokina *et al*., 2011).

There are also other aspects of interactions related to these three stocks, the most important being: 1) the variation in spatial overlap between the three stocks, 2) inter- and intraspecific competition for food between and within the two clupeid stocks, 3) cod growth in relation to amount of food available, and 4) herring and sprat predation on cod eggs and clupeid food competition with cod larvae. These interactions are less certain and therefore not included in the quantitative analysis, but dealt with in a qualitative way below.

Management of fisheries for cod has an impact on fishing opportunities for sprat and herring, and vice versa; management of the clupeid fisheries influences the food availability for cod, and thereby indirectly cod yield. If the cod stock is large, the yield of herring and sprat will be reduced. Management of the herring and sprat fisheries will influence the growth of individual fish (of both cod and clupeids) and thus the potential yield.

A stochastic multispecies (SMS) model (ICES, 2012a) is used to illustrate 1) a potential maximum sustainable yield in a multispecies context, and 2) alternative management harvest control rules (HCRs) compared to the present single-species approach. The illustrated results are based on the assumptions that i) cod and clupeid dynamics are sufficiently described by accounting only for the cod predation mortality inflicted on clupeids and on juvenile cod, ignoring all other interactions, and ii) the distributions of cod and clupeids are constant and overlapping.

Results of the SMS model

Multispecies F_{MSY}

Figure 8.3.3.2 presents the main results of the SMS model. Equilibrium yield is simulated in SMS for various fishing mortalities for cod (0.4 to 0.7 with 0.05 increment)[2], herring F (0.2 to 0.3 with 0.02 increment), and sprat F (0.3 to 0.5 with 0.02 increment). The plots by species show the distribution of yields for any given F, taking into account the range of Fs for the other species. For example, the yield of cod (upper left panel) has a median yield at 70 kt for cod F at 0.4. The variation in yield for cod F at 0.4 is due to the varying F on sprat and herring. Since cod predation on a particular prey in the model depends on the availability of the other two types of prey, cod cannibalism increases if abundance of sprat and herring decreases, which affects the yield of cod.

[2] Note that the current estimate of F_{MSY} = 0.30, which is also the F_{target} in the management plan, is not included in this range.

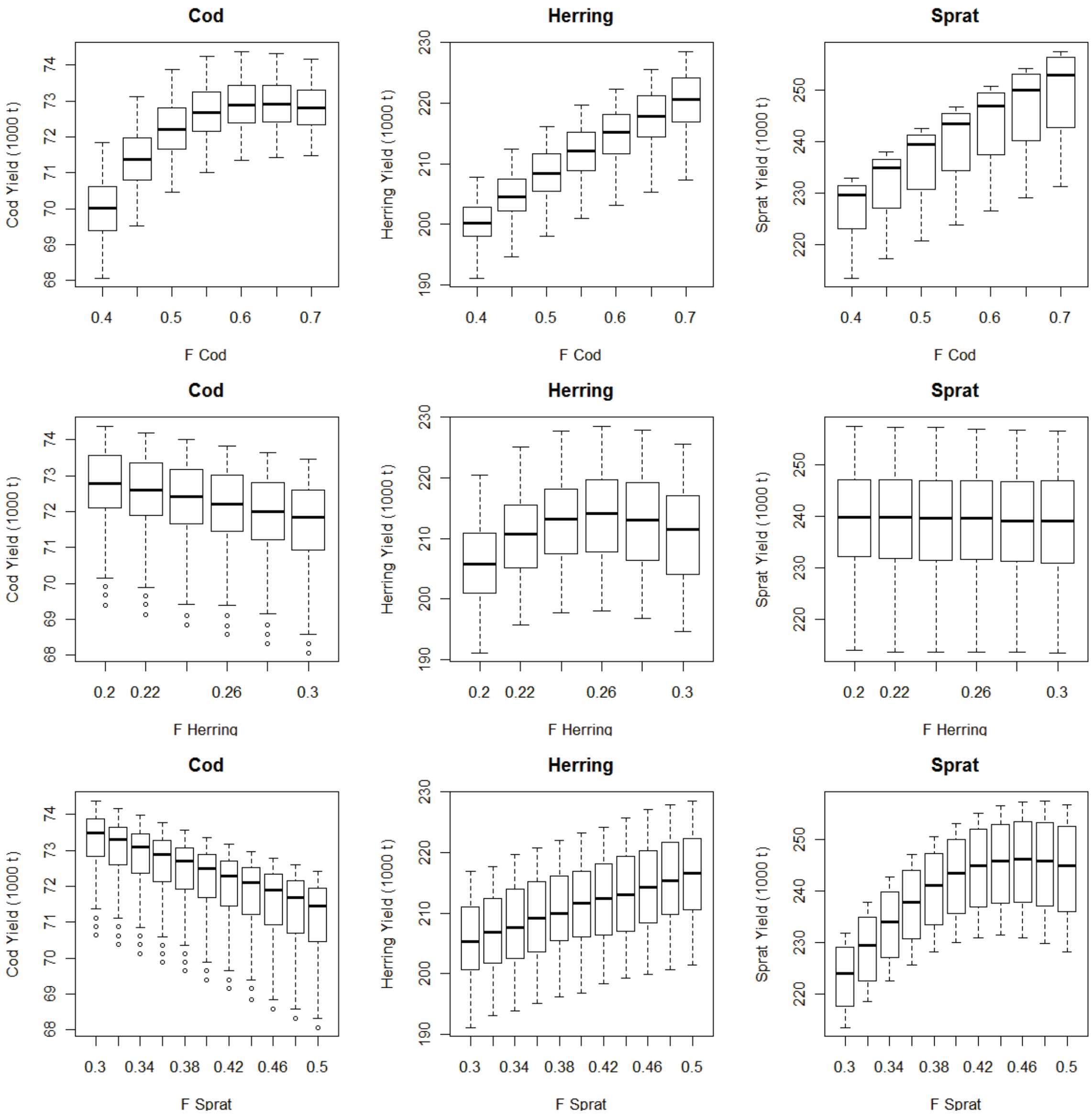

Figure 8.3.3.2 Equilibrium yield simulated in SMS for various levels of fishing mortality for cod (0.4 to 0.7, 0.05 increment), herring F (0.2 to 0.3, 0.02 increment), and sprat F (0.3 to 0.5, 0.02 increment). The graph by species shows the distribution of yields for any given F shown on the X-axis, taking into account to the range of Fs for the other species.

The preliminary modeling work reveals that the highest sum of yields of the individual species could be obtained with fishing mortalities considerably higher than the present single-species Fs (0.60–0.65 for cod, 0.26 for herring, and 0.46 for sprat). It should be noted that the yield of cod is not significantly higher and that at such high Fs, the probability of SSB falling below a biomass limit is higher (Fig. 8.3.3.4) and there was no analysis conducted to explore the impact on other components of the ecosystem. It should further be noted that the effects on yields, and the corresponding F-values, are based on the assumption of constant geographical overlap of cod and clupeids, and on cod growth being independent of what it eats.

Potential multispecies reference points and examples of HCR

The multispecies modelling and the potential multispecies reference points can be used for the following HCR illustrated in Figure 8.3.3.3. Note that the F and SSB reference points used are for illustrative purposes and would need to be confirmed by additional analyses and discussion with managers and stakeholders on their tolerance to risk.

Stock	F_{MSY} proxy	Low SSB limit (kt)	T1 (kt)	T2(kt)	Comments
Cod	0.6–0.65	100	50	100	Low SSB limit based on segmented regression of post-1989 S–R data.
Herring	0.26	400	200	600	Low SSB limit set at B_{loss}.
Sprat	0.46	400	200	600	Low SSB limit set higher than B_{loss} in order to prevent cod food supply being too low.

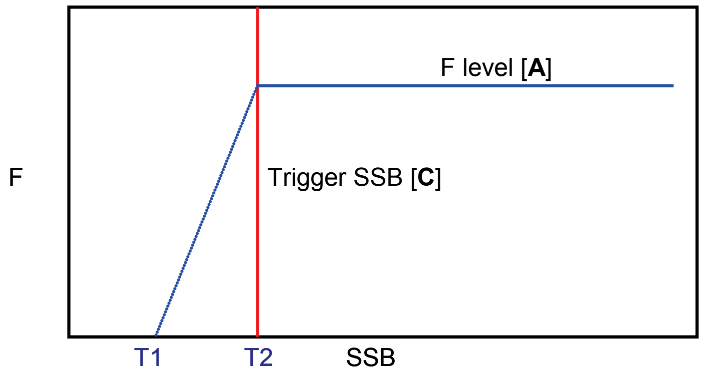

Figure 8.3.3.3 Outline of a potential harvest control rule, which was tested for each of the three stocks. T1 is here defined as 50% of the low SSB limit. This should depend on the risk tolerance of the fishery management authority. T2 is set at 150% of the low SSB limit, which is roughly similar to the definition of the B_{pa} value and is related to the amount of uncertainty in the stock assessments for these three stocks. This reference point is similar to the so-called MSY $B_{trigger}$ (see Section 1.2).

This HCR has been evaluated with the SMS model, including stochastic recruitment and uncertainties in assessments, with three scenarios of HCR (see STECF (2012) for details):

1) Existing plan/single-species F_{MSY}: Cod target F = 0.3, +-15% TAC constraint (management plan), herring F = 0.16, and sprat F = 0.35;

2) Multispecies F_{MSY} proxy: Cod F = 0.65, herring F = 0.26, and sprat F = 0.46;

3) With TAC constraint, and lower target F than in 2): Cod F = 0.45 +-15% TAC constraint, herring F = 0.26 +-15% TAC constraint, and sprat F = 0.40 +-20% TAC constraint.

The scenarios were selected as follows: Scenario 1 mimics the existing management plan for cod and the default ICES approach to MSY management for herring and sprat. Scenario 2 investigates the potential multispecies based MSY reference points. Scenario 3 adds TAC constraints currently in use for Eastern Baltic cod and suggested by ICES (2009b) for the pelagic stocks. The F targets chosen for this scenario are slightly lower than the ones applied in scenario 2, as it is often seen that constraining TAC variability can increase variability in SSB and thus increase the risk. So to have comparable risks the F targets in scenario 3 need to be slightly lower. The F-values chosen are for illustrative purposes only and managers must consider objectives, risk, and transition costs and benefits in implementing a multispecies-based management approach. However, it should be noted that small changes in F_{target} within the range selected will give very small changes in mean yield.

A comparison of results from the scenarios is presented in Figures 8.3.3.4–6 for each of the three stocks. For cod, the average yield is similar for the three scenarios, but the variation in yield is lower in the two TAC constraint scenarios (scenarios 1 and 3). The SSB is highest for the single-species F_{MSY} scenario (scenario 1), and lowest for the multispecies management scenario without TAC constraints (scenario 2). The probability of SSB falling below the

“Low SSB” threshold is high for scenario 2, and for scenario 3 also results in an SSB close to the “Low SSB” limit under the assumed recruitment scenarios.

Herring yield is considerably lower in the single-species F_{MSY} scenario (scenario 1) compared to the multispecies management scenarios (2 and 3), due to the low target F on herring in combination with the low F on cod and resulting large predator stock. The effect of the low cod F is also clearly seen in the “Eaten biomass” plot where scenario 1 results in a considerably higher biomass eaten. SSB is above the “Low SSB” limit with high probability for all three scenarios. Mean yield depends strongly on the size of the cod stock, such that a highly variable cod stock results in a highly variable herring yield.

The effect on the sprat stock in the three scenarios is very similar to the one on herring. The probability of SSB falling below the “Low SSB” limit is, however, greater for sprat than for herring given the selected target Fs, and the difference in sprat yield between the single-species management scenario and the multispecies management scenarios is smaller.

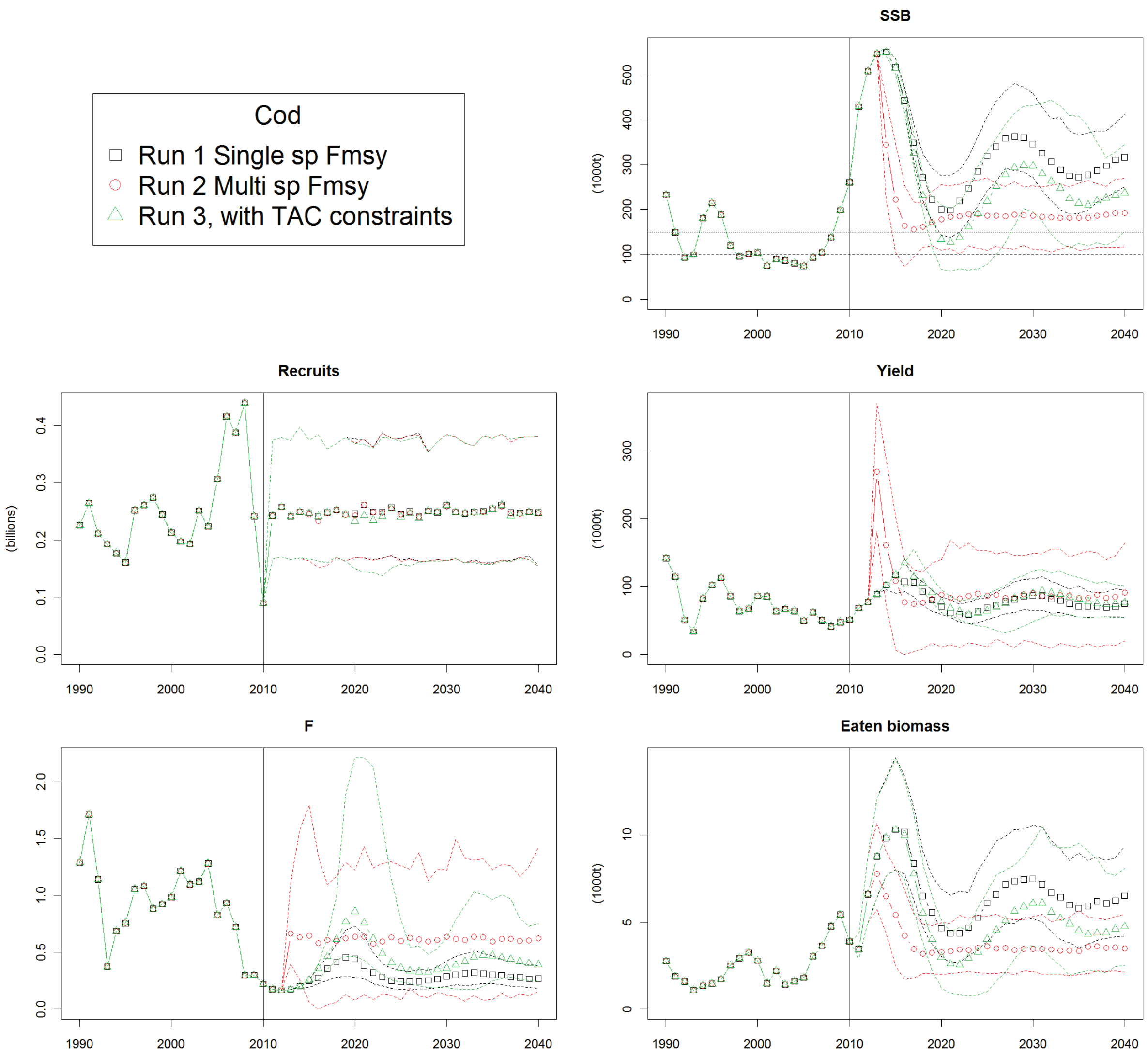

Figure 8.3.3.4 Cod. HCR evalution with the SMS model. For each scenario, the median value and the 5th and 95th percentiles are shown.

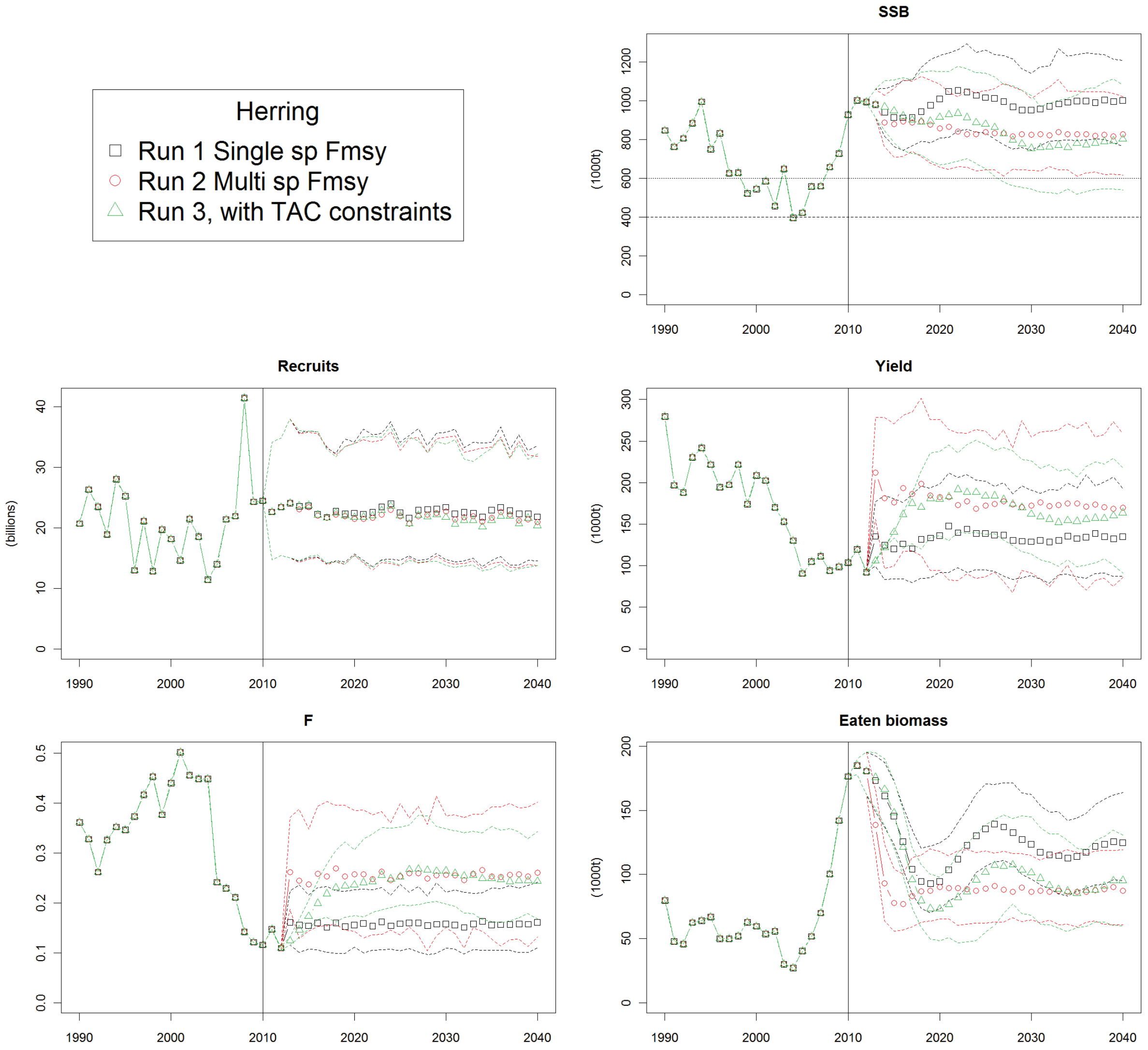

Figure 8.3.3.5 Herring. HCR evalution with the SMS model. For each scenario, the median value and the 5th and 95th percentiles are shown.

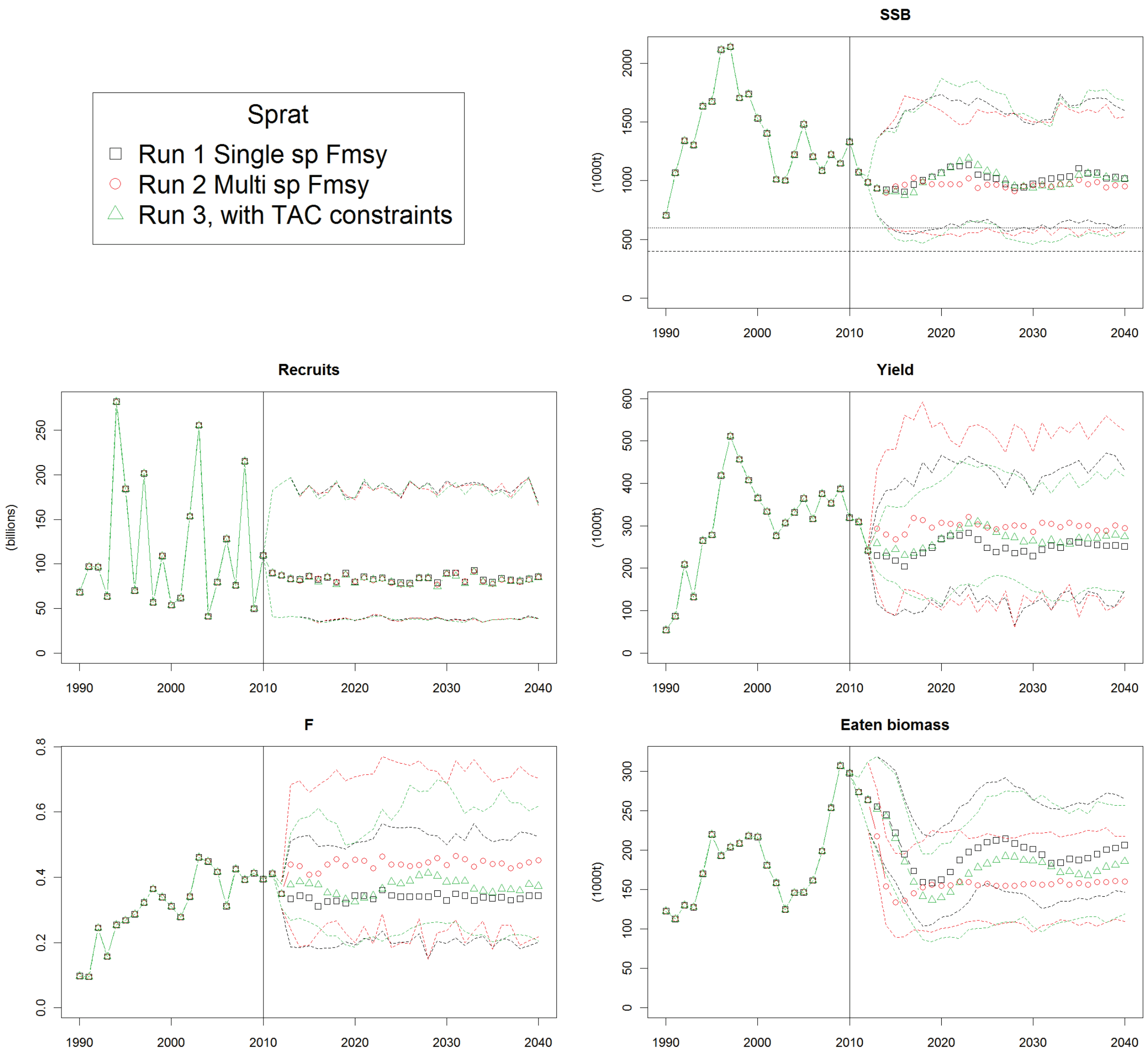

Figure 8.3.3.6 Sprat. HCR evalution with the SMS model. For each scenario, the median value and the 5th and 95th percentiles are shown.

Additional considerations

Changing spatial distributions of cod and clupeids

The relative distributions of predator (cod) and clupeid prey (herring and sprat) have changed over the recent decades, and for the time being most herring and sprat are outside the predatory reach of cod at least for parts of the year (Figure 8.3.3.7). It is not clear to what extent the low density of herring and sprat in Subdivisions 25 and 26 is due to predation from cod.

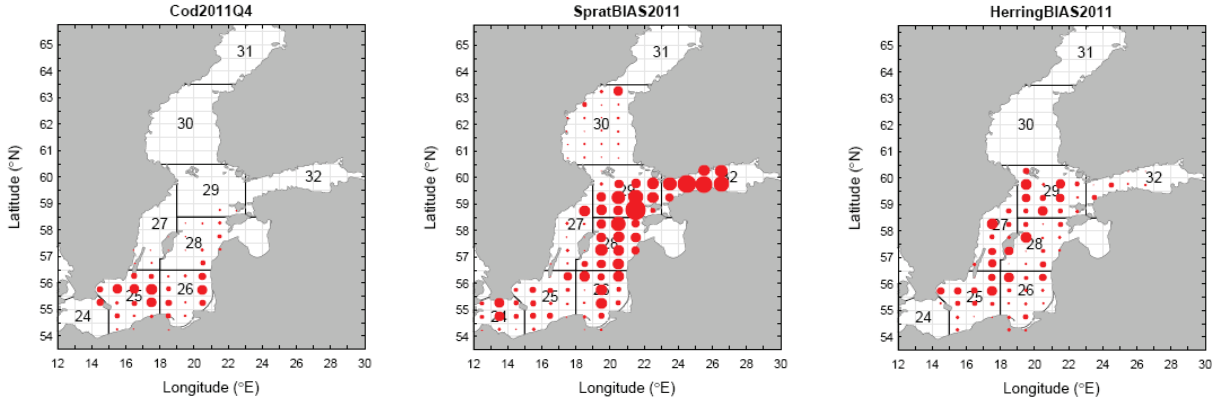

Figure 8.3.3.7 Spatial distribution of cod in Subdivisions 25–32, herring in Subdivisions 25–29 and 32(excl. GoR), and sprat in Subdivisions 22–32 in the 4th Quarter of 2011, from acoustic survey (BIAS, sprat and herring) and bottom trawl survey (BITS, cod).

The combination of an increasing cod stock and low abundance of sprat and herring in Subdivision 25 (in the main distribution area of cod) has resulted in the lowest biomass of clupeids currently available in this area since the 1970s. Consistent with the low biomass of clupeids in the area and thus low amount of food for cod, the mean weight of older cod (age-groups 4–7) in Subdivision 25 has sharply declined since 2007 (see advice on cod in Subdivisions 25–32, Section 8.4.2).

Currently, it is assumed in the SMS model that the overlap between cod and clupeids is taken as the mean for the whole area, and that the overlap remains unchanged during the model period. In contrast, at present the overlap between cod and clupeids is limited to Subdivisions 25 and 26, with almost no overlap between cod and clupeids in the northeastern areas (Subdivisions 27–32).

The reason for not integrating the spatial considerations in the SMS simulations presented above was that too little is known about the mechanism leading to future changes in the species' distributions. However, due to the recent changes in distribution of the three stocks in the Baltic, it might be appropriate for management to mainly exploit sprat and herring outside Subdivisions 25 and 26 in order to have more food (herring and sprat) available to cod in Subdivisions 25 and 26 (ICES, 2012a).

Cod growth

Even though a steep decrease in cod mean weight has been observed in the most recent years with high cod density, cod growth is not, yet, included in the model. For a review on problems in modelling cod growth, see STECF (2012).

Clupeid growth

Clupeid somatic growth has been implemented in sensitivity runs of the SMS as purely density dependent. The rational for this is that when clupeid abundance/biomass increases, the individual growth of sprat and herring slow down, likely because of food competition (ICES, 2012a). ICES (2012a) and STECF (2012) concluded that more work is needed to fully understand the results of the runs in which density-dependent growth is included. The current literature, however, shows that sprat is able to influence the common food resources and therefore drive the density dependence; this influence is less pronounced for herring. The density dependence has been stronger in the northern areas, where the sprat has increased the most. Future multi-species management evaluations should therefore include these aspects.

Due to the changes in distribution of the sprat stock in the Baltic since the mid-1990s, it might be appropriate for management to confine the exploitation of sprat mainly to Subdivisions 27–29 and 32, in order to reduce the density dependence in these areas (ICES, 2012a).

Predation on cod eggs and competition for food between cod larvae and sprat

It is noted that the change in the timing of cod spawning may have consequences for predation on cod eggs and larvae. This necessitates a new sampling programme for herring and sprat stomachs. The latest data are from 1994. Cod larvae compete also for planktonic food with clupeids. Currently, clupeid predation on cod eggs and food competition between cod larvae and clupeids are not included in the model.

Sources

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ECOREGION Baltic Sea
STOCK Cod in Subdivisions 22–24

Advice for 2013

ICES advises on the basis of the EU management plan (EC 1098/2007) that landings in 2013 should be 20 800 tonnes.

Stock status

F (Fishing Mortality)				
	2009	2010	2011	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Management plan (F_{MGT})	✗	✓	✓	Below target
SSB (Spawning Stock Biomass)				
	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MGT})	?	?	?	Undefined

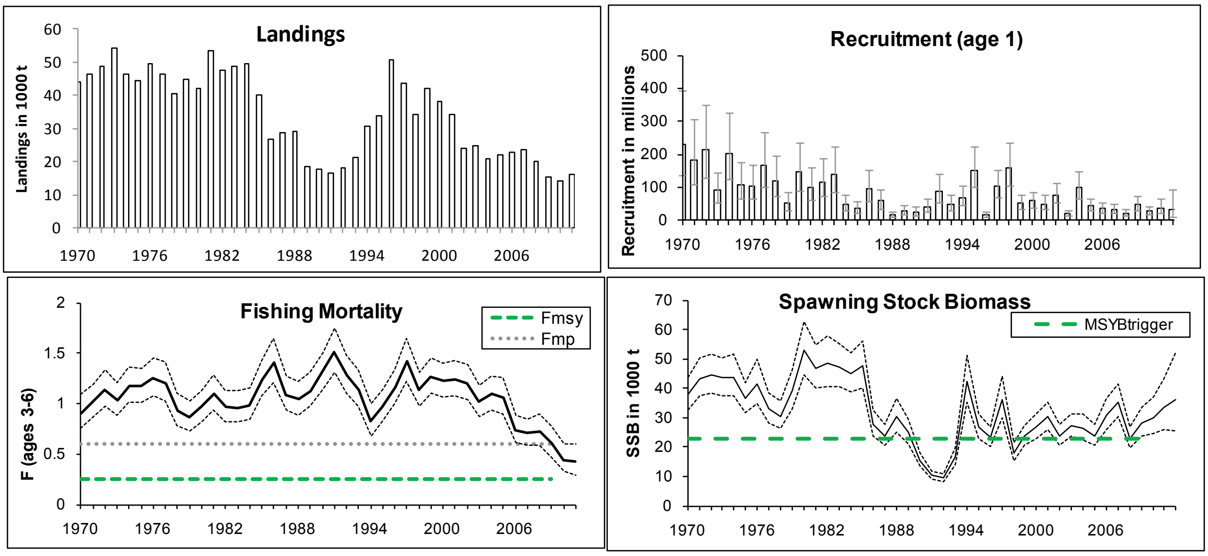


Figure 8.4.1.1 Cod in Subdivisions 22–24. Summary of stock assessment (weights in thousand tonnes) (Recruitment, F, and SSB have uncertainty boundaries (95%) in the plot). Top right: SSB/F for the time-series used in the assessment.

SSB has been fluctuating just above B_{pa} since 2000 with an increase in recent years. F (ages 3–6) has decreased since the late 1990s and fell below the target F specified in the management plan in 2010. The latest year classes have been below the 10-year average. The 2003 year class is the latest above-average year class.

Management plan

A management plan for cod in the western Baltic Sea was agreed in September 2007 by the EU (EC 1098/2007). This plan aims for a reduction in F by 10% each year until the target F is reached. ICES has evaluated the management plan in 2009 and considered it to be in accordance with the precautionary approach. The management plan is currently under revision and it should be noted that there is a large difference between the current estimate of F_{MSY} proxy and the target F in the management plan.

Biology

There is a mixture of the eastern and western Baltic cod stocks, especially in Subdivision 24. The mixing has not been quantified, but it is likely that it has increased in recent years, as the eastern Baltic stock is increasing. The increase seems to be larger for older age groups and this has had an effect on the stock assessment, with a higher proportion of larger cod than expected showing up in the catches. At present three main spawning sites are considered for this stock: the Sound (Subdivision 23), the Belt Sea (Subdivision 22), and the Arkona Basin (Subdivision 24). There are indications of juvenile cod migrating from the western Baltic to the east, but also of adult cod migrating the other way. Furthermore, a recent study indicates that the cod in the Sound might constitute a separate resident stock.

The fisheries

The main portion is taken by trawl, but also by gillnets and to a minor extent by longlines and Danish seines. Bycatch consists mainly of flatfish, with flounders being the most abundant. Western Baltic cod is usually taken in mixed demersal fisheries. In Subdivision 22, different flatfish species (flounder, plaice, dab, and turbot) are caught with cod; in Subdivision 24, flounder is the main bycatch, at least in some periods.

Catch distribution	Total catch (2011) is 17.2 kt, where 16.3 kt are landings (68% trawlers, 32% gillnetters) and 907 t discards.

Quality considerations

Mixing of the eastern and western Baltic cod stocks in recent years is considered an increasing problem for the quality of the assessment. A larger part of the commercial fleet targets cod in Subdivision 24 (considered the mixing zone) and some of these fish are considered to be of eastern origin.

Data are needed to quantify the amount of mixing of cod by age groups between the Baltic areas. Tagging experiments or/and genetic analysis could provide such data.

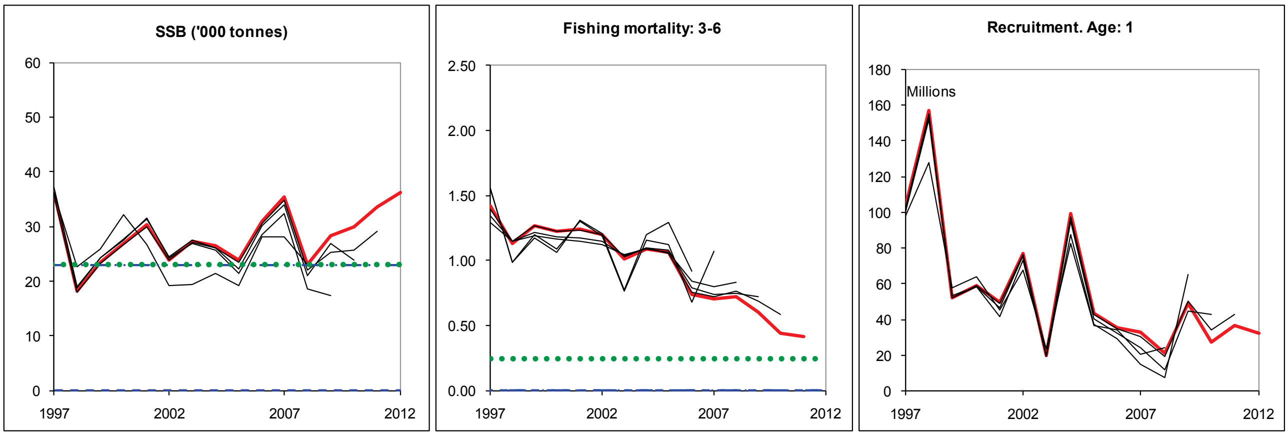


Figure 8.4.1.2 Cod in Subdivisions 22–24. Historical assessment results (final-year recruitment estimates included). The stock was benchmarked in 2009, which caused a revision in data input.

Scientific basis

Assessment type	Analytical (SAM – statespace–assessment model).
Input data	Three survey indices: Havfisken in the 1st and 4th quarters (KASU-1Q, KASU-4Q) and Solea in the 1st quarter (SOLEA-1Q); one commercial cpue index (Danish trawlers).
Discards and bycatch	Discards included in the assessment (since 1970).
Indicators	None.
Other information	Last benchmarked in 2009 (WKROUND 2009). The next benchmarking for this stock is scheduled for 2013.
Working group report	WGBFAS

ECOREGION Baltic Sea
STOCK Cod in Subdivisions 22–24

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	23 000 t	B_{pa} (23 000 t)
	F_{MSY}	0.25	F_{max} (ICES, 2011)
Precautionary Approach	B_{lim}	not defined	
	B_{pa}	23 000 t	MBAL
	F_{lim}	not defined	
	F_{pa}	not defined	
Management Plan	SSB_{MGT}	not defined	
	F_{MGT}	0.60	EU management plan based on stochastic simulations.

(unchanged since 2011)

Outlook for 2013

Basis: F = TAC constraint (2012) = 0.57; SSB (2013) = 35.7; R age 1 (2012) = 32.1 million; human consumption (HC) landings (2012) = 21.3; Discards (2012) = 1.5.

Rationale	**Human consumption (2013)**	**Basis**	**F Total (2013)**	**F (HC) (2013)**	**Catch Total (2013)**	**Discards (2013)**	**SSB (2014)**	**%SSB change [1)]**	**% TAC change [2)]**
Management plan	20.8	F = 0.6	0.60	0.54	22.3	1.42	35.2	-1.6	-2.2
MSY framework	9.9	F_{MSY}	0.25	0.23	10.6	0.68	44.1	+23.3	-53.4
MSY transition	12.7	$0.4*F_{2010}+ 0.6*F_{MSY}$	0.33	0.30	13.5	0.86	41.7	+16.8	-40.4
Zero catch	0	F = 0	0.00	0.00	0	0	52.63	+47.1	-100
Other options	13.1	F_{2012} *0.6	0.34	0.31	14.0	0.90	41.40	+15.9	-38.4
	16.7	F_{2012} *0.8	0.46	0.42	17.9	1.15	38.4	+7.6	-21.4
	18.1	−15% TAC change (F_{2012} *0.88)	0.50	0.46	19.3	1.25	37.4	+4.6	-15.0
	18.4	F_{2012} *0.9	0.51	0.47	19.7	1.27	37.1	+3.8	-13.5
	20.0	F_{2012} *1.0	0.57	0.52	21.4	1.38	35.8	+0.2	-5.9
	21.3	0%TAC change (F_{2012} *1.08)	0.62	0.57	22.8	1.45	34.8	-2.6	0.0
	21.6	F_{2012} *1.1	0.63	0.58	23.1	1.48	34.6	-3.3	+1.4
	24.5	+15% TAC change (F_{2012} *1.3)	0.74	0.68	26.3	1.78	32.2	-9.8	+15.0
	25.8	F_{2012} *1.4	0.80	0.73	27.7	1.88	31.1	-12.9	+21.2
	29.6	F_{2012} *1.7	0.97	0.89	31.7	2.11	28.2	-21.2	+39.0

Weights in thousand tonnes.
1) SSB 2014 relative to SSB 2013.
2) Human consumption landings 2013 relative to TAC 2012.

Management plan approach

Following the agreed EU management plan implies fishing at an F management plan of 0.6, which will lead to a TAC of 20 800 tonnes in 2013. This is expected to lead to an SSB of 35 200 tonnes in 2014. No further reduction in days-at-sea is required.

MSY approach

Following the ICES MSY framework implies fishing mortality being reduced to 0.25, resulting in landings of 9900 tonnes in 2013. This is expected to lead to an SSB of 44 100 tonnes in 2014.

Following the transition scheme towards the ICES MSY framework implies fishing mortality being reduced to 0.33, resulting in landings of 12 700 tonnes in 2013. This is expected to lead to an SSB of 41 700 tonnes in 2014.

Precautionary approach

As there is no F_{pa} defined for this stock, the catch corresponding to the precautionary approach cannot be calculated. B_{pa} is 23 000 tonnes, and all options in the outlook will result in an SSB above B_{pa} in 2014.

Additional considerations

The fishery is largely based on recruiting year classes. The last three year classes have been estimated to be below the average of the last 10 years, and much lower than the average of the entire time-series.

Removals of cod in recreational fisheries in the Baltic are substantial, but currently not consistently and completely sampled, and therefore not included in the assessment. Work is ongoing to harmonize sampling procedures to include recreational fisheries data in the assessment.

The spawning stock has increased, especially age groups 4+ are showing up in relatively large numbers compared to the younger ages for the same cohorts. This may be an effect of older age groups migrating from the eastern Baltic Sea into the western Baltic (Figure 8.4.1.6). This situation might be expected when the eastern Baltic cod stock in Subdivision 25 is increasing and its expansion into more northern areas is prevented by poor hydrological conditions. The increase of SSB since 2008 could to some extent explain this spillover. However, migrations of younger cod from the western Baltic stock into the eastern Baltic also occur.

Management plan evaluations

ICES evaluated the EC management plan in March 2009 and concluded that the plan is in accordance with the precautionary approach. In its evaluation, ICES assumed that the annual effort reduction is fully achieved. Under the evaluations, F is assumed to decrease in line with the annual 10% effort reduction. The plan is sensitive to assumptions about implementation error, and the effectiveness of effort limitations. However, it should be noted that the target F in the EC management plan is much larger than the current estimate of the F_{MSY} proxy.

STECF re-evaluated the management plan in 2011 (ICES, 2011b), and considered that, within the historical stock sizes, an exploitation of the two Baltic cod stocks at target fishing mortalities of 0.33 is consistent with the objective of reaching MSY (by 2015 at the latest). If the stock sizes increase sufficiently that growth or recruitment is reduced, it may be necessary to increase the target fishing mortalities to obtain MSY. The harvest control rules of the present management plan were considered appropriate in defining the TACs. However, the simulations indicated that a 15% constraint on inter-annual variation in the TACs is not required to achieve the biological objectives. Although discards appear at present not to be a problem in relation to limiting fishing mortality, a management plan should include explicit rules for addressing discards. This could be implemented by defining the TAC as total allowable catch and by ensuring that all catches (landings as well as discards) are counted against the TAC.

In the past, F has not been reduced as much as anticipated by the management plan, indicating that effort limitations are not effectively limiting the fishery.

Information from the fishing industry

The increase in flatfish abundance interferes with the selectivity of the “Bacoma” codend, and discarding has increased in 2011 and 2012.

Regulations and their effects

The fishery is managed through TAC, effort, seasonal fisheries restrictions, and technical measures.

The Baltic cod management plan (EC Regulation 1098/2007) *inter alia* called for a reduction in fishing effort (10% annually in terms of number of fishing days per year), until the target F has been reached. The maximum number of fishing days for the Subdivisions 25–28.2 was fixed at 160 in 2010, and kept at 160 days in 2011 and 2012. In 2012, member states may allocate additional days absent from port to vessels if an equal amount of days absent from port is withdrawn from other vessels. The number of receiving vessels may not exceed 10% of the total number of vessels. The provisions in the management plan (EC 1098/2007, Art 8 Para 5), however, would have allowed an increase in the days-at-sea to 169 in 2012 and to 241 in 2013 (days-at-sea $_{\text{current year}}$ x F_{target} / $F_{\text{preceeding year}}$).

The cod fisheries in the western Baltic have also been regulated since 2009 by a seasonal closure from 1 April to 30 April to protect spawning aggregations of cod. The TAC was not fully utilized in 2011 (87%).

To decrease discards, a “Bacoma” codend with a 120 mm mesh was introduced by the International Baltic Sea Fisheries Commission (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. This was expected to enhance compliance and to be in better accordance with the minimum landing size, which was changed from 35 to 38 cm in the same year. As of 1 January 2010 the “Bacoma” 120 mm was re-introduced along with a extended “Bacoma” window (5.5 m) to further decrease discarding, and the minimum landing size was kept at 38 cm.

From 1 January 2009 a small area (“the triangle”) in Subdivision 23 (the Sound) was closed for all fisheries in February and March, when traditionally the directed cod fishery was large. This has implied a reduction of the cod catch in Subdivision 23 by close to 50% compared to the time period from 2001–2008 (Table 8.4.1.2).

In Denmark, annual quota shares for individual vessels were introduced on 1 January 2007. Since then, fishers can fish, trade, exchange, or pool their share with other fishers. This could potentially affect the efficiency of the vessels, but an effective change in efficiency has not been found so far.

Scientific basis

Data and methods

The assessment includes catch data, supplemented with one commercial cpue index and three survey indices. The assessment is based on the recently developed stochastic state-space model (SAM) that provides statistically sound estimates of uncertainty in the model results. The model was adopted at the benchmark workshop in 2009.

Discard data have been available since 1996 and are used in the assessment as yearly proportions discarded per age-group. Thus, for 1970 to 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. Recent changes in technical regulations such as the increase of minimum landing size, the introduction of “Bacoma”, a ban on highgrading, and varying closures may contribute to the variability in discard rates.

Uncertainties in assessment and forecast

Including the commercial tuning index in the assessment results in a lower fishing mortality and higher SSB, than using the scientific surveys alone.The commercial cpue is the only tuning index with information on the abundance of the older age groups (4–7) .

A recent study indicates strong natal homing and spawning fidelity for the cod in the Sound (Subdivision 23). This could indicate that the cod in this area constitute a separate resident stock (Svedäng *et al.*, 2010) with distinct dynamics.

Comparison with previous assessment and advice

The SSB estimates for 2011 have been revised upwards by 15% compared to last year’s assessment, and the 2010 fishing mortality was revised downwards by 24%. The recruitment of the 2010 year class has been revised upwards by 20%.

The basis for the advice is the same as last year.

Sources

ICES. 2011a. Report of the Baltic Fisheries Assessment Working Group (WGBFAS). ICES Headquarters, 12–19 April 2011. ICES CM 2011/ACOM:10. 824 pp.

ICES. 2011b. Report of the ICES WKROUNDMP2 2011 / STECF EWG 11-07. Evaluation and Impact Assessment of Management Plans PT II, 20–24 June 2011, Hamburg, Germany. ICES CM 2011/ACOM:56. 331 pp.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group (WGBFAS). ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

Svedäng, H., André, C., Jonsson, P., Elfman, M., and Limburg, K. E. 2010. Migratory behaviour and otolith chemistry suggest fine-scale sub-population structure within a genetically homogenous Atlantic cod population. Environmental Biology of Fishes, 89:383–397.

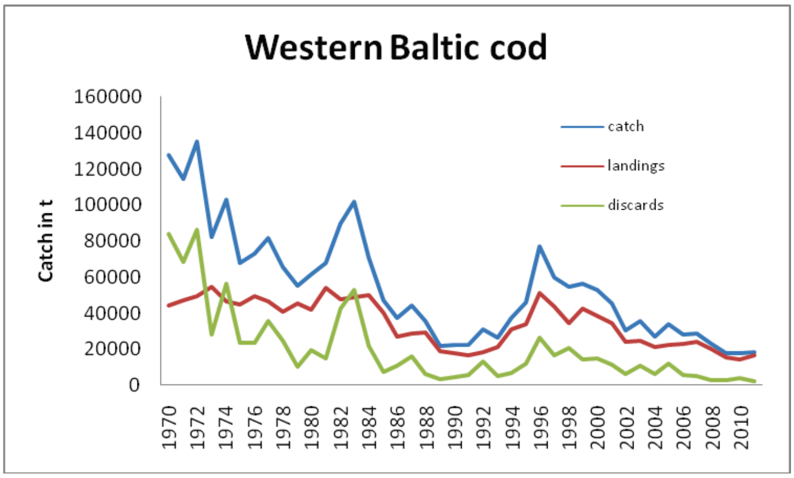


Figure 8.4.1.3 Cod in Subdivisions 22–24. Landings, discards, and catches in tonnes.

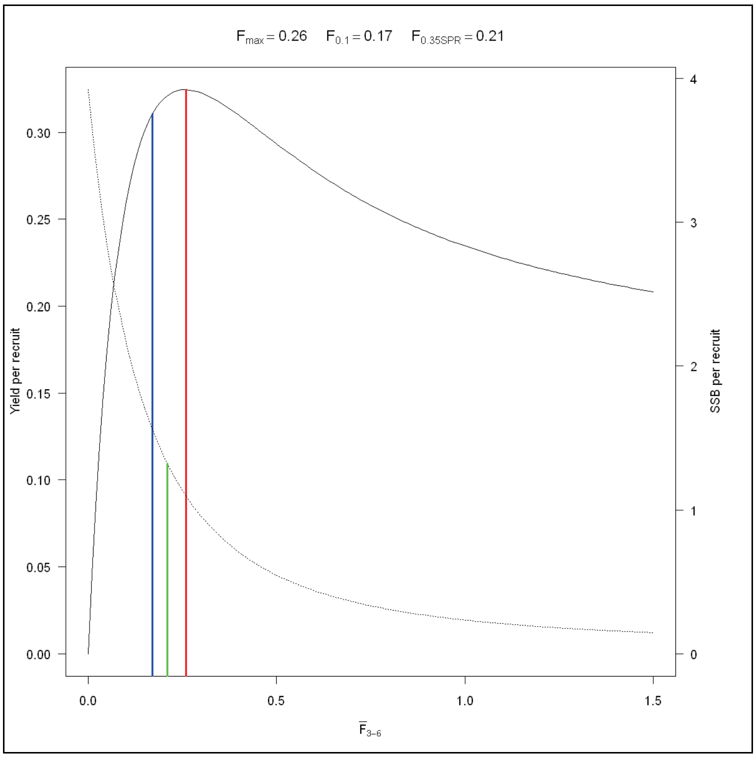


Figure 8.4.1.4 Cod in Subdivisions 22–24. Yield- and SSB-per-recruit plots. The vertical lines represent biological reference points (blue: $F_{0.1}$, green: $F_{0.35SPR}$, and red: F_{max}).

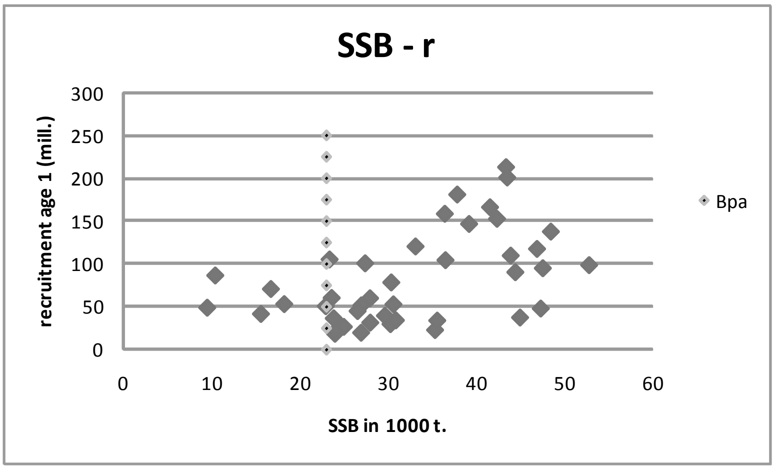


Figure 8.4.1.5 Cod in Subdivisions 22–24. Stock and recruitment plot.

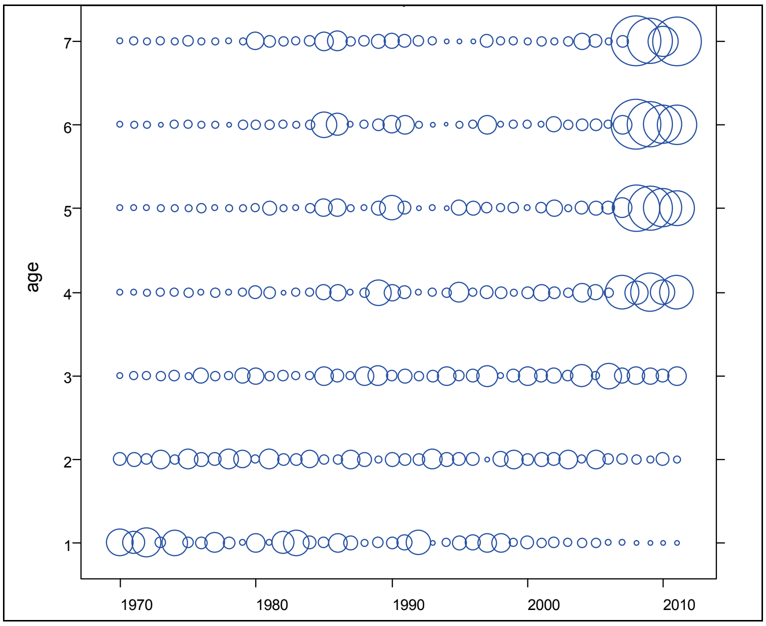


Figure 8.4.1.6 Cod in Subdivisions 22–24**.** Relative distribution of cod catches standardized by age and year. First every year is standardized to 1, and then the age group within a year is compared to the average of that age group. Larger bubbles for age groups 4–7 in the time frame 2007–2011 are overrepresented in the catches compared to the cohort in the same years.

Table 8.4.1.1 Cod in Subdivisions 22–24. ICES advice, management, and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1]	ICES Landings (22–24)	ICES 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 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	23	*
2007	Keep SSB at B_{pa}	< 20.5	26.7	24	*
2008	Rebuild SSB to B_{pa}	< 13.5	19.2	20	*
2009	Rebuild SSB to B_{pa}	< 13.7	16.3	15.3	
2010	Management plan	<17.7	17.7	14.1	
2011	See scenarios	-	18.8	16.3	
2012	Management plan	21.3	21.3		
2013	Management plan	20.8			

Weights in thousand tonnes. [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.
* Separate management for western and eastern Baltic cod since 2004.

Table 8.4.1.2 Cod in Subdivisions 22–24. Official and ICES landings (thousand tonnes) by country and area.

	Denmark		Finland	German Dem.Rep.[1]	Germany, FRG	Estonia		Lithuania	Latvia	Poland	Sweden		Total				
	23	22+24	24	22+24	22+24	22	24	24	24	24	23	24	22	23	24	Unalloc.	Total
1965		19457		9705	13350							2182	27867		17007		44874
1966		20500		8393	11448							2110	27864		14587		42451
1967		19181		10007	12884							1996	28875		15193		44068
1968		22593		12360	14815							2113	32911		18970		51881
1969		20602		7519	12717							1413	29082		13169		42251
1970		20085		7996	14589							1289	31363		12596		43959
1971		23715		8007	13482							1419	32119		14504		46623
1972		25645		9665	12313							1277	32808		16092		48900
1973		30595		8374	13733							1655	38237		16120		54357
1974		25782		8459	10393							1937	31326		15245		46571
1975		23481		6042	12912							1932	31867		12500		44367
1976	712	29446		4582	12893							1800	33368	712	15353		49433
1977	1166	27939		3448	11686						550	1516	29510	1716	15079		46305
1978	1177	19168		7085	10852						600	1730	24232	1777	14603		40612
1979	2029	23325		7594	9598						700	1800	26027	2729	16290		45046
1980	2425	23400		5580	6657						1300	2610	22881	3725	15366		41972
1981	1473	22654		11659	11260						900	5700	26340	2373	24933		53646
1982	1638	19138		10615	8060						140	7933	20971	1778	24775		47524
1983	1257	21961		9097	9260						120	6910	24478	1377	22750		48605
1984	1703	21909		8093	11548						228	6014	27058	1931	20506		49495
1985	1076	23024		5378	5523						263	4895	22063	1339	16757		40159
1986	748	16195		2998	2902						227	3622	11975	975	13742		26692
1987	1503	13460		4896	4256						137	4314	12105	1640	14821		28566
1988	1121	13185		4632	4217						155	5849	9680	1276	18203		29159
1989	636	8059		2144	2498						192	4987	5738	828	11950		18516
1990	722	8584		1629	3054						120	3671	5361	842	11577		17780

[1]Includes landings from October to December 1990 of Fed. Rep. Germany.

Table 8.4.1.2 cont.

	Denmark		Finland	German Dem.Rep.[2]	Germany, FRG	Estonia		Lithuania	Latvia	Poland	Sweden		Total				
	23	22+24	24	22+24	22+24	22	24	24	24	24	23	24	22	23	24	Unalloc.	Total
1991	1431	9383			2879						232	2768	7184	1663	7846		16693
1992	2449	9946			3656						290	1655	9887	2739	5370		17996
1993	1001	8666			4084						274	1675	7296	1275	7129	5528	21228
1994	1073	13831			4023						555	3711	8229	1628	13336	7502	30695
1995	2547	18762	132		9196				15		611	2632	16936	3158	13801		33895
1996	2999	27946	50		12018		50		32		1032	4418	21417	4031	23097	2300	50845
1997	1886	28887	11		9269		6			263	777	2525	21966	2663	18995		43624
1998	2467	19192	13		9722		8		13	623	607	1571	15093	3074	16049		34216
1999	2839	23074	116		13224		10		25	660	682	1525	20409	3521	18225		42155
2000	2451	19876	171		11572		5		84	926	698	2564	18934	3149	16264		38347
2001	2124	17446	191		10579		40		46	646	693	2479	14976	2817	16451		34244
2002	2055	11657	191		7322				71	782	354	1727	11968	2409	9781		24158
2003	1373	13275	59		6775				124	568	551	1899	9573	1925	13127		24624
2004	1927	11386			4651				221	538	393	1727	9091	2320	9430	13	20854
2005	1902	9867	2		7002	72	67		476	1093	720	835	8729	2621	10686	9	22045
2006	1899	9761	242		7516		91		586	801		1855	9979	1914	10858		22751
2007	2169	8975	220		6802		69		273	2371	534	2322	7840	2713	13183		23736
2008	1612	8582	159		5489		134		30	1361	525	2189	5687	2139	12256		20082
2009	567	7871	259		4020		194		23	529	269	1817	3451	839	11259		15549
2010	689	6849	203		4250			9	159	319	490	1151	3925	1179	9016		14120
2011[2]	783	7799	149		4521				24	487	414	2153	5493	1198	9641		16332

[2]Provisional data.

Table 8.4.1.3 Cod in Subdivisions 22–24. Summary of stock assessment (weights in tonnes). Recruits (age 1, in thousand), Low = 5% confidence limit, High = 95% confidence limit. $F_{3\text{–}6} = F_{bar}$ 3–6 years.

Year	Recruits	Low	High	TSB	Low	High	SSB	Low	High	F36	Low	High
1970	231422	135996	393808	105451	87964	126415	37873	32759	43786	0.906	0.757	1.085
1971	181498	107641	306030	113777	96121	134677	43391	37482	50231	1.019	0.872	1.191
1972	213844	130431	350600	109207	92721	128624	44445	38300	51576	1.139	0.974	1.332
1973	89859	55440	145647	105662	89584	124626	43521	37565	50421	1.035	0.887	1.207
1974	201793	123963	328489	97052	82464	114221	43915	37439	51510	1.176	1.015	1.363
1975	109426	67734	176780	93714	78722	111560	36498	31655	42080	1.169	1.01	1.354
1976	103881	64414	167530	94561	79636	112284	41523	34680	49716	1.254	1.081	1.454
1977	166542	103043	269170	80017	68146	93956	33057	28362	38531	1.202	1.023	1.411
1978	120211	74307	194471	85905	71682	102950	30607	26300	35621	0.925	0.779	1.099
1979	51948	31733	85042	87904	74057	104341	39222	33076	46511	0.87	0.734	1.032
1980	146679	90897	236693	83868	71616	98216	52839	44409	62869	0.966	0.826	1.129
1981	98223	60233	160175	90219	76514	106380	46864	40186	54651	1.097	0.934	1.289
1982	117125	72286	189780	87466	74662	102465	48533	40790	57746	0.965	0.819	1.136
1983	137448	84390	223865	86682	74247	101199	47335	40425	55426	0.958	0.816	1.124
1984	46864	28884	76036	79380	67668	93118	44981	38665	52330	0.983	0.84	1.15
1985	36316	22356	58991	70898	60946	82476	47524	40181	56210	1.238	1.074	1.428
1986	94466	58448	152680	44712	38733	51614	27889	23901	32543	1.414	1.212	1.649
1987	58924	36351	95513	55826	45959	67812	23933	20551	27871	1.087	0.93	1.27
1988	17123	10500	27924	48679	40913	57919	30242	25104	36432	1.041	0.891	1.215
1989	28481	17367	46708	37086	31743	43329	24959	21004	29659	1.129	0.976	1.305
1990	25261	15547	41043	31320	26846	36539	15508	13390	17961	1.314	1.146	1.506
1991	40498	25010	65576	19936	17289	22990	10305	8901	11931	1.512	1.306	1.751
1992	85905	52891	139528	22137	18411	26617	9399	8076	10940	1.279	1.107	1.478
1993	47810	28843	79251	38988	32060	47412	16649	13935	19891	1.141	0.974	1.338
1994	69913	45699	106955	59635	50135	70935	42362	35086	51146	0.825	0.683	0.998
1995	151297	101967	224493	60295	51963	69963	26876	22950	31474	0.974	0.832	1.141
1996	18356	11984	28115	72984	61980	85942	23295	20215	26844	1.157	1.003	1.334
1997	103881	70305	153491	62944	52972	74793	36388	30030	44093	1.417	1.223	1.642
1998	157157	105219	234732	59397	50771	69488	18160	15434	21368	1.132	0.977	1.313
1999	52000	35269	76668	60174	51302	70580	23553	20468	27103	1.266	1.101	1.455
2000	59160	40243	86970	49662	42943	57433	26930	23085	31416	1.224	1.064	1.407
2001	49961	32767	76177	47524	41251	54752	30303	26152	35112	1.239	1.076	1.426
2002	76957	52228	113394	40015	34801	46009	23933	20776	27568	1.2	1.035	1.39
2003	19885	13213	29924	44091	37771	51468	27337	23743	31475	1.015	0.869	1.184
2004	99211	66459	148103	44981	38553	52482	26503	22481	31243	1.093	0.942	1.267
2005	43739	29642	64541	48194	41121	56484	23790	20484	27628	1.063	0.9	1.255
2006	35383	23360	53594	50413	42909	59229	30884	26046	36622	0.738	0.612	0.889
2007	32794	21678	49611	55437	47678	64458	35454	30226	41587	0.707	0.591	0.846
2008	21465	14016	32874	40215	34684	46629	23086	19821	26890	0.725	0.588	0.895
2009	48825	32341	73712	48243	40713	57165	28339	23818	33718	0.604	0.468	0.779
2010	27255	17270	43015	46444	37970	56808	30001	24420	36859	0.443	0.327	0.599
2011	36938	21239	64241	47620	37359	60699	33523	25901	43390	0.42	0.296	0.596
2012	32241	10967	94786	55271	39202	77926	36279	25337	51946			

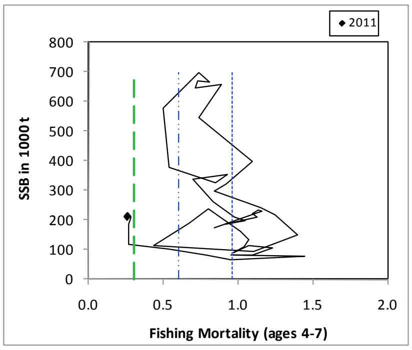
ECOREGION Baltic Sea
STOCK Cod in Subdivisions 25–32

Advice for 2013

ICES advises on the basis of the EU management plan (EC 1098/2007) that landings in 2013 should be 65 900 tonnes.

Stock status

F (Fishing Mortality)	2009	2010	2011
MSY (F_{MSY})	✓	✓	✓ Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓ Harvested sustainably
Management plan (F_{MGT})	✓	✓	✓ Below target
SSB (Spawning-Stock Biomass)	**2010**	**2011**	**2012**
MSY ($B_{trigger}$)	?	?	? Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	? Undefined
Qualitative evaluation	↗	↗	✓ Above poss. reference points



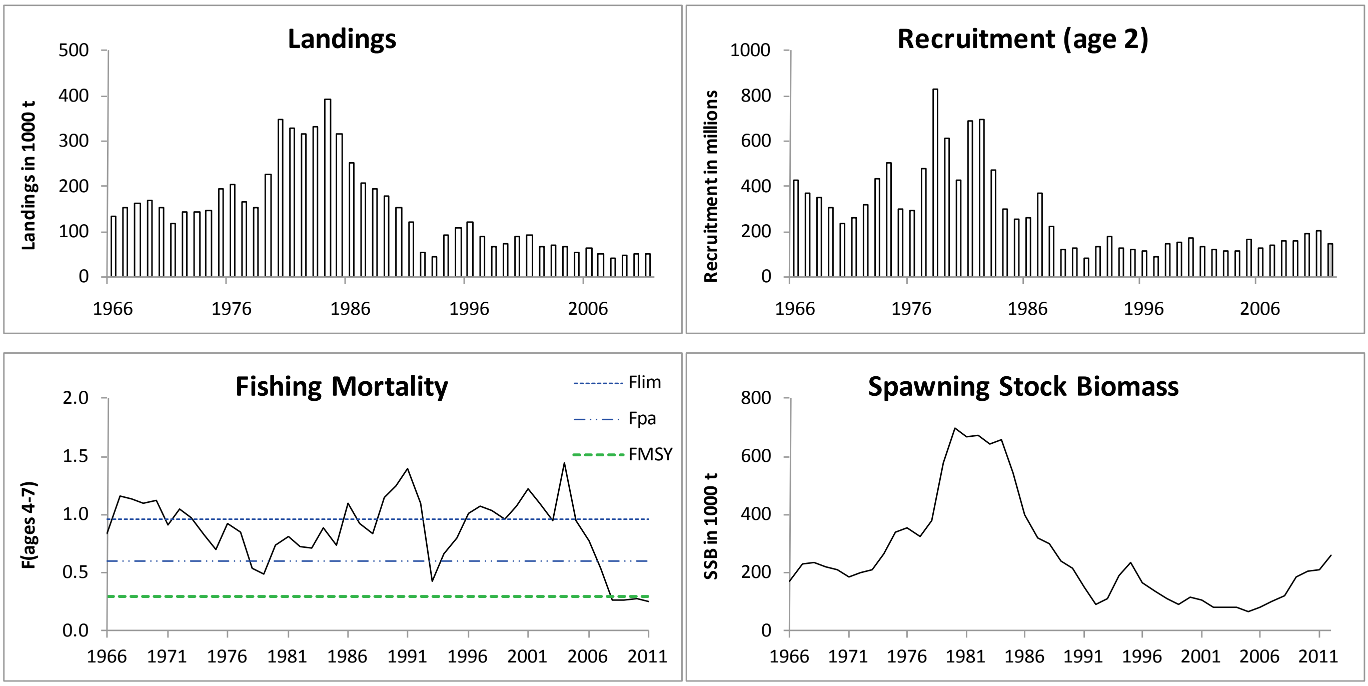


Figure 8.4.2.1 Cod in Subdivisions 25–32. Summary of stock assessment (weights in '000 tonnes). Predicted values are shaded. Top right: SSB and F for the time-series used in the assessment.

ICES considers the present SSB to be above any candidate precautionary biomass reference points. The SSB has increased in recent years and is estimated to be 263 000 tonnes at the start of 2012. Fishing mortality in 2008–2011 was estimated to be the lowest in the series. The abundance of the 2006, 2007, 2008, and 2009 year classes (at age 2) is above the average of the last 20 years.

Management plans

A multi-annual plan for cod in the Baltic Sea has been agreed by the EU in 2007 ((EC) No. 1098/2007). ICES has evaluated the management plan in 2009 and considers it to be in accordance with the precautionary approach. The target F in the management plan is equal to the recent estimate of F_{MSY} for this stock. The management plan is currently under revision.

Biology

Cod is the main predator on sprat and herring, and given the recent increase of the eastern Baltic cod stock the natural mortality of the pelagic stocks is likely to be affected. However, as the adult sprat and herring predate on cod eggs and larvae, an increased predation on clupeids can also have a positive effect on cod recruitment. At present, there is limited geographical overlap between cod and the pelagic stocks during parts of the year. Consistent with declining availability of sprat and herring and an increasing cod stock in the current main distribution area of cod (Subdivision 25), the mean weight of larger cod has sharply declined in this area in recent years.

Environmental influence on the stock

Recruitment is strongly driven by hydrological factors. At present, successful reproduction of the eastern Baltic cod occurs only in the Bornholm Basin (Subdivision 25). The distribution of cod is currently mainly confined to Subdivision 25 and to a lesser degree Subdivision 26, with very low abundance in northern areas (Subdivisions 27–32).

The fisheries

The fisheries for cod in the eastern Baltic have very little bycatch of other species.

Catch distribution	Total catch (2011) is 54.2 kt, where 93% are landings (20% by gillnetters, 80% by trawlers) and 7% discards.

Effects of the fisheries on the ecosystem

Because sprat and herring are the major prey for cod, the cod fishery can indirectly affect the sprat and herring stocks by changing predation mortality on these species. Furthermore, the fishery for sprat and herring in the distribution area of cod can influence the available food base for cod.

Quality considerations

The SBB has been consistently overestimated in the last three years. The longest survey series has a break in 2001 when the survey design was altered. The commercial fleet, on which the cpue index has been based, was subjected to a new quota regulation system prohibiting high-grading and aimed at improving selectivity of gears. Substantial underreporting of catches occurred in 1993–1996 and 2000–2007. In this situation, ICES has chosen to include estimates of non-reported landings in the assessment. These estimates are likely to be lower than the actual non-reported landings. Ageing problems are a concern for the quality of the assessment. Collection of cod stomach contents data would improve the basis for application of multispecies stock assessment models. Data are needed to quantify the amount of mixing of cod by age groups between the eastern and western Baltic. Tagging experiments or/and genetic analysis could provide such data.

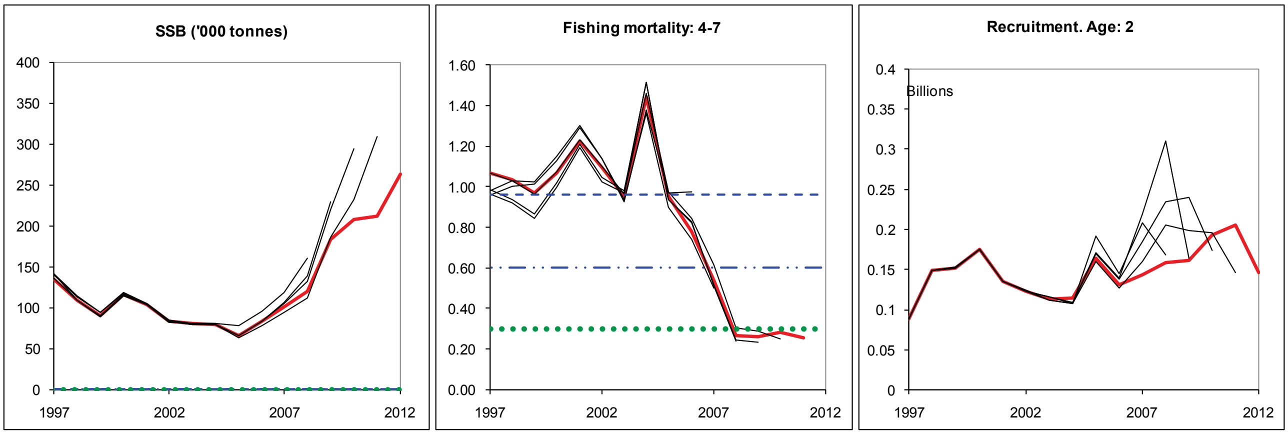


Figure 8.4.2.2 Cod in Subdivisions 25–32. Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical (XSA).
Input data	Two surveys (BITS Q1&4), five indices (two BITS Q1 of ages 3–6 backshifted, two BITS Q1_of age 2, and one commercial index (Den_Trawl_>90 mm)).
Discards and bycatch	Discards included in the assessment.
Indicators	None.
Other information	Last benchmarked in 2009. The next benchmarking for this stock is scheduled for 2013.
Working group report	WGBFAS

ECOREGION **Baltic Sea**
STOCK **Cod in Subdivisions 25–32**

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Undefined	
	F_{MSY}	0.30	Based on stochastic simulations.
Precautionary Approach	B_{lim}	Undefined	
	B_{pa}	Undefined	
	F_{lim}	0.96	F_{med} (estimated in 1998).
	F_{pa}	0.60	5th percentile of F_{med}.
Management Plan	SSB_{MGT}	Undefined	
	F_{MGT}	0.30	EU management plan based on stochastic simulations.

(unchanged since: 2010)

Outlook for 2013

Basis: F(2012) = F_{sq} = 0.27; SSB (2013) = 303; human consumption (HC) landings (2012) = 59.4; R(2012) = 147 million; Discards (2012) = 3.9.

Rationale	Human consumption landings (2013)	Basis	F Total (2013)	F HC (2013)	F Disk (2013)	Catch Total (2013)	Discards (2013)	SSB (2014)	%SSB change 1)	%TAC change 2)
Management plan	65.9	F_{MP}	0.30	0.27	0.02	69.9	4.0	313	+3	-11
MSY framework	65.9	F_{MSY}	0.30	0.27	0.02	69.9	4.0	313	+3	-11
Precautionary approach	118	$F_{PA} = F_{sq}$*2.22	0.60	0.55	0.05	125	7.1	239	-21	+59
Zero catch	0	F = 0	0	0	0	0	0	409	+35	-100
Other options	49.8	F_{sq} *0.8	0.22	0.2	0.02	52.7	2.9	336	+11	-33
	55.3	F_{sq} *09	0.24	0.22	0.02	58.6	3.3	328	+8	-25
	60.7	F_{sq} *1	0.27	0.25	0.02	64.3	3.6	321	+6	-18
	63.1	−15%TAC	0.28	0.26	0.02	66.8	3.7	317	+5	-15
	66.0	F_{sq} *1.1	0.29	0.27	0.02	69.9	3.9	313	+3	-11
	71.1	F_{sq} *1.2	0.32	0.3	0.02	75.3	4.2	306	+1	-4
	74.2	TAC change=0	0.34	0.31	0.03	78.6	4.4	301	-1	0
	76.2	F_{sq} *1.3	0.35	0.32	0.03	80.7	4.5	298	-2	+3
	81.1	F_{sq} *1.4	0.38	0.35	0.03	85.9	4.8	291	-4	+9
	85.3	+15%TAC	0.40	0.37	0.03	90.4	5.1	285	-6	+15
	85.8	F_{sq} *1.5	0.40	0.37	0.03	90.9	5.1	285	-6	+16

Weights in thousand tonnes.
1) SSB 2014 relative to SSB 2013.
2) Human consumption landings 2013 relative to TAC 2012.
Discard proportions in the projections were assumed to be the average proportions discarded per age in 2009–2011 (fishing pattern partitioned in landings and discards and taken as an average 2009–2011).

Management plan

Following the agreed EU Management plan implies fishing at an F of 0.3, which results in a TAC in 2013 of 65 900 tonnes. This is expected to lead to an increase in SSB to 313 000 tonnes in 2014.

MSY approach

As no MSY $B_{trigger}$ has been identified for this stock, the ICES MSY framework has been applied with F_{MSY} without consideration of SSB in relation to MSY $B_{trigger}$.

Following the ICES MSY framework implies fishing at an F of 0.30, resulting in landings of 65 900 tonnes in 2013. This is expected to lead to an SSB of 313 000 tonnes in 2014.

No transition is needed as F in 2011 is below F_{MSY}.

Precautionary approach

The fishing mortality of F_{pa} = 0.6 corresponds to landings of 118 000 tonnes in 2013. This is expected to reduce SSB to 239 000 tonnes in 2014.

Additional considerations

Management considerations

Following the management plan, F in 2012 is predicted to be at 0.27, which is 4% higher than F estimated for 2011. No direct effort reduction is required according to the management plan, as F in both 2011 and 2012 are estimated to be below the target F of 0.3. This leads to a discrepancy between available effort and catching opportunities. In addition the 2006, 2007, 2008, and 2009 year classes appear to be above the recent average. These factors may lead to an increased risk of highgrading and discarding. Since 2010, the management has prohibited high-grading and aimed at improving selectivity of gears to mitigate these risks. There are indications that discards of older age-groups of cod have increased in recent years.

STECF re-evaluated the management plan in 2011 (ICES, 2011), and considered that, within the historical stock sizes, an exploitation of the two Baltic cod stocks at target fishing mortalities of 0.33 is consistent with the objective of reaching MSY (by 2015 at the latest). If the stock size increases sufficiently that growth or recruitment is reduced, it may be necessary to increase the target fishing mortalities to obtain MSY. The harvest control rules of the present management plan were considered appropriate in defining the TACs. However, the simulations indicated that a 15% constraint on inter-annual variation in the TACs is not required to achieve the biological objectives. Although discards appear at present not to be a problem in relation to limiting fishing mortality, a management plan should include explicit rules for addressing discards. This could be implemented by defining the TAC as total allowable catch and by ensuring that all catches (landings as well as discards) are counted against the TAC.

During WKMULTBAL (ICES, 2012b) and STECF (2012) candidate multispecies F_{MSY} values were estimated, which were higher for cod than defined in the current single-species management plan. This is mainly due to cannibalism being taken into account in multispecies F_{MSY} estimates. The present distribution pattern implies that an increase in F on cod will not necessarily result in increasing Baltic wide clupeid stock sizes, and conversely a decrease in F on cod will not necessarily result in a decrease of the Baltic clupeid stock size if it is not accompanied by a cod expansion to northern areas. However, cod cannibalism will be higher, and slower cod growth due to food deprivation will be a bigger problem. On the other hand, a reduction of clupeid F in Subdivision 25 will likely improve growth and condition of cod as well as reduce cannibalism. An increase in clupeid F in northern areas (Subdivisions 27–32) will likely not have a negative effect on cod, since this will not affect the stock component distributed in southern areas (Subdivisions 25–26). Furthermore, a higher F on clupeids in northern areas would likely reduce density dependence and improve the growth and condition of clupeid stocks. The multispecies F_{MSY} (+ 0.60) is twice the single-species estimate of F_{MSY} (0.30). Increasing F on cod would not result in substantial increase in yield but would imply higher risks of low SSBs.

To optimize the growth potential and yield of cod, sprat, and herring, a spatially explicit management plan needs to be developed.

Regulations and their effects

The fishery is managed through TAC, effort, seasonal fisheries restrictions, and technical measures.

The Baltic cod management plan (EC Regulation 1098/2007) *inter alia* called for a reduction in fishing effort (10% annually in terms of number of fishing days per year) until the target F has been reached. The maximum number of fishing days for the Subdivisions 25–28.2 was fixed at 160 in 2010, and kept at 160 days in 2011 and 2012. In 2012, member states may allocate additional days absent from port to vessels if an equal amount of days absent from port is withdrawn from other vessels. The number of receiving vessels may not exceed 10% of the total number of vessels.

The provisions in the management plan (EC 1098/2007, Art 8 Para 5), however, would have allowed an increase in the days-at-sea to 192 in 2012 and to 224 in 2013 (days-at-sea $_{current\ year}$ x F_{target} / $F_{preceeding\ year}$).

The cod fisheries in the eastern Baltic are also regulated by a seasonal closure during 1 July to 31 August to protect spawning fish. A closure of a central part of the main spawning area in the Bornholm Deep has been implemented during the main spawning seasons since the mid-1990s for all fisheries. A year-round area closure for all fisheries in specific areas of the Bornholm Deep, the Gotland Basin, and the Gdansk Deep was introduced in 2005 aimed at reducing fishing mortality. Since 2006, area closures have been implemented from 1 May to 31 October.

Highgrading has been prohibited since 1 January 2010 in all Baltic Sea fisheries.

To decrease discards, a "Bacoma" codend with a 120 mm mesh was introduced by the International Baltic Sea Fisheries Commission (IBSFC) in 2001 in parallel with 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. This was expected to enhance the compliance and to be in better accordance with the minimum landing size, which was changed from 35 to 38 cm in the same year. On 1 March 2010 the "Bacoma" 120 mm was re-introduced along with an extended "Bacoma" window (5.5 m) to further decrease discarding, and the minimum landing size was kept at 38 cm.

Changes in fishing technology and fishing patterns

Cod in the eastern Baltic are taken primarily by trawlers and gillnetters. There was a substantial increase in the use of gillnets in the 1990s. In 2011, gillnet catches accounted for about 20% of the total catch.

Data and methods

The assessment is based on commercial landings and discards data, one commercial cpue index, and two survey indices. The longest survey series has a break in 2001 when the survey design was altered.

Substantial underreporting of catches occurred in 1993–1996, and also from 2000 to 2007. In this situation, ICES chose to include mis- and non-reported landings in the assessment. Estimates of the amount of misreporting are available from the national industries and control agencies, and indicated that total catches during 2000–2007 were about 32–45% higher than the reported figures. This information is highly uncertain and incomplete, and no data were available for some countries where misreporting was suspected to occur. ICES considers that, in 2008 and 2009, the enforcement of fishing control led to a significant reduction of non-reporting; the available information suggests that unreported landings in 2009 were only 6% of the reported landings. In 2010 and 2011 the unreported landings are assumed to be zero. Although the adjusted landings values in previous years derived by ICES are the best possible estimates, they are likely to be minimum estimates.

Discard data have been available since 1996 and are applied in the assessment as yearly proportions discarded per age-group. For 1966–1995, an average proportion discarded per age-group, estimated for 1996–2003, was applied. From 2004 onwards, annual estimates of discards have been derived from the biological sampling of catches. The season and area coverage of discard sampling still requires improvement. Due to changes in technical regulations (e.g. increase in minimum landing size, the introduction of different codend sizes, highgrading ban, and various fishery closures), discard rates have been variable.

The benchmark workshop in 2009 identified problems with the commercial tuning fleets (ICES, 2009). In the recent assessment the commercial tuning fleets have been revised and a new standardized Danish trawler tuning fleet is used as the only commercial index.

The analysis of the output of another alternative model (XSA) indicates that indices of cohort size from subsequent surveys produce lower estimates of survivors than the indices referring to younger ages of the cohorts. This contributes to retrospective overestimation of stock size by the XSA and may be related to survey catchability underestimated at younger ages and/or overestimated at older.

In the 2011 assessment, the mean weights-at-age for 2010 were taken as average mean weights-at-age in 2005–2009 because of the substantial decrease in mean weights, especially in Subdivision 25, about which the expert group was doubtful. Inspection of the DATRAS database and otolith re-reading revealed that the decrease in growth of Eastern cod is real. Taking this into account, the mean weights-at-age for both 2010 and 2011 were taken directly from the BITS survey (DATRAS database).

Information from the fishing industry

Some of the information on mis- and underreporting came from industry sources, indicating that the estimates used in the assessment are minimum values. However, from 2010 the mis- and underreporting has been negligible. Discards of juveniles increased in 2011 and 2012.

The increase in flatfish abundance interferes with the selectivity of the “Bacoma” codend, and discarding has increased in 2011 and 2012.

Uncertainties in assessment and forecast

Uncertainties in the assessment are mainly due to problems with underreporting, discarding, and age-reading.

Sampling for discards is insufficient and raising procedures have been problematic in the recent past. This led to revisions in this year’s assessment of the strength of incoming year classes. Predicted discards for 2012 are based on the average proportions discarded per age in 2009–2011. Relatively strong year classes are entering the fishery from 2010 onwards. This may lead to increased discarding of juveniles.

Large inconsistencies exist in age determinations for the eastern Baltic cod stock owing to the lack of clear growth rings in the otoliths. ICES attempted to resolve the inconsistencies in age determinations for this stock, but no consensus was reached on the age determinations. An EU-funded study initiated in 2007 (project DECODE) has taken a different approach to delivering validated aging data for the assessment, but this method is not fully validated from tagging studies.

Removals of cod in recreational fisheries in the Baltic are currently not consistently and completely sampled, and are therefore not included in the assessment.

Mixing of the eastern and western Baltic cod stocks is considered to have increased in recent years. This can introduce uncertainty and affect the quality of the assessment. This is a bigger problem for the western than for the eastern Baltic cod stock.

Environmental conditions

Cod distribution in the Baltic is affected by environmental conditions, specifically lack of oxygen. This is taken into account in the way the survey results are raised, assuming that no cod occur in oxygen-depleted areas. As a consequence, two (the Gotland and the Gdansk basins) out of three spawning areas have ceased to significantly contribute to the reproduction of the eastern Baltic cod. In recent years, even though the stock has substantially increased in Subdivision 25 and is apparently suffering from food limitation, there is no strong northwards expansion (Figure 8.4.2.5). This could potentially be related to continued poor hydrographic conditions in the northeastern areas of the Baltic Sea.

In the 2000s, salinity conditions have been reasonably good, which corresponds to relatively strong year classes formed since 2005. However, the estimates of reproductive volume have been variable by year.

Comparison with previous assessment and advice

The current perception of the status of the eastern Baltic cod stock in terms of trends is similar to that of the 2011 assessment (SSB has been increasing and F has been on relatively stable below F = 0.3 over the past 4 years). The estimate of SSB in 2011 has been revised downwards by 31% and the F in 2010 upwards by 13%.

The basis for the advice is the same as last year.

Sources

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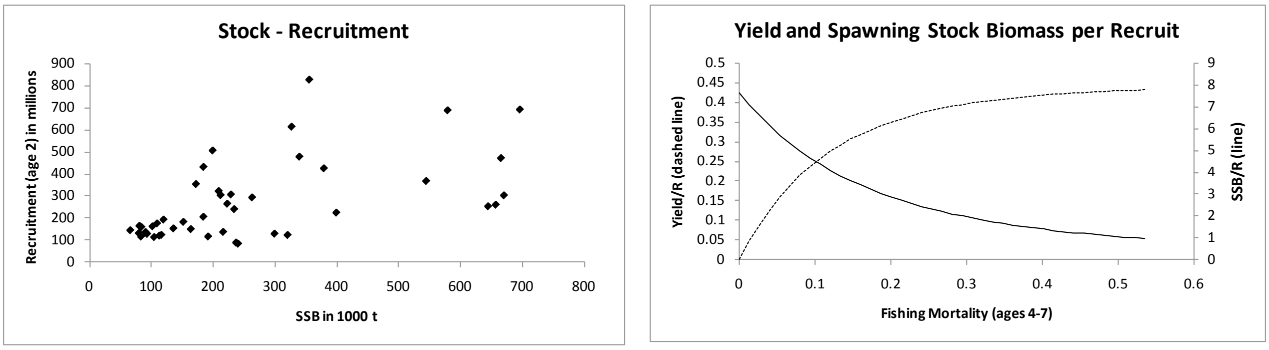


Figure 8.4.2.3 Cod in Subdivisions 25–32 (Baltic Sea). Stock–recruitment plot and yield-per-recruit analysis.

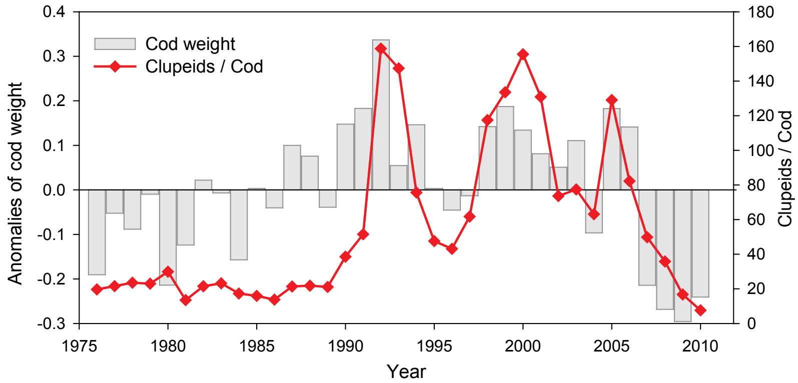


Figure 8.4.2.4 Cod in Subdivisions 25–32 (Baltic Sea). Anomalies in mean weight of cod (average of age-groups 4–7) in Subdivision 25 (bars) compared to changes in the biomass of clupeids (sprat plus herring) relative to the number of adult cod (at age 4 and older) in the same area (line).

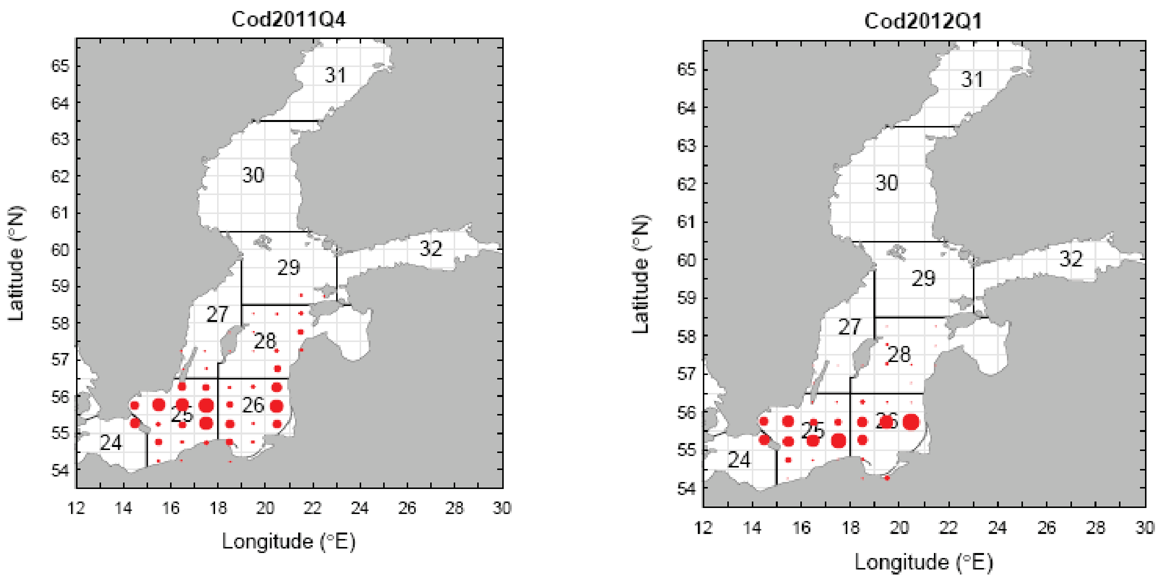


Figure 8.4.2.5 Cod in Subdivisions 25–32 (Baltic Sea). Distribution from bottom trawl surveys (BITS) during the 4th quarter 2011 and the 1st quarter 2012.

Table 8.4.2.1 Cod in Subdivisions 25–32. ICES advice, management, and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1]	ICES landings (25–32)	ICES landings (22–32)
1987	Reduce towards 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 F_{pa} (= 0.6)	88	126	73	115
2000	40% reduction in F from 96–98 level	60	105	89[2]	128
2001	Fishing mortality of 0.30	39	105	91[2]	126
2002	No fishing	0	76	68[2]	92
2003	70% reduction in F	See option table	75	69[2]	94
2004	90% reduction in F	< 13.0	45.4	68[2]	*
2005	No fishing	0	42.8	55[2]	*
2006	Develop Management plan	< 14.9	49.2	66[2]	*
2007	No fishing	0	44.3	51[2]	*
2008	No fishing	0	42.3[3]	42[2]	*
2009	Limit (total) landings to 48 600 t	≤ 48.6	49.38[3]	48[2]	*
2010	Follow management plan	56.8	56.1[3]	50	*
2011	See scenarios	-	64.5[3]	50	*
2012	Follow management plan	74.2	74.2[3]		
2013	Follow management plan	65.9			

Weights in thousand tonnes.
[1] For total Baltic until and including 2003.
[2] The reported landings in 1992–1995 and 2000–2009 are likely to be minimum estimates due to incomplete reporting.
[3] TAC is calculated as EU + Russian autonomous quotas.
* Separate management for western and eastern Baltic cod since 2004.

Table 8.4.2.2 Cod in Subdivisions 25–32. Total landings (tonnes) 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	35 313		23	10 680	15 713			41 498		21 705	22 420				147 352
1966	37 070		26	10 589	12 831			56 007		22 525	38 270				177 318
1967	39 105		27	21 027	12 941			56 003		23 363	42 980				195 446
1968	44 109		70	24 478	16 833			63 245		24 008	43 610				216 353
1969	44 061		58	25 979	17 432			60 749		22 301	41 580				212 160
1970	42 392		70	18 099	19 444			68 440		17 756	32 250				198 451
1971	46 831		53	10 977	16 248			54 151		15 670	20 910				164 840
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			120 901		37 730	87 746	2 765			331 642
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		18 978	50 711
1994	9 901	952	594		3 056	2 831	1 887	14 335	1 257	21 264		779		44 000	100 856
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	10 815	124 189
1997	9 776	1 414	1 536		5 215	6 187	4 601	31 396	2 803	25 072		600			88 600
1998	7 818	1 188	1 026		1 270	7 765	4 176	25 155	4 599	14 431					67 428
1999	12 170	1 052	1 456		2 215	6 889	4 371	25 920	5 202	13 720					72 995
2000	9 715	604	1 648		1 508	6 196	5 165	21 194	4 231	15 910				23 118	89 289
2001	9 580	765	1 526		2 159	6 252	3 137	21 346	5 032	17 854				23 677	91 328
2002	7 831	37	1 526		1 445	4 796	3 137	15 106	3 793	12 507				17 562	67 740
2003	7 655	591	1 092		1 354	3 493	2 767	15 374	3 707	11 297				22 147	69 476
2004	7 394	1 192	859		2 659	4 835	2 041	14 582	3 410	12 043				19 563	68 578
2005	7 270	833	278		2 339	3 513	2 988	11 669	3 411	7 740				14 991	55 032
2006	9 766	616	427		2 025	3 980	3 200	14 290	3 719	9 672				17 836	65 532
2007	7 280	877	615		1 529	3 996	2 486	8 599	3 383	9 660				12 418	50 843
2008	7 374	841	670		2 341	3 990	2 835	8 721	3 888	8 901				2 673	42 235
2009	8 295	623			3 665	4 588	2 789	10 625	4 482	10 182				3 189	48 439
2010	10 739	796	826		3 908	5 001	3 140	11 433	4 264	10 169					50 277
2011[1]	10842	1180	958		3054	4916	3017	11348	5022	10031					50 368

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

[3]Working group estimates. No information available for years prior to 1993.

[4] For 1997 landings not officially reported, estimated by the WG.

Table 8.4.2.3 Cod in Subdivisions 25–32. Summary of stock assessment (weights in tonnes).

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	DISCARDS	YIELD/SSB	FBAR 4–7
1966	430264	355416	172018	134867	8735	0.7840	0.8370
1967	370921	436280	228679	152378	11733	0.6663	1.1587
1968	354063	422232	233958	164472	9700	0.7030	1.1303
1969	306727	395953	222659	169909	10654	0.7631	1.0962
1970	240011	351666	208842	154492	7625	0.7398	1.1241
1971	264787	314516	184181	118217	5426	0.6419	0.9133
1972	322278	350280	198996	143833	8490	0.7228	1.0434
1973	432140	394362	211991	143164	7491	0.6753	0.9732
1974	506893	500395	262952	147815	7933	0.5621	0.8311
1975	303683	575916	339545	194649	9576	0.5733	0.6955
1976	293397	535740	355564	203303	4341	0.5718	0.9261
1977	479002	533503	326914	164792	2978	0.5041	0.8440
1978	829398	712485	379201	154009	9875	0.4061	0.5358
1979	615355	983040	579671	227699	14576	0.3928	0.4952
1980	425886	1026484	696743	347619	8544	0.4989	0.7342
1981	689813	984216	666132	330742	6185	0.4965	0.8091
1982	693590	1057369	670941	316052	11548	0.4711	0.7301
1983	472374	1003058	645258	332148	10998	0.5148	0.7124
1984	302921	920299	657667	391952	8521	0.5960	0.8896
1985	253078	737751	544911	315083	8199	0.5782	0.7334
1986	260214	547640	399371	252558	3848	0.6324	1.0936
1987	368090	492367	320470	207081	9340	0.6462	0.9196
1988	224301	462420	299274	194787	7253	0.6509	0.8400
1989	122489	352911	240274	179178	3462	0.7457	1.1478
1990	128378	271623	216027	153546	4187	0.7108	1.2432
1991	82753	193206	151596	122517	2741	0.8082	1.3958
1992	136367	133380	92879	54882	1904	0.5909	1.1003
1993	181970	172116	112719	45188	1558	0.4009	0.4321
1994	127237	265878	191724	93380	1956	0.4871	0.6682
1995	119563	311250	236986	107712	1872	0.4545	0.7965
1996	115525	224231	163717	121877	1443	0.7444	1.0142
1997	88060	195386	135486	88600	3462	0.6539	1.0690
1998	149188	175399	109014	67429	2299	0.6185	1.0341
1999	152334	180222	90246	72989	1838	0.8088	0.9672
2000	174950	214697	115928	89168	6019	0.7692	1.0704
2001	135774	171083	104229	91325	2891	0.8762	1.2262
2002	122472	140633	83094	67740	1462	0.8152	1.0947
2003	112745	135937	80394	71386	2024	0.8880	0.9526
2004	115077	131965	79488	67768	1201	0.8526	1.4457
2005	164235	122556	65577	55254	1670	0.8426	0.9534
2006	131041	154782	83503	65532	4644	0.7848	0.7801
2007	143846	161596	101652	50843	4146	0.5002	0.5397
2008	158464	182676	119417	42235	3746	0.3537	0.2656
2009	161770	272265	184040	48439	3328	0.2632	0.2625
2010	192503	279955	208152	50277	3543	0.2415	0.2826
2011	205390	290523	211344	50368	3850	0.2383	0.2571
2012	146965*		262701				
Arith. Mean	275246	409297	260509	148245	5626	0.6139	0.871
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)		

*Output from recruitment prediction model (RCT3) using BITS survey (2001–2012).

ECOREGION **Baltic Sea**
STOCK **Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners**

This stock has now been moved to Book 6 North Sea (Section 6.4.15)

ECOREGION Baltic Sea

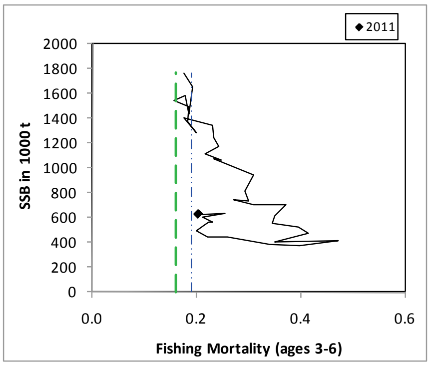
STOCK Herring in Subdivisions 25–29 and 32 (excluding Gulf of Riga herring)

Advice for 2013

ICES advises on the basis of the transition to the MSY approach that catches in 2013 should be no more than 117 000 tonnes.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✗	✗	✗	Harvested unsustainably
SSB (Spawning-Stock Biomass)	**2010**	**2011**	**2012**	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined
Qualitative evaluation	→	→	→	Stable but low biomass



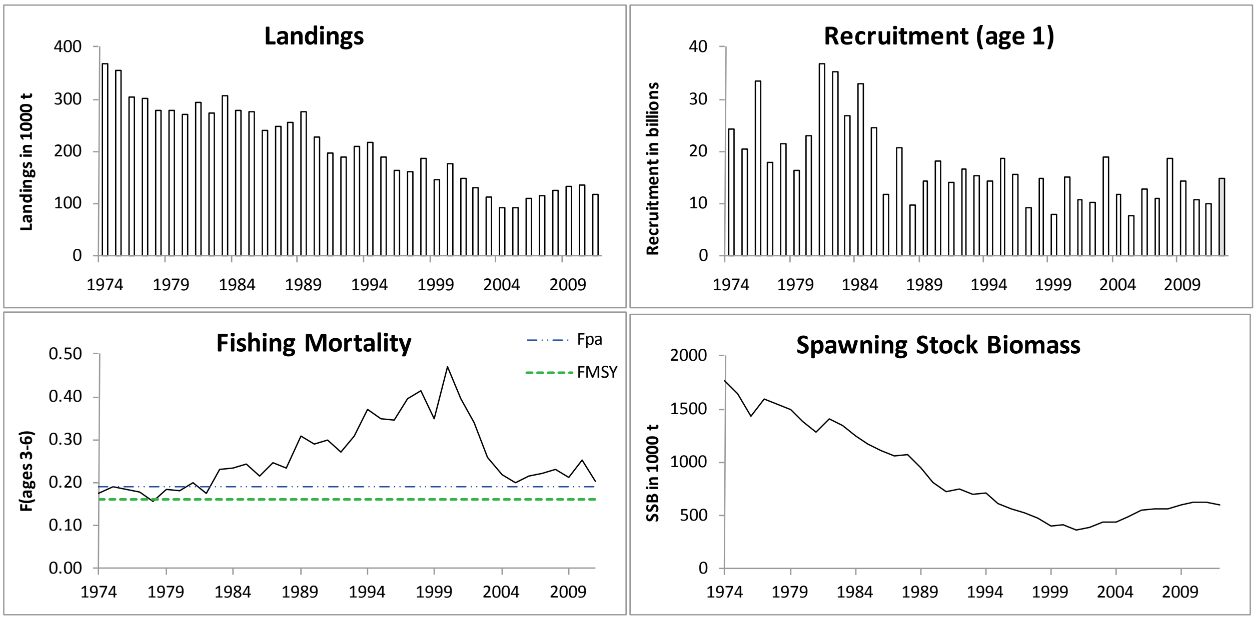


Figure 8.4.4.1 Herring in Subdivisions 25–29 and 32 (excluding Gulf of Riga herring). Summary of stock assessment (SSB and recruitment in 2012 predicted). Top right: SSB and F for the time-series used in the assessment.

SSB in 2011 (628 000 t) was 70% of the long-term (1974–2011) average. Fishing mortality has been above F_{pa} and F_{MSY} since the beginning of the 1980s. The last stronger year classes were the 2002 and 2007 year classes. Both year classes are, however, just above the long-term average.

Management plans

No specific management objectives are known to ICES.

Biology

Herring biomass is dependent on the cod stock through predator–prey interactions, and on sprat through competition. Regional differences in growth rate result in a high proportion of small individuals in the north (Subdivisions 28.2, 29, and 32) and large individuals in the south (Subdivisions 25 and 26). The strong increase in sprat stock size since the early 1990s in the northern areas (Subdivisions 27–29 and 32) exacerbated the inter-specific competition and the decrease in herring weight-at-age especially in these northern areas. Herring mean weights have stabilized since the late 1990s, but remain low.

Environmental influence on the stock

The decline in SSB of Central Baltic herring was partly caused by a reduction in mean weights-at-age. Growth rate tends to change due to salinity variations, changes in zooplankton (prey) community, and competition with the Baltic sprat, i.e. density-dependent effect.

Recently, a strong increase of cod has occurred in the southern Baltic (mainly in Subdivision 25 and, to a lesser degree in Subdivision 26), whereas in the northern areas (Subdivisions 27–32) no significant increase has been noticed. The increase of cod in Subdivision 25 might have a significant effect on herring in this area, but very limited effect on the whole central Baltic herring population.

The fisheries

The pelagic fisheries take a mixture of herring and sprat and this causes uncertainties in the catch of each species. The extent to which species misreporting has occurred is not well known. Since 2006 the restrictions on unsorted landings, including EU member states obligation to ensure adequate sampling, may have improved the accuracy of estimating proportions of sprat and herring in the catches.

Catch distribution	Total landings (2011) are 117 kt. Discards are considered to be low.

Effects of the fisheries on the ecosystem

As both herring and sprat are the major prey of cod, the mixed pelagic fishery can indirectly affect the cod stock.

Quality considerations

There are uncertainties related to mixed landings of herring and sprat. It would be beneficial to have a higher sampling coverage of the species composition of the small-mesh industrial fisheries targeting sprat in Subdivisions 27–29 and 32 to decrease the potential uncertainty. The overall biological sampling (length and age data) seems to be sufficient. However, for Germany it is difficult to monitor the national fishing activities since a larger part of the herring/sprat catches are landed in foreign ports.

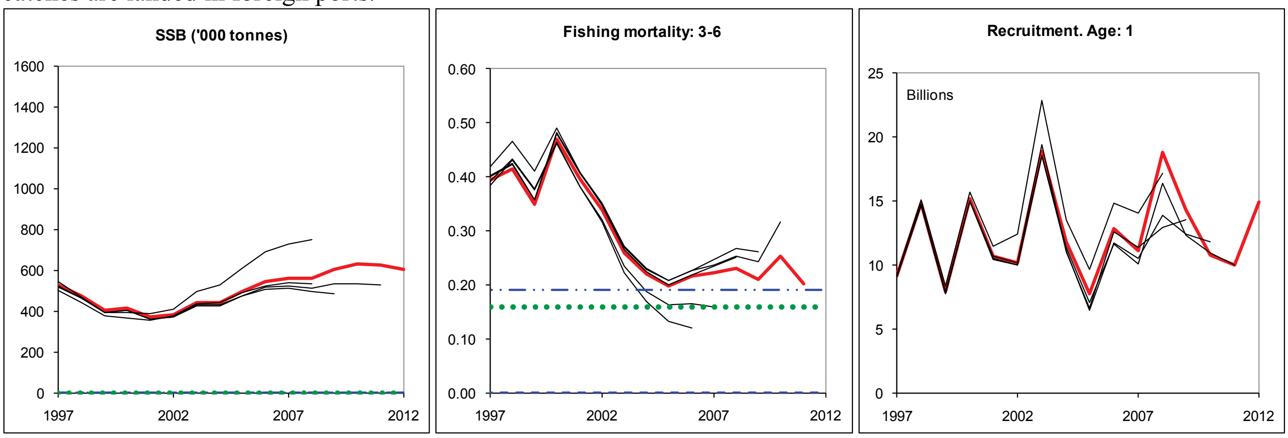


Figure 8.4.4.2 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Historical performance of the assessments. F_{pa} and F_{MSY} are indicated as horizontal lines in the middle panel.

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	One acoustic survey index (BIAS) and catch-at-age data.
Discards and bycatch	Discards are not included, but are considered to be low. The bycatch of sprat and juvenile cod is unknown.
Indicators	None.
Other information	The latest benchmark was performed in 2004. A new benchmark is planned for 2013.
Working group report	WGBFAS

ECOREGION Baltic Sea
STOCK Herring in Subdivisions 25–29 and 32 (excluding Gulf of Riga herring)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	not defined	
	F_{MSY}	0.16	Based on stochastic simulations and long-term deterministic simulations (ICES, 2011).
Precautionary Approach	B_{lim}	not defined	
	B_{pa}	not defined	
	F_{lim}	not defined	
	F_{pa}	0.19*	F_{med} (assessment 2000).

(F_{MSY} changed in 2011)

* Simulations (see Section 8.3.3.1 in ICES, 2009) indicate that the F_{pa} needs revision.

Outlook for 2013

Basis: F_{2012} = TAC constraint = 0.156; SSB (2012) = 604; Recruitment (age 1 in 2012) = 14.9 billion; Catches (2012) = 93.

Rationale	**Catches (2013)**	**Basis**	**F (2013)**	**SSB (2013)**	**SSB (2014)**	**%SSB change[1)]**	**%TAC change[2)]**
MSY framework	99	F_{MSY}	0.16	641	666	+4%	+7%
MSY transition	117	F_{pa}	0.19	635	645	+2%	+25%
Precautionary approach	117	F_{pa}	0.19	635	645	+2%	+25%
Zero catch	0	F = 0	0.00	675	794	+18%	-100%
Status quo	79	−15%TAC (F_{sq} *0.56)	0.13	648	692	+7%	-15%
	93	0%TAC (F_{sq} *0.67)	0.15	643	674	+5%	0%
	107	+15%TAC (F_{sq} *0.78)	0.17	638	657	+3%	+15%
	122	F_{sq} *0.9	0.20	632	638	+1%	+31%
	135	F_{sq} *1	0.22	628	623	-1%	+44%
	146	F_{sq} *1.1	0.24	623	609	-2%	+57%
	158	F_{sq} *1.2	0.27	619	595	-4%	+70%
	170	F_{sq} *1.3	0.29	614	581	-5%	+82%
	181	F_{sq} *1.4	0.31	610	568	-7%	+94%

Weights in thousand tonnes.
[1)] SSB 2014 relative to SSB 2013.
[2)] Catches 2013 relative to TAC 2012 (EU 78 417 t + EU/Russia 14 900 t).

MSY approach

As no MSY $B_{trigger}$ has been identified for this stock, the ICES MSY framework has been applied with F_{MSY} without considering SSB in relation to MSY $B_{trigger}$.

Following the ICES MSY framework implies fishing at F = 0.16, corresponding to catches of less than 99 000 tonnes in 2013. This is expected to lead to an SSB of 666 000 tonnes in 2014.

Following the ICES transition to the MSY framework implies a fishing mortality of 0.22 (F_{2010}*0.4+F_{MSY}*0.6), which is higher than F_{pa} = 0.19. Therefore, F_{pa} is used as the basis for advice, resulting in catches of less than 117 000 tonnes in 2013. This is expected to lead to an SSB of 645 000 tonnes in 2014.

Precautionary approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to catches of less than 117 000 tonnes in 2013. This is expected to lead to an SSB of 645 000 tonnes in 2014.

Additional considerations

Management considerations

Most pelagic fisheries in the Baltic take a mixture of herring and sprat and this contributes to uncertainties in the actual catch. All passive gears and purse seiners, which are directed for human consumption, can be regarded as an almost clean herring fishery. Only the pelagic trawl fishery takes a mixture of herring and sprat. The landings figures taken in small-mesh (minimum mesh size >16 mm) industrial trawl fisheries, which are directed to catch sprat, can be considered as the most uncertain ones.

The reported landings have been well below the TAC in the period 1992–2002; since then the reported landings have increased and the TAC was fully taken in 2010 and in 2011. This may have resulted in an incentive for misreporting of herring as sprat. However, the extent to which species misreporting has occurred is not well known. From 2005 onwards, EU vessels operating in the sprat and herring fishery have not been allowed to land unsorted catches, unless there is a proper sampling scheme to monitor species composition. This is thought to have led to a reduction in the amount of species misreporting.

The mean weights-at-age for this stock have decreased during 1980–1998 (Figure 8.4.4.4) after which the weights fluctuated without clear trend. The decrease in weight-at-age has been relatively more pronounced in the northern areas (Subdivisions 27–29) where the sprat stock has been concentrated since the beginning of the 1990s. This could result from inter-specific density-dependent effects.

The herring stock is affected by cod predation. However, the present species distribution pattern implies that an increase in F on cod will not necessarily result in Baltic-wide positive effects on herring stock size. Conversely, a decrease in F on cod will not necessarily result in a negative impact on the herring stock size if it is not accompanied by a cod expansion into northern areas.

An increase in herring F in the northern areas (Subdivisions 27–29 and 32) will not have a negative effect on cod, given that this will not affect the cod stock that is now mainly distributed in southern areas (Subdivisions 25–26). On the other hand, a reduction of herring F in Subdivision 25 will likely improve the growth and condition of cod, as well as reducing cod cannibalism in this area.

An increase in sprat F in the northern areas (Subdivisions 27–32), where the sprat stock is currently mainly concentrated, would be potentially beneficial for herring weights-at-age by releasing density dependence.

Preliminary investigations indicate that western Baltic spring-spawning herring (WBSSH, Division IIIa and Subdivisions 22–24) and central Baltic herring (CBH) are mixing in Subdivisions 24–26. The degree of mixing will be explored during the next benchmark assessment of WBSSH and CBH in 2013.

A mixture of central Baltic herring (Subdivisions 25–27, 28.2, 29, and 32) and the Gulf of Riga (Subdivision 28.1) herring is caught in Subdivisions 28.1 and 28.2. All catches of the central Baltic herring stock, taken both in as well as outside the central Baltic Sea, are considered in the assessment and the advice. The TAC is set for herring caught in Subdivisions 25–27, 28.2, 29, and 32, which includes a small percentage of Gulf of Riga herring caught in Subdivision 28.2 but does not include central Baltic herring taken in the Gulf of Riga. The fraction of herring caught outside the stock area should be taken into account when setting the TAC. In the past five years, the average annual catch of:

- Central Baltic herring taken in Subdivision 28.1 (Gulf of Riga) was 4600 t (4.0% of total catches of central Baltic herring);
- Gulf of Riga herring taken in Subdivision 28.2 was 160 t (less than 0.2% of the catches of herring in the central Baltic).

In 2004 the management areas for herring in the Baltic were revised to coincide with the stock definition used in the assessment.

To optimize the growth potential and yield of cod, sprat, and herring, a spatially explicit management plan needs to be developed.

Scientific basis

Data and methods

The assessment is based on catch data and on an international acoustic survey. Natural mortality (M) is derived from a multispecies model that was last updated in 2006, and takes cod predation into account. To account for the increase of the cod stock in recent years, M for 2006–2011 was taken from a regression of M fitted against eastern cod SSB. Recruitment estimates for forecasts are based on the acoustic survey. Catches of central Baltic spring-spawning herring taken in the Gulf of Riga are included in the assessment.

Uncertainties in assessment and forecast

The quality of the assessment is acceptable and can be used for the calculation of forecasts. However, there are uncertainties with the catch data due to problems estimating the catch composition in the mixed landings of herring and sprat.

Herring in the central Baltic is composed of a number of local populations differing in biological parameters and population dynamics. Among other factors recruitment success for the separate populations influences the future mean weight-at-age of the stock. Separate trial assessments for different populations conducted earlier, however, showed only a limited impact of this complex stock structure on the perception of the overall stock dynamics.

Comparison with previous assessment and advice

In comparison to the 2011 advice the updated assessment this year shows a decline of 20% in the estimated fishing mortality and 18% increase for the SSB in 2010.

The basis for the advice is the same as last year.

Sources

ICES. 2009. Report of the ICES Advisory Committee, 2009. ICES Advice, 2009. Book 8. 132 pp.

ICES. 2011. Report of the Baltic Fisheries Assessment Working Group. ICES Headquarters, Copenhagen, 12–19 April 2011. ICES CM 2011/ACOM:10.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group. ICES Headquarters, Copenhagen, 12–19 April 2012. ICES CM 2012/ACOM:10.

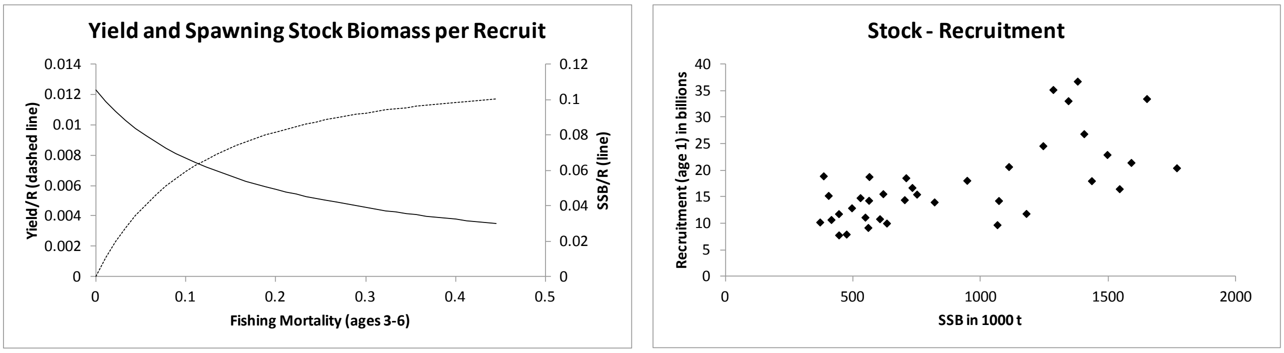


Figure 8.4.4.3 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Yield-per-recruit analysis (left panel) and stock–recruitment plot (right panel).

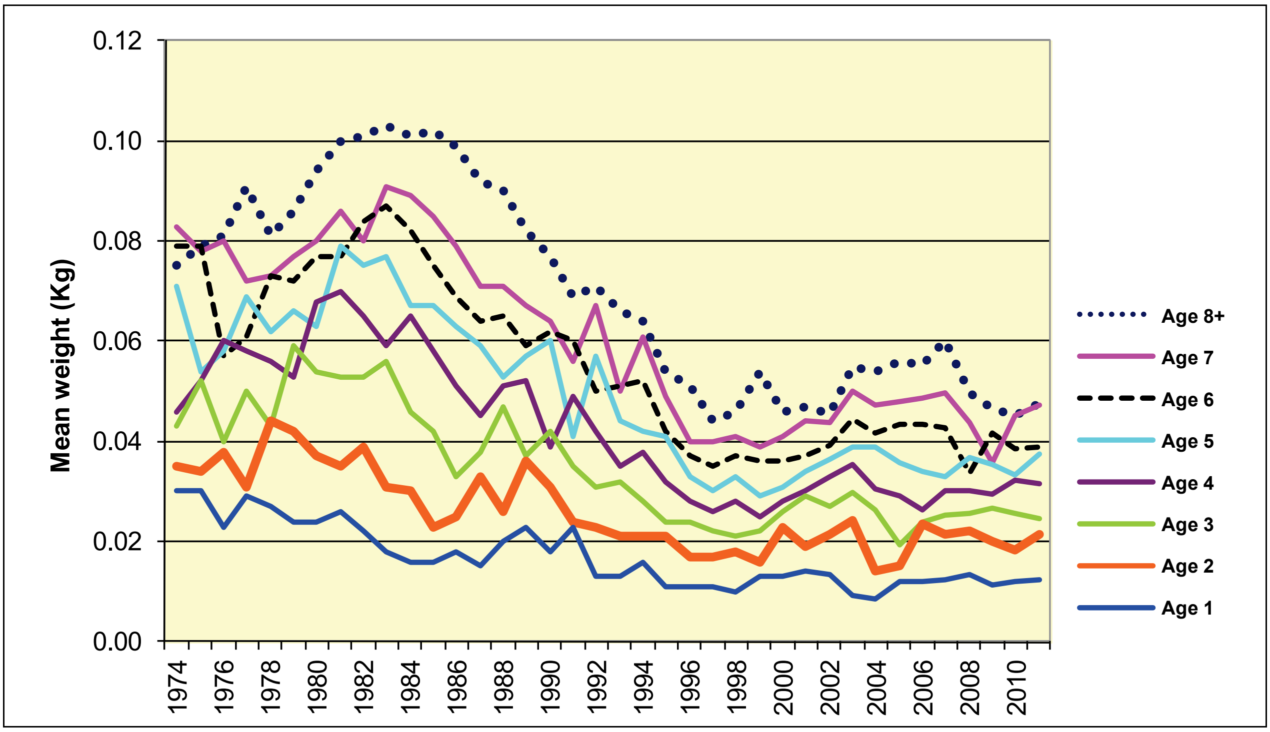


Figure 8.4.4.4 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Trends in the mean weights-at-age (kg) in the catch.

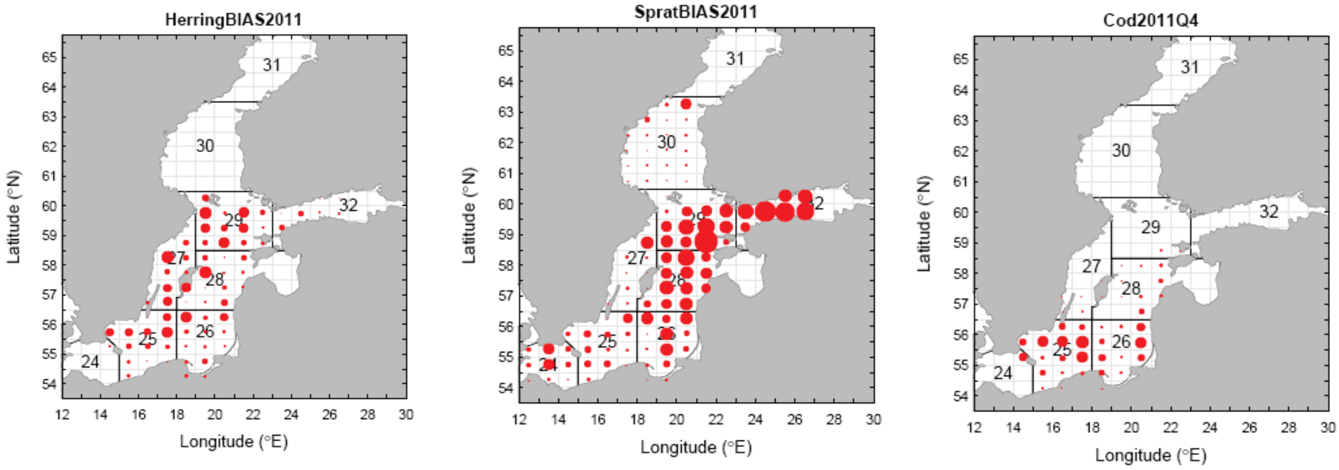


Figure 8.4.4.5 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Distribution of central Baltic herring (Subdivisions 25–29 and 32, excl. GoR, left panel), Baltic Sea sprat (Subdivisions 22–32, central panel), and eastern Baltic cod (Subdivisions 25–32, right panel) from acoustic surveys (BIAS, herring and sprat) and bottom trawl surveys (BITS, cod) in the 4th quarter.

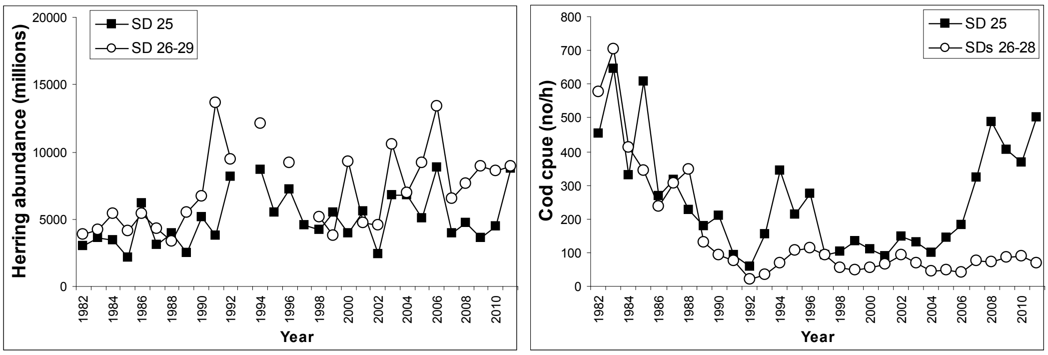


Figure 8.4.4.6 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Trends of average herring abundance (left panel) and cod cpue in the southwest (Subdivision 25) and northeast (Subdivisions 26–29, right panel), respectively from acoustic and BITS surveys.

Table 8.4.4.1 Herring in Subdivisions 25–29 and 32 (excluding Gulf of Riga herring). ICES advice, management, and official landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1]	Official landings		
				22–24	25–29+32	Total
1988[4]		204	399	99	286	385
1989[4]		176	399	95	290	385
1990[4]		112	399	78	244	322
1991[4]	TAC for entire area	293	402	70	213	283
1992[4]	F near present level	343	402	85	210	295
1993[4]	Increase in yield at higher F	371	560	81	231	312
1994[4]	Increase in yield at higher F	317–463	560	66	242	308
1995[4]	TAC	394	560	74	221	295
1996[4]	TAC	394	560	58	195	253
1997[4]	No advice	-	560	67	208	276
1998[4]	No advice	-	560	51	212	263
1999[4]	Proposed $F_{pa\,=}$ (0.17)	117	476	50	178	228
2000[4]	Proposed $F_{pa\,=}$ (0.17)	95	405	54	208	262
2001[4]	Proposed $F_{pa\,=}$ (0.17)	60	300	64	188	252
2002[4]	$F < F_{pa}$	<73	Not agreed	53	168	221
2003	$F < F_{pa}$	<72	143	41	154	195
2004	$F < F_{pa}$	<80	171	**	93*	
2005	$F < F_{pa}$ (single-stock exploitation boundaries)	<130	130[2]	**	92*	
2006	$F < F_{pa}$ (single-stock exploitation boundaries)	<120	128[2]	**	110*	
2007	$F < F_{pa}$ (single-stock exploitation boundaries)	<164	133[3]	**	116*	
2008	$F < F_{pa}$ (single-stock exploitation boundaries)	<194	153[3]	**	126*	
2009	$F < F_{pa}$ (single-stock exploitation boundaries)	<147	144[3]	**	132*	
2010	$F < F_{pa}$ (single-stock exploitation boundaries)	<103	126[3]	**	137*	
2011	MSY Framework (F = 0.19)	< 95	107[3]	**	117*	
2012	MSY transition ($F = F_{pa} = 0.19$)	< 92	78[3]			
2013	MSY transition ($F = F_{pa} = 0.19$)	< 117				

Weights in thousand tonnes.
[1] TAC for Subdivisions 22–29S and 32.
[2] TAC for Subdivisions 25–28(2), 29, and 32.
[3] EU quota for Subdivisions 25–28(2), 29, and 32.
[4] 1987–2002 incl. Gulf of Riga herring.
* Excl. GoR (Subdivision 28.1).
** Separate management since 2004.

Table 8.4.4.2 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Official landings ('000 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
2006	0.1	13.4	9.6	3.2	3.0	1.2	16.8	7.6	55.3	110.4
2007	1.4	14.0	13.9	1.7	3.2	3.5	19.8	8.8	49.9	116.0
2008	1.2	21.6	19.1	3.4	3.5	1.7	13.3	8.6	53.7	126.2
2009	1.5	19.9	23.3	1.3	4.1	3.6	18.4	***11.8	50.2	134.1
2010	5.4	17.9	21.6	2.2	3.9	1.5	25.0	9	50.0	136.7
2011*	1.8	14.9	19.2	2.7	3.4	2.0	28.0	8.5	36.2	116.8

* Preliminary.
** In 1977–1990 sum of catches for Estonia, Latvia, Lithuania, and Russia.
*** Updated in 2011.

Table 8.4.4.3 Herring in Subdivisions 25 to 29 and 32, excluding the Gulf of Riga. Summary of stock assessment (weights in tonnes).

Year	Recruitment Age 1 thousands	SSB* tonnes	Landings tonnes	Mean F Ages 3–6
1974	24353882	1768238	368652	0.1759
1975	20427920	1650878	354851	0.1921
1976	33471388	1434874	305420	0.1850
1977	17994640	1589773	301952	0.1782
1978	21432602	1543964	278966	0.1558
1979	16484494	1495911	278182	0.1843
1980	22927592	1379454	270282	0.1828
1981	36753320	1283970	293615	0.2001
1982	35176940	1405001	273134	0.1744
1983	26851980	1343336	307601	0.2299
1984	33070424	1244498	277926	0.2334
1985	24589392	1178582	275760	0.2422
1986	11821557	1110258	240516	0.2162
1987	20658080	1064920	248653	0.2462
1988	9702218	1070763	255734	0.2334
1989	14257203	946425	275501	0.3090
1990	18060628	818604	228572	0.2917
1991	13990298	731585	197676	0.3005
1992	16712554	749827	189781	0.2717
1993	15457907	701646	209094	0.3078
1994	14413552	707488	218260	0.3702
1995	18547548	617581	188181	0.3496
1996	15542234	558868	162578	0.3456
1997	9178268	528239	160002	0.3944
1998	14794665	473966	185780	0.4148
1999	7932189	403493	145922	0.3490
2000	15214451	414310	175646	0.4704
2001	10677889	370079	148404	0.3960
2002	10207247	384139	129222	0.3396
2003	18909054	443723	113584	0.2599
2004	11779709	444118	93006	0.2202
2005	7776287	494830	91592	0.1990
2006	12882180	547358	110372	0.2158
2007	11120635	563194	116030	0.2223
2008	18772570	561729	126155	0.2303
2009	14294974	604571	134127	0.2111
2010	10823758	631782	136706	0.2539
2011	10006729	627856	116785	0.2028
2012	**14908000	***604117		
Average	17486589	884460	210111	0.2620

* At spawning time.

** Output from RCT3 analysis.

***Predicted.

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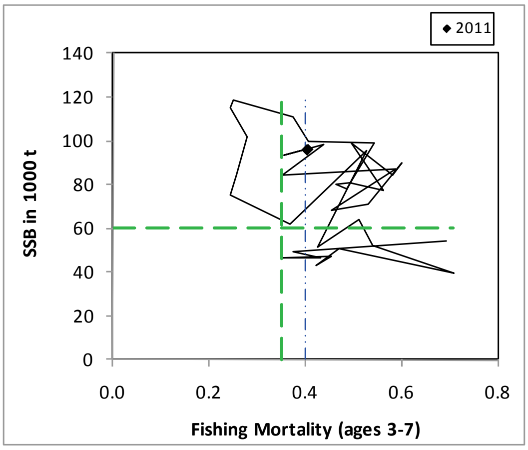
Advice for 2013

ICES advises on the basis of the MSY approach that catches in 2013 should be no more than 23 200 tonnes.

Stock status

F (Fishing Mortality)				
	2009	2010	**2011**	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✗	✓	✓	Harvested sustainably
SSB (Spawning-Stock Biomass)				
	2010	2011	**2012**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined



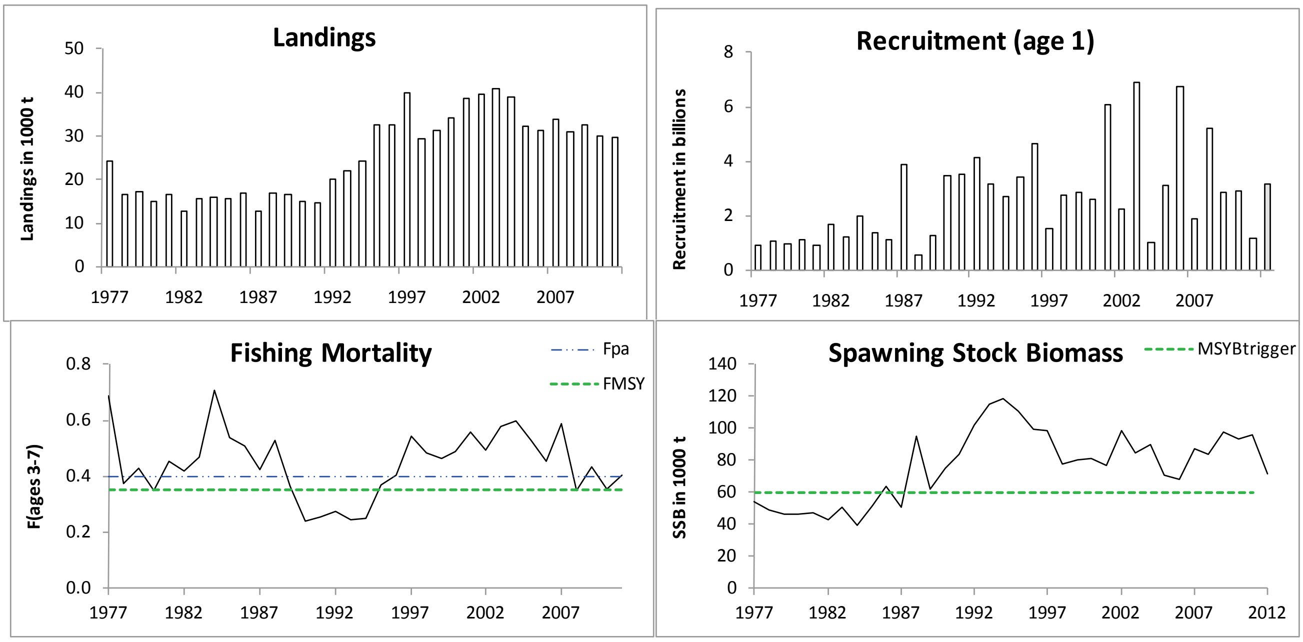


Figure 8.4.5.1 Herring in Subdivision 28.1 (Gulf of Riga). Summary of stock assessment (predicted recruitment values are shaded). Top right: SSB and F for the time-series used in the assessment.

The estimated SSB in 2011 is 95 900 tonnes, well above the MSY $B_{trigger}$ biomass of 60 000 t. Following high recruitment, SSB increased in the late 1980s and is currently estimated to be above the long-term average. The year classes of 2005, 2007, and 2009 are strong, while the 2006 and 2010 year classes are poor.

Management plans

No specific management objectives are known to ICES.

Biology

The year-class strength of the Gulf of Riga herring is strongly influenced by the severity of winter, which determines the water temperature and the abundance of zooplankton in spring. A series of mild winters since 1989 has been favourable for the reproduction of Gulf of Riga herring and resulted in a series of rich year classes for the period 1989–2010; the year classes were below average only in 1996, 2003, 2006, and 2010 after cold winters. Due to favourable reproduction conditions the SSB has been high since the beginning of the 1990s. The mean weight-at-age started to decrease in the mid-1980s and in 1997 reached the lowest values, especially in the older age groups. Afterwards the mean weight-at-age increased and since 2000 it has fluctuated without a clear trend, being still much lower than in the 1980s.

Environmental influence on the stock

The Gulf of Riga is a semi-enclosed ecosystem of the Baltic Sea characterized by low salinity that restricts the occurrence of marine species. The predation mortality by cod is likely to be low because cod is found in the Gulf of Riga only in periods when the cod stock size is very high (last time in the early 1980s).

The fisheries

The herring fishery in the Gulf of Riga is performed by Estonia and Latvia, using both trawls and trapnets. In the recent years the share of trapnets has been slightly above 30% and has been rather stable. Herring catches in the Gulf of Riga include the local Gulf of Riga herring and the open-sea herring, which enters the Gulf of Riga for spawning.

Catch distribution	Total herring landings in Gulf of Riga (2011) are 29.6 kt (69.8 % trawls and 30.2% trapnets). No discards or unallocated removals have been taking place. All landings are for human consumption.

Effects of the fisheries on the ecosystem

Pelagic trawl is the main fishing gear used in the trawl fishery. The bycatch of sprat is low (about 10% in recent years), and bycatch of other species is insignificant. The bycatches of other species in herring trapnets are also very low. Discarding in the herring fishery is not allowed and has not been observed by on-board sampling.

Quality considerations

The sampling of trawl and trapnet catches was performed by Estonia and Latvia on a regular basis; there are no gaps in fisheries coverage. The amount of unallocated catches has been gradually decreasing in the recent years and in 2011 it was considered that there are no unallocated catches of the Gulf of Riga herring.

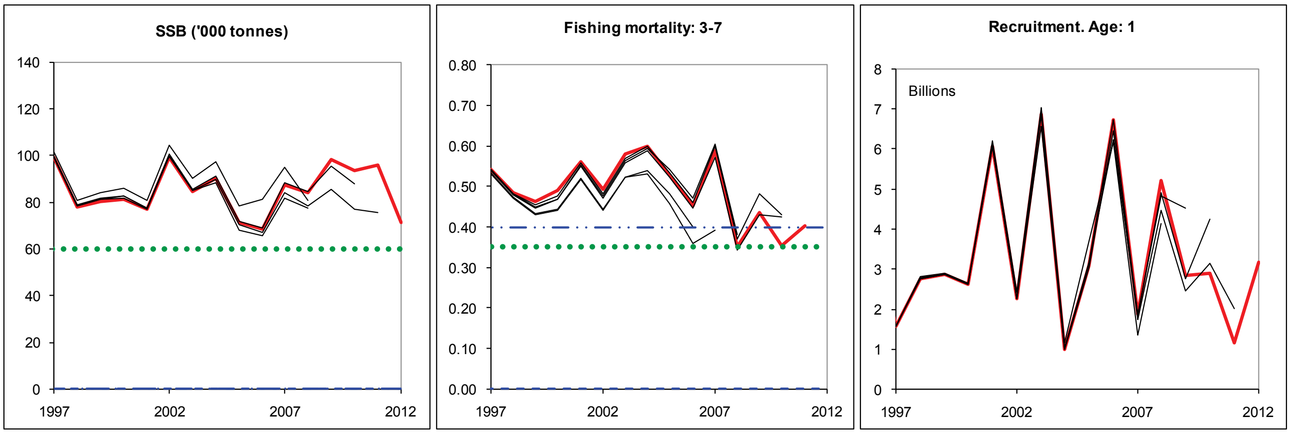


Figure 8.4.5.2 Herring in Subdivision 28.1 (Gulf of Riga). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	One acoustic survey index (BIAS); One commercial cpue index (trapnets).
Discards and bycatch	No indications of discarding of target or non-target species.
Indicators	None.
Other information	The latest benchmark was performed in 2008.
Working group report	WGBFAS

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Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	60 000 t	WKMAMPEL (ICES, 2009).
	F_{MSY}	0.35	WKMAMPEL (ICES, 2009), based on stochastic simulations.
Precautionary Approach	B_{lim}	not defined	
	B_{pa}	not defined	
	F_{lim}	not defined	
	F_{pa}	0.4	From medium-term projections.

(unchanged since: 2010)

Outlook for 2013

Basis: F_{2012} = F_{sq} = 0.398; R (2012) = 3.2 billion; SSB (2012) = 71.4; Catches (2012) = 26.4.

Rationale	**Catch (2013)**	**Basis**	**F (2013)**	**SSB (2013)**	**SSB (2014)**	**%SSB change[1)]**	**%TAC change[2)]**
MSY framework	23.2	F_{MSY}	0.35	74.0	80.4	+8.6	-9.0
Precautionary approach	25.9	F_{pa}	0.4	73.4	77.3	+5.3	+1.5
Zero catch	0	F=0	0	78.6	107.6	+36.9	-100
Other options	21.7	−15%TAC(F_{2012}* 0.82)	0.32	74.4	82.1	+10.3	-15.0
	23.6	F_{2012}* 0.9	0.36	73.9	79.9	+8.1	-7.5
	24.8	F_{2012}*0.95	0.38	73.7	78.6	+6.6	-2.8
	25.5	0%TAC (F_{2012}*0.98)	0.39	73.5	77.7	+5.7	0
	25.9	F_{2012}*1	0.398	73.4	77.3	+5.3	+1.5
	28.0	F_{2012} *1.1	0.44	72.9	74.9	+2.7	+9.8
	29.3	+15% TAC (F_{2012} *1.16)	0.46	72.7	73.5	+1.1	+15.0

Weights in thousand tonnes.

[1)] SSB 2014 relative to SSB 2013.

[2)] Human consumption landings 2013 relative to EU TAC 2012.

MSY approach

Following the ICES MSY framework implies fishing at F = 0.35, which corresponds to catches of less than 23 200 tonnes in 2013. This is expected to lead to an SSB of 80 400 tonnes in 2014.

Precautionary approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to catches of less than 25 900 tonnes in 2013. This is expected to keep SSB above the long-term average.

Additional considerations

A mixture of central Baltic herring (Subdivisions 25–27, 28.2, 29, and 32) and Gulf of Riga (Subdivision 28.1) herring is caught in Subdivisions 28.1 and 28.2.

All catches of the Gulf of Riga herring stock, taken both in as well as outside the Gulf of Riga, are considered in the assessment and the advice. The TAC is set for herring caught in the Gulf of Riga, which includes a percentage of central Baltic herring caught in the Gulf of Riga but does not include Gulf of Riga herring taken outside the Gulf of Riga. The fraction of herring caught outside the stock area should be taken into account when setting the TAC. In the past five years, the average catches outside the normal distribution area were:

- Central Baltic herring taken in the Gulf of Riga (Subdivision 28.1), on average 4600 tonnes (12.9% of catches in the Gulf of Riga);
- Gulf of Riga herring taken in Subdivision 28.2, on average 160 tonnes (0.5% of the total catches of Gulf of Riga herring).

In 2008–2011 the fraction of central Baltic herring caught in the Gulf of Riga has been rather stable in the range of 4900–6100 tonnes. In 2011, 5500 t of central Baltic herring were taken in the Gulf of Riga.

ICES (2009) recommended a trigger spawning-stock biomass of 60 000 tonnes for this stock. The evaluations used a stochastic multispecies model and a forecast model that suggested two candidates for F_{MSY}: $F_{MSY} = 0.35$ and $F_{MSY} = F_{0.1} = 0.26$, with an interannual variation in TAC for the two F options of 20% and 15%, respectively. ICES decided to use the higher value based on stochastic simulations. Such a high value should only be used together with a 20% limit on interannual variation in TAC.

Factors affecting the fisheries and the stock

Herring fishing in the Gulf of Riga is performed by Estonia and Latvia, using both trawls and trapnets. The proportion of catches taken by trawls and trapnets has been rather stable in recent years. The number of trawlers and their engine power is limited in the Gulf of Riga. The performance of the trawl fleet is gradually improving due to replacement of older vessels by a smaller number of new vessels. The misreporting has decreased along with this renewal.

Data and methods

The assessment is based on catch data, a commercial cpue index (passive gear), and an acoustic index.

Discrimination between the central Baltic herring and the Gulf of Riga herring is based on the different otolith structure, due to different feeding conditions and growth of herring in the Gulf of Riga and the Baltic Proper.

Uncertainties in the assessment and forecast

In recent years, unallocated catches have gradually decreased and in 2011 it was considered that there are no misreported catches of the Gulf of Riga herring.

Environment conditions

The period since the end of the 1980s, when the majority of winters have been mild, has been favourable for the reproductive success of Gulf of Riga herring. The year-class strength of the Gulf of Riga herring has been negatively correlated with the severity of the winter. Recruitment predictions were based on average water temperature in the 0–20 m layer in May, during the peak spawning and the biomass of the copepod *Eurytemora affinis*, when the hatching of larvae begins. However, the RCT3 did not predict the rich year classes adequately. Therefore, for the short-term forecast in 2012, the number of age group 1 (year class 2011) was defined as the geometric mean of the 1989–2009 year classes. This was based on the results of the hydro-acoustic survey in 2011, which indicated a record-high abundance of

0-group herring, and on the analysis of the factors affecting year-class strength (Putnis *et al*., 2011), describing new factors which significantly contribute to the emergence of very rich year classes.

Comparison with previous assessment and advice

The current assessment has revised the value of SSB in 2010 upwards by 21.8% and fishing mortality in 2010 downwards by 17.3%.

The basis for this year's advice is the MSY transition.

Sources

ICES. 2009. Workshop on Multiannual Management of Pelagic Stocks in the Baltic. ICES Headquarters, Copenhagen, 23–27 February 2009. ICES CM 2009/ACOM:38.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group. ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

Putnis, I., Müller-Karulis, B., and Kornilovs, G. 2011. Changes in the reproductive success of Gulf of Riga herring. ICES CM 2011/H:13.

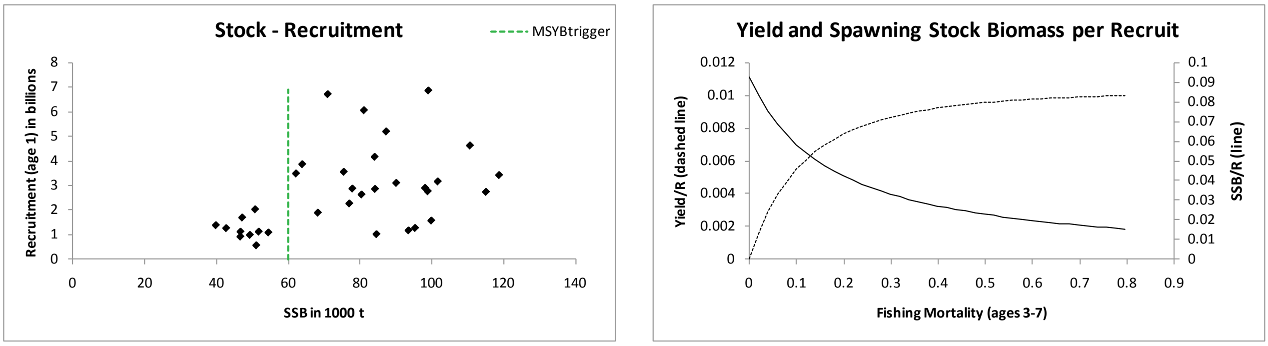


Figure 8.4.5.3 Herring in Subdivision 28.1 (Gulf of Riga). Stock–recruitment (left panel) and yield-per-recruit analysis (right panel) plots.

Table 8.4.5.1 Herring in Subdivision 28.1 (Gulf of Riga). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice*	Agreed TAC**	I CES landings
1987	Reduce F towards $F_{0.1}$	8	-	13
1988	Reduce F towards $F_{0.1}$	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 F_{pa}	<41	41	40.8
2004	$F=F_{sq}$	39	39.3	39.1
2005	$F=F_{sq}$	35.3	38.0	32.2
2006	$F=F_{pa}$	39.9	40.0	31.2
2007	$F=F_{pa}$	33.9	37.5	33.7
2008	$F<F_{pa}$	<30.1	36.1	31.1
2009	$F<F_{pa}$	<31.5	34.9	32.6
2010	$F<F_{pa}$	<33.4	36.4	30.2
2011	$F<F_{pa}$	< 33	32.7	29.6
2012	MSY transition	<25.5	30.6	
2013	MSY framework	<23.2		

Weights in thousand tonnes.
* The catch of open-sea herring is not included.
** The catch of open-sea herring is included.

Table 8.4.5.2a Herring in Subdivision 28.1 (Gulf of Riga). Total catches of Gulf of Riga herring and central Baltic herring caught in the Gulf of Riga by nation. Official landings and unallocated landings (thousand tonnes).

Year	Estonia	Latvia	Unallocated landings	Total
1991	7.420	13.481	-	20.901
1992	9.742	14.204	-	23.946
1993	9.537	13.554	3.446	26.537
1994	9.636	14.05	3.512	27.198
1995	16.008	17.016	3.401	36.425
1996	11.788	17.362	3.473	32.623
1997	15.819	21.116	4.223	41.158
1998	11.313	16.125	3.225	30.663
1999	10.245	20.511	3.077	33.833
2000	12.514	21.624	3.244	37.382
2001	14.311	22.775	3.416	40.502
2002	16.962	22.441	3.366	42.769
2003	19.647	21.78	3.267	44.694
2004	18.218	20.903	3.136	42.257
2005	11.213	19.741	2.961	33.915
2006	11.924	19.186	2.878	33.988
2007	12.764	19.425	2.914	35.103
2008	15.877	19.290	1.929	37.096
2009	17.167	18.323	1.832	37.322
2010	15.422	17.751	1.775	34.948
2011	14.721	20.303	-	35.024

Table 8.4.5.2b Herring in Subdivision 28.1 (Gulf of Riga). Gulf of Riga herring caught in the Gulf of Riga and in the central Baltic. (thousand tonnes).

Year	Catches in the Gulf of Riga			Gulf of Riga herring catches	
	Gulf of Riga herring	Central Baltic herring	Total	In the Central Baltic	Total
1976	27.4	4.5	31.9	-	27.4
1977	24.2	2.4	26.6	-	24.2
1978	16.7	6.3	23	-	16.7
1979	17.1	4.7	21.8	-	17.1
1980	15.0	5.7	20.7	-	15
1981	16.8	5.9	22.7	-	16.8
1982	12.8	4.7	17.5	-	12.8
1983	15.5	4.8	20.3	-	15.5
1984	15.8	3.8	19.6	-	15.8
1985	15.6	4.6	20.2	-	15.6
1986	16.9	1.3	18.2	-	16.9
1987	12.9	4.8	17.7	-	12.9
1988	16.8	3.0	19.8	-	16.8
1989	16.8	5.9	22.7	-	16.8
1990	14.8	6.0	20.8	-	14.8
1991	14.8	6.1	20.9	-	14.8
1992	20.5	3.5	23.9	1.3	21.8
1993	22.2	4.3	26.5	1.2	23.4
1994	22.2	5.0	27.2	2.1	24.3
1995	30.3	6.1	36.4	2.4	32.7
1996	28.2	4.4	32.6	4.3	32.5
1997	36.9	4.3	41.2	2.9	39.8
1998	26.6	4.1	30.7	2.8	29.4
1999	29.5	4.3	33.8	1.9	31.4
2000	32.8	4.6	37.4	1.9	34.7
2001	37.6	2.9	40.5	1.2	38.8
2002	39.2	3.5	42.8	0.4	39.7
2003	40.4	4.3	44.7	0.4	40.8
2004	38.9	3.3	42.3	0.2	39.1
2005	31.7	2.3	33.9	0.5	32.2
2006	30.8	3.2	34.0	0.4	31.2
2007	33.6	1.5	35.1	0.1	33.7
2008	31.0	6.1	37.1	0.1	31.1
2009	32.4	4.9	37.3	0.1	32.6
2010	29.7	5.2	34.9	0.4	30.2
2011	29.6	5.5	35.0	0.1	29.7

Table 8.4.5.3 Herring in Subdivision 28.1 (Gulf of Riga). Summary of stock assessment.

	Recruits Age 1	**SSB**	**Landings**	**FBAR 3–7**
1977	943160	54521	24186	0.6903
1978	1076417	49354	16728	0.3752
1979	976831	46736	17142	0.431
1980	1110166	46707	14998	0.3499
1981	908215	47214	16769	0.4526
1982	1687227	42747	12777	0.4199
1983	1252616	50824	15541	0.468
1984	2021960	39875	15843	0.7075
1985	1374055	51828	15575	0.539
1986	1110544	63951	16927	0.5114
1987	3864301	51135	12884	0.425
1988	551348	95388	16791	0.5266
1989	1258962	62216	16783	0.3673
1990	3486226	75520	14931	0.2423
1991	3553583	84129	14791	0.2571
1992	4165842	101717	20000	0.2776
1993	3160982	115143	22200	0.2439
1994	2733675	118807	24300	0.2481
1995	3419420	110690	32656	0.3721
1996	4628394	99915	32584	0.406
1997	1562221	98931	39843	0.5428
1998	2759235	77920	29443	0.4859
1999	2870028	80474	31403	0.4619
2000	2627666	81146	34069	0.4898
2001	6069800	77067	38785	0.5603
2002	2260926	99092	39701	0.4938
2003	6876277	84634	40803	0.5801
2004	1008256	90143	39115	0.5998
2005	3099993	71057	32225	0.5287
2006	6727374	68304	31232	0.4519
2007	1884579	87336	33742	0.5883
2008	5202792	84230	31137	0.3516
2009	2854305	98172	32554	0.4357
2010	2895910	93566	30174	0.3553
2011	1161650	95919	29639	0.4036
2012	3185591*	71362		
Arith. Mean	2661284	77040	25379	0.4469
Units	(Thousands)	(Tonnes)	(Tonnes)	

*Geometric mean 1989–2009.

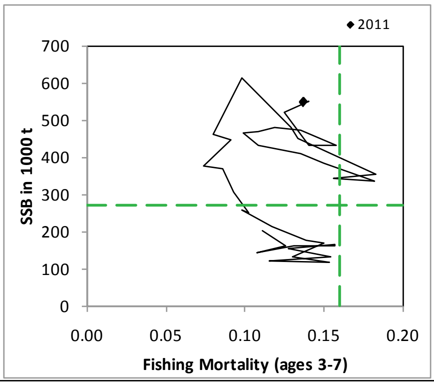
ECOREGION Baltic Sea
STOCK Herring in Subdivision 30 (Bothnian Sea)

Advice for 2013

ICES advises on the basis of the MSY framework that catches in 2013 should be no more than 97 000 tonnes.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning Stock Biomass)	**2010**	**2011**	**2012**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined



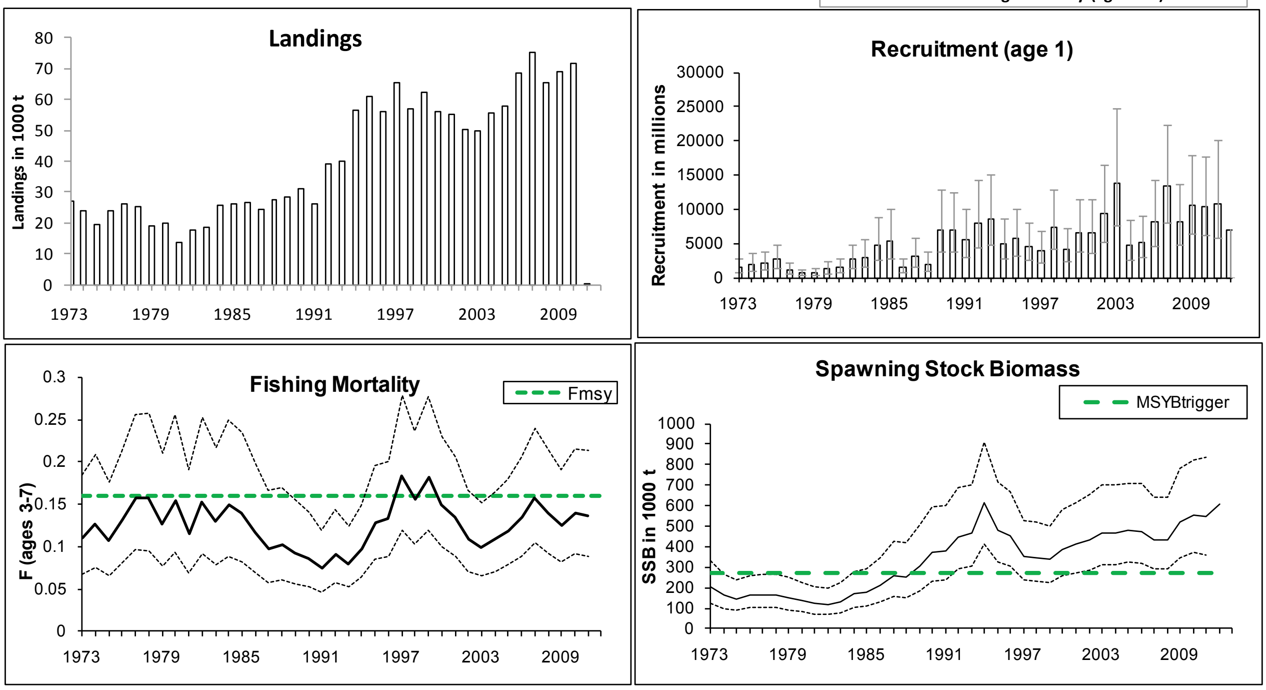


Figure 8.4.6.1 Herring in Subdivision 30, Bothnian Sea. Summary of stock assessment (weights in thousand tonnes). Recruitment in 2012 is estimated. Recruitment, F, and SSB have confidence intervals (95%) in the plot. Top right: SSB and F for the time-series used in the assessment.

The spawning-stock biomass tripled between the mid-1980s and mid-1990s and thereafter decreased by 40% until 1999. In the 2000s SSB remained high and has increased further after 2008. There is, however, great uncertainty around the estimates. Since the beginning of the time-series, the most likely estimates of fishing mortality have been below F_{MSY} and have exceeded F_{MSY} only in 1997 and 1999. Prior to 1994, recruitment was stable and low and has continued to remain stable over the past 20 years, but at a slightly higher average value than previously. The three year classes 2002, 2006, and 2008 are the most abundant in recent years. Landings in 2011 were the highest recorded over the time-series.

Management plans

No specific management objectives are known to ICES.

Biology

The growing grey seal population in the Bothnian Sea has resulted in increased predation on herring.

Environmental influence on the stock

The body weight of herring in the Bothnian Sea has declined over the last 20 years. The decrease in weight-at-age may be the result of a combination of density-dependent effects and a decrease in zooplankton prey.

The fisheries

On average, 95% of the total catch is taken by the trawl fishery; the trapnet fishery is of minor importance. The small-scale herring gillnet fishery has a declining importance in coastal areas in Sweden. In the trawl fishery, larger and more effective trawls have been introduced in the 1990s. Sprat bycatches in herring fisheries are low in ICES Subdivision 30.

Catch distribution	Total landings (2011) are 78.5 kt (4% trapnets, 95% trawls, and 1% gillnets). Discards are negligible.

Effects of the fisheries on the ecosystem

With a low fishing mortality and high stock size, the effect of the fisheries on the ecosystem is probably not significant from a trophic point of view.

Quality considerations

In contrast to the XSA model used previously, the retrospective patterns on SSB and F from the state–space model (SAM) do not show any trends. It is anticipated that extending the acoustic survey time-series and reconstructing commercial tuning fleets will improve the quality of the assessment.

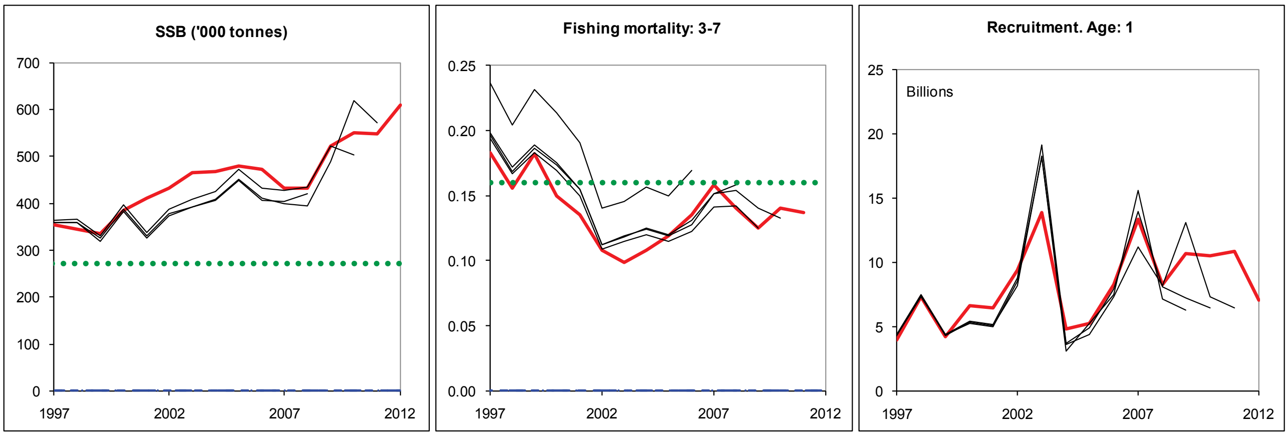


Figure 8.4.6.2 Herring in Subdivision 30, Bothnian Sea. Historical performance of the assessment. A new assessment model and revision of input data was considered in 2012.

Scientific basis

Assessment type	State–space model (SAM).
Input data	Acoustic survey indices from 2007 to 2011, and one commercial cpue series, Finnish trapnet fleet.
Discards and bycatch	Negligible discards. Small bycatches of sprat/mixed landings of herring and sprat, mainly from southern parts of the Bothnian Sea.
Indicator	The trends in acoustic abundance and biomass estimates support the assessment results.
Other information	Benchmark for the Subdivision 30 herring stock was carried out in 2012.
Working group report	WGBFAS

ECOREGION Baltic Sea
STOCK Herring in Subdivision 30 (Bothnian Sea)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	271 000 t	2.5% lower percentile of B_{MSY}.
	F_{MSY}	0.16	F giving the highest yield based on stochastic stock simulations with the hockey-stick S–R relationship.
Precautionary Approach	B_{lim}	not defined*	
	B_{pa}	not defined*	
	F_{lim}	not defined	
	F_{pa}	not defined**	

(unchanged since: 2012)

*) A recent integrated ecosystem assessment (ICES, 2008) shows a major shift in foodweb composition and in environmental drivers in the Bothnian Sea, and therefore the previously defined precautionary biomass reference points are no longer considered appropriate and were not used in assessing stock status.

**) The defined value for F_{pa} (F = 0.21 = F_{med} in 2000) was no longer considered to be a valid reference point.

Outlook for 2013

Basis: F_{2012} = (average 2009–2011 unscaled) = 0.13; SSB (2012) = 609; R (2012) = 7060 million; Catch (2012) = 81.

Rationale	**Catch (2013)**	**Basis**	**F (2013)**	**SSB (2013)**	**SSB (2014)**	**%SSB change** [1)]	**%TAC change** [2)]
MSY framework	97	F_{MSY}	0.16	622	597	-4.0	-8.1
Zero catch	0	F = 0	0	637	703	10.4	-100
Other options	82	F_{sq}	0.13	625	613	-2.0	-22
	90	-15%TAC (F_{sq} * 1.1)	0.15	623	605	-3.0	-15
	106	0%TAC (F_{sq}* 1.31)	0.18	621	588	-5.4	0
	122	+15%TAC (F_{sq} * 1.53)	0.20	618	570	-7.8	+15

Weights in thousand tonnes.
1) SSB 2014 relative to SSB 2013.
2) Catches 2013 relative to EU TAC 2012 in Subdivisions 30 and 31.

MSY approach

Following the ICES MSY framework implies a fishing mortality of 0.16, resulting in catches of no more than 97 000 tonnes in 2013. This is expected to result in an SSB of 597 000 tonnes in 2014.

No transition scheme applies as fishing mortality is below F_{MSY}.

Additional considerations

The TAC has not been limiting.

Given the different development of the two herring stocks in Subdivisions 30 and 31, a common TAC set for both areas might not adequately protect the weaker stock. ICES, therefore, recommends separate management measures for the two stocks.

Regulations and their effects

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.

With the present low fishing mortality 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) is likely to increase in the stock and in the catch.

The EU has granted Finland and Sweden a standing dispensation to utilize and sell fish with higher contents of dioxin and PCB than the limit. No decrease has been observed in the dioxin contents in Baltic herring from the Bothnian Sea since the 1990s.

The lack of large herring in the stock (low mean weight-at-age) is causing problems for the small-scale fisheries, which target large herring for human consumption, mainly on the Swedish coast.

Data and methods

The assessment is based on catch data with a revised method of ageing for the years 2002–2011, on an acoustic time-series (introduced first time to the assessment in 2012), one revised commercial cpue series, and a new model (SAM).

The growing grey seal population in the Bothnian Sea has resulted in increased predation on herring but this is considered to have a minimal impact in the assessment.

Uncertainties in assessment and forecast

The present assessment uses for tuning a fishery-independent acoustic survey time-series of five years, which is still relatively short, and a commercial trapnet cpue series, which may introduce some bias in the assessment if its efficiency has changed over time. Both tuning fleets, however, show similar trends in stock development, and good correlation for age classes 5–7 ($r^2 = 0.81–0.86$). However, the wide confidence intervals show that the results are uncertain.

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.

Comparison with previous assessment and advice

The assessment with a new method shows a similar increasing trend in the SSB estimate and a decrease in fishing mortality as in the 2011 assessment. Between the two methods used, the estimate of SSB in 2010 has been revised downwards by 11% and the F in 2010 has been revised upwards by 5%.

The basis for the advice is the same as in 2011, the ICES MSY approach.

Assessment and management area

The advice (Subdivision 30) and management area (Subdivisions 30 and 31) are different.

Source

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group. ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

Table 8.4.6.1 Herring in Subdivision 30, Bothnian Sea. ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[2]	ICES landings
1987				25
1988				28
1989				29
1990				31
1991	TAC for eastern part of Subdivision 30, 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	$F_{pa} = 0.21$	36	72	55
2002	F below F_{pa}	53	64	50
2003	F below F_{pa}	50	60	50
2004	F below F_{pa}	50	61.2	55
2005	F below F_{pa}	60.2	64	58
2006	F below F_{pa}	88/93	91.6	69
2007	F below F_{pa}	83.4	82.8	75
2008	F below F_{pa}	67.3	87.0	65.4
2009	*Same advice as last year*	67.3	82.7	68.9
2010	F below F_{pa}	109.6	103.3	71.7
2011	F below F_{pa}	< 115	104.4	78.5
2012	MSY framework	104	106	
2013	MSY framework	97		

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

Table 8.4.6.2 Herring in Subdivision 30. Landings by country (tonnes).

Year	Finland	Sweden	Total
1971	24284	5100	29384
1972	24027	5700	29727
1973	20027	6944	26971
1974	17597	6321	23918
1975	13567	6000	19567
1976	19315	4455	23770
1977	22694	3610	26304
1978	22215	2890	25105
1979	17459	1590	19049
1980	18758	1392	20150
1981	12410	1290	13700
1982	16117	1730	17847
1983	16104	2397	18501
1984	23228	2401	25629
1985	24235	1885	26120
1986	23988	2501	26489
1987	22615	1905	24520
1988	24478	3172	27650
1989	25453	3205	28658
1990	28815	2467	31282
1991	23219	3000	26219
1992	35610	3700	39310
1993	36600	3579	40179
1994	53860	2520	56380
1995	58806	2280	61086
1996	54372	1737	56109
1997	63532	1995	65527
1998	54115	2777	56892
1999	60483	1862	62345
2000	54886	1374	56261
2001	52987	1997	54984
2002	46315	3903	50218
2003	45932	3707	49638
2004	50236	5214	55450
2005	55422	2 520	57 942
2006	66962	1 403	68 365
2007	72116	3 317	75 432
2008	61756	3 674	65 430
2009	64881	3992	68873
2010	68760	2967	71726
2011	75130(*	3370	78500

*) preliminary

Table 8.4.6.3 Herring in Subdivision 30, Bothnian Sea. Summary of stock assessment.

Year	Recruits	Low	High	TSB	Low	High	SSB	Low	High	F37	Low	High
1973	1556577	837754	2892177	256530	161319	407934	203008	124734	330400	0.111	0.067	0.185
1974	1957150	1070268	3578950	217945	138018	344159	161297	99167	262351	0.126	0.076	0.208
1975	2143606	1194908	3845522	215993	137836	338466	145365	89879	235103	0.107	0.066	0.176
1976	2716894	1498088	4927291	233048	150251	361472	162267	101578	259217	0.131	0.081	0.212
1977	1201402	666463	2165713	233048	149995	362087	164062	102441	262750	0.157	0.097	0.256
1978	727959	399081	1327861	206076	130402	325664	166043	102843	268080	0.157	0.095	0.257
1979	789378	432337	1441277	185350	115317	297914	153584	93667	251828	0.127	0.077	0.210
1980	1293678	708851	2361010	162918	100234	264803	134726	81006	224071	0.154	0.093	0.255
1981	1533403	842695	2790245	155282	94911	254053	121419	72144	204348	0.115	0.069	0.191
1982	2687172	1470657	4909978	152512	94555	245993	119134	71914	197359	0.153	0.092	0.253
1983	3051061	1667907	5581231	193494	120052	311863	133653	80274	222526	0.130	0.078	0.217
1984	4785016	2601451	8801388	249946	156151	400080	168215	101804	277951	0.150	0.089	0.250
1985	5432989	2908011	10150363	279847	174633	448453	177904	107773	293672	0.139	0.082	0.234
1986	1495543	786572	2843539	315843	196823	506835	213630	130815	348872	0.117	0.069	0.198
1987	3156581	1707089	5836839	327748	202517	530418	258074	156705	425015	0.098	0.058	0.166
1988	2012725	1069883	3786452	358613	221944	579442	251199	151294	417074	0.102	0.061	0.170
1989	7060313	3829788	13015871	428909	267555	687571	307122	186954	504529	0.093	0.056	0.155
1990	6892883	3803377	12492013	500819	316659	792082	370275	229702	596873	0.086	0.052	0.141
1991	5604049	3129488	10035306	496828	319880	771661	378890	239901	598403	0.074	0.046	0.119
1992	8024420	4525054	14229958	633490	419056	957652	447307	290861	687901	0.091	0.058	0.143
1993	8546223	4850634	15057398	714258	479980	1062888	464167	306300	703399	0.080	0.052	0.124
1994	4915972	2803278	8620900	759184	516918	1114994	612314	411926	910182	0.098	0.064	0.149
1995	5740174	3275890	10058212	617849	422642	903219	482145	324753	715817	0.129	0.085	0.195
1996	4671543	2676927	8152376	563544	385818	823139	452707	305602	670621	0.133	0.088	0.201
1997	3976848	2276569	6946997	478303	327735	698046	353982	237290	528057	0.183	0.120	0.278
1998	7370529	4180243	12995582	478303	324811	704328	344552	228493	519561	0.156	0.103	0.237
1999	4197501	2392334	7364782	455887	312107	665903	336045	224875	502173	0.182	0.119	0.277
2000	6622609	3777678	11610031	485046	328752	715645	385001	256638	577567	0.150	0.099	0.229
2001	6497968	3696363	11423007	531788	359763	786069	409626	272327	616146	0.135	0.088	0.205
2002	9388537	5336390	16517649	577232	388707	857194	431490	285764	651531	0.108	0.071	0.166
2003	13880562	7764402	24814532	662649	446744	982897	465562	309112	701194	0.099	0.065	0.151
2004	4828276	2717710	8577903	669308	455349	983802	467895	312825	699835	0.108	0.071	0.165
2005	5225181	2978112	9167728	622190	424743	911421	479261	322881	711379	0.119	0.078	0.180
2006	8252279	4727939	14403762	624683	425755	916557	472125	315780	705880	0.135	0.089	0.205
2007	13376366	8023618	22300062	613540	421098	893928	433220	291536	643759	0.158	0.104	0.240
2008	8252279	4943776	13774919	615999	421013	901288	431490	289607	642884	0.140	0.092	0.214
2009	10702629	6398154	17903021	738961	502585	1086509	520737	347876	779494	0.125	0.082	0.191
2010	10501199	6215520	17741907	710696	483739	1044136	551281	370986	819197	0.140	0.091	0.215
2011	10864379	5878311	20079702	764517	510109	1145807	548532	360072	835629	0.137	0.088	0.214
2012	7060313						609322					

ECOREGION Baltic

STOCK Herring in Subdivision 31 (Bothnian Bay)

Advice for 2013

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 2100 tonnes.

This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Given the different development of the two herring stocks in Subdivisions 30 and 31, a common TAC set for both areas might not adequately protect the weaker stock. Therefore ICES recommends a separate management for the two stocks.

Stock status

	F (Fishing Mortality)	
	2000–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
Qualitative evaluation	✓	Low to moderate

	SSB (Spawning-Stock Biomass)	
	2007–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	↘	Decreasing stock abundance

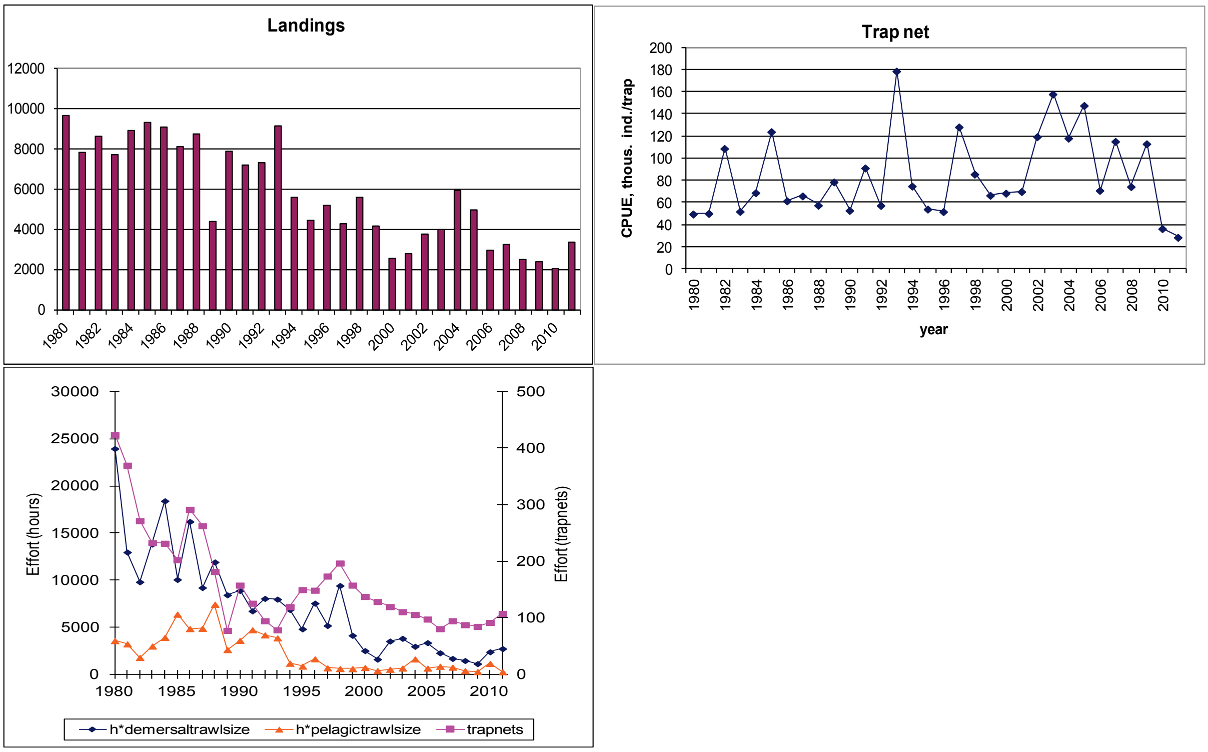


Figure 8.4.7.1 Herring in Subdivision 31 (Bothnian Bay). Top left panel: Total landings (tonnes). Top right panel: Cpue in the trapnet fishery, regarded as representative for the variation of stock abundance over time. Bottom left panel: Effort by fishery, regarded as representative for the variation of fishing pressure over time.

Cpue from trapnet fisheries shows fluctuations with a decreasing trend since 2003. Fishing effort has generally decreased since the 1980s and is considered to be low. The average stock abundance indicator (cpue from trapnet) in the last two years (2010–2011) is 68% lower than the abundance indices in the three previous years (2007–2009).

Management plans

No specific management objectives are known to ICES. The EU manages fisheries on this stock in conjunction with those on the stock in Subdivision 30.

Biology

Growth for this stock is limited by environmental conditions and biotic factors such as competition for prey. The mean weight-at-age decreased in the 1990s from high values in the 1980s and has continued to be low. This variation over time in weight-at-age is very similar to that of herring in the Bothnian Sea. The main predators on herring are ringed seal and grey seal.

Environmental influence on the stock

Environmental conditions in this area are extreme for herring. Low salinity (1–3%), long winters, prolonged ice periods, and cool summers affect the growth. Environmental conditions seem to determine the recruitment. For example, the strong year classes of 1988, 1999, 2002, and 2006 hatched during very warm summers.

The fisheries

Fluctuations in total trawl catches and the length of the fishing season depend on the onset of winter and the ice cover in the autumn. Normally, the trawl fishing season starts in late April and ends in late May to July. The trawl fishery starts again in August/September. The ice cover usually appears in early November. Sprat bycatches in herring fisheries are very small, as sprat is found only occasionally in Subdivision 31.

Catch distribution	Total catches (2011) 3350 t, where 100% are landings (94% trawls, 5% trapnets, and 1% gillnets).

Effects of the fisheries on the ecosystem

The main part of the catch is used for fodder; there is no unwanted bycatch. The proportion of other species is of minor importance; these include smelt (*Osmerus eperlanus*), vendace (*Coregonus albula*), whitefish (*Coregonus lavaretus*), and three-spined stickleback (*Gasterosteus aculeatus*).

Quality considerations

The advice is based on cpue from trapnet, as an indicator of stock abundance. The uncertainty of these indices is not available.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Cpue and effort analysis.
Input data	Commercial fleet indices (pelagic and demersal trawl fleets and trapnet).
Discards and bycatch	Negligible.
Indicators	Mean weight-at-age of herring.
Working group report	WGBFAS

ECOREGION Baltic
STOCK Herring in Subdivision 31 (Bothnian Bay)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment can be presented for this stock.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have decreased by more than 20% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies a decrease of catches of at most 20% in relation to last three years' average landings, corresponding to catches of no more than 2100 t in 2013.

Considering that fishing effort has been decreasing since the 1980s and is considered to be low, no additional precautionary reduction is needed.

Given the different development of the two herring stocks in Subdivisions 30 and 31, a common TAC set for both areas might not adequately protect the weaker stock. ICES, therefore, recommends a separate management for the two stocks.

Additional considerations

The observations on the difference in otolith structure between herring in the Bothnian Sea and in the Bothnian Bay support the conclusion that migration between the Bothnian Bay and the Bothnian Sea is currently not significant. This supports the current definition of two separate stocks in Subdivisions 30 and 31, which implies separate management for the two areas.

The continuous decline in fishing effort is probably independent of fish stock trends and related to socioeconomic factors.

Data requirements

Fisheries-independent data are needed for unbiased estimates of stock sizes.

Assessment and management area

The advice (Subdivision 31) and management area (Subdivisions 30 and 31) are different.

Sources

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group, ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

Table 8.4.7.1 Herring in Subdivision 31 (Bothnian Bay). ICES advice, management, and catches.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ICES 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	3.0
2007	Less than average catches (2002–2005)	4.7	82.8	3.2
2008	No increase in catch	<3.0	87.0	2.5
2009	Same advice as last year	<3.0	82.7	2.4
2010	Same advice as last year	<3.0	103.3	2.1
2011	No basis for advice	<3.0	104.4	3.4
2012	No increase in catches	<3.0	106.0	
2013	Reduce catches by more than 20%	<2.1		

Weights in thousand tonnes.
[1]TAC for Subdivisions 29N, 30, and 31 (IBSFC Management Unit 3), and from 2005 for Subdivisions 30 and 31.

Table 8.4.7.2 Herring in Subdivision 31 (Bothnian Bay). Official landings (tonnes).

Year	Finland	Sweden	Total	% change
1971	6 143	820	6 963	
1972	3 550	770	4 320	-38
1973	3 152	727	3 976	-8
1974	5 737	665	6 482	63
1975	4 802	800	5 547	-14
1976	7 763	750	8 508	53
1977	6 580	750	7 330	-14
1978	9 068	700	9 768	33
1979	6 275	785	7 060	-28
1980	8 899	760	9 659	37
1981	7 206	620	7 826	-19
1982	7 982	670	8 652	11
1983	7 011	696	7 707	-11
1984	8 322	594	8 916	16
1985	8 595	717	9 312	4
1986	8 754	336	9 090	-2
1987	7 788	320	8 108	-11
1988	8 501	267	8 768	8
1989	4 005	423	4 428	-49
1990	7 603	295	7 898	78
1991	6 800	400	7 200	-9
1992	6 900	400	7 300	1
1993	8 752	383	9 135	25
1994	5 195	411	5 606	-39
1995	3 898	563	4 461	-20
1996	5 080	114	5 194	16
1997	4 195	86	4 281	-18
1998	5 358	224	5 582	30
1999	3 909	248	4 157	-26
2000	2 479	113	2 592	-38
2001	2 755	67	2 822	9
2002	3 532	219	3 750	33
2003	3 855	150	4 004	7
2004	5 831	142	5 973	49
2005	4 800	169	4 970	-17
2006	2 684	269	2 954	-41
2007	2 992	253	3 245	10
2008	2 309	175	2 484	-23
2009	2 166	209	2 375	-4
2010	1 898	177	2 075	-13
2011	3 218	132	3 350	61

Table 8.4.7.3 Herring in Subdivision 31 (Bothnian Bay). Cpue from trapnet.

Year	Cpue trapnet (thousands ind. / trap)
1980	50.02
1981	50.57
1982	109.19
1983	52.36
1984	69.22
1985	124.33
1986	61.92
1987	66.35
1988	57.91
1989	78.97
1990	53.29
1991	91.59
1992	57.79
1993	178.99
1994	75.25
1995	54.47
1996	52.21
1997	128.62
1998	86.04
1999	66.90
2000	68.84
2001	70.31
2002	119.83
2003	158.29
2004	118.49
2005	147.96
2006	71.36
2007	115.58
2008	74.77
2009	113.41
2010	36.85
2011	28.98

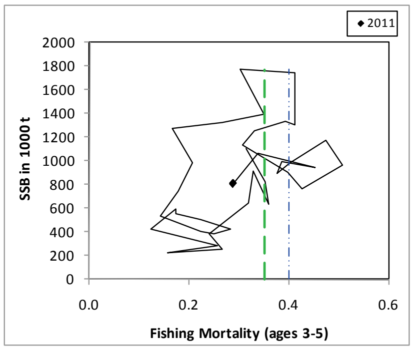
ECOREGION Baltic Sea
STOCK Sprat in Subdivisions 22–32 (Baltic Sea)

Advice for 2013

ICES advises on the basis of the MSY approach that catches in 2013 should be no more than 278 000 tonnes and furthermore that a spatial management plan needs to be developed. .

Stock status

F (Fishing Mortality)			
	2009	2010	2011
MSY (F_{MSY})	✗	✓	✓ Below target
Precautionary approach (F_{pa})	✗	✓	✓ Harvested sustainably
SSB (Spawning-Stock Biomass)			
	2010	2011	2012
MSY ($B_{trigger}$)	?	?	? Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	? Undefined
Qualitative evaluation	↘	→	→ Stable at average level



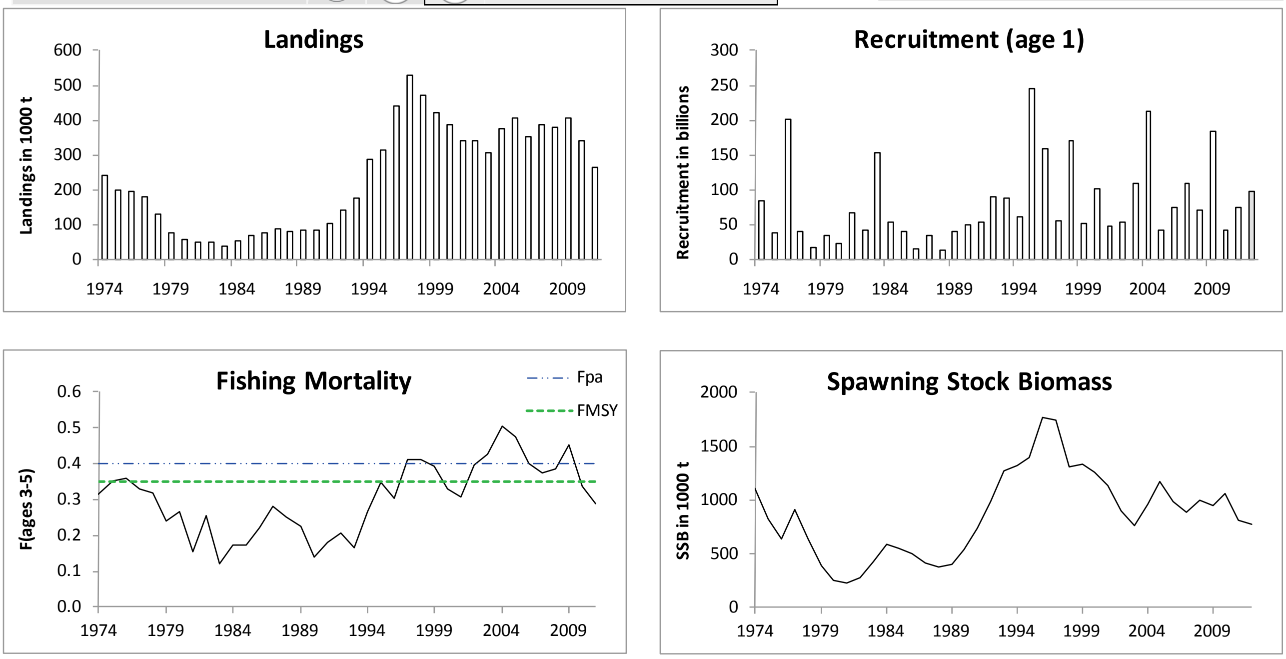


Figure 8.4.8.1 Sprat in Subdivisions 22–32 (Baltic Sea). Summary of stock assessment. Top right: SSB and F for the time-series used in the assessment.

SSB has declined from a historical high in the late 1990s, and the SSB in 2011 was estimated at close to the long-term average. The fishing mortality in 2011 declined to 0.29, which is the lowest estimated for the past ten years. None of the recent three year classes (2009–2011) are strong; the 2009 year class is estimated to be weak, the 2010 close to average, and the 2011 year class is predicted to be close to the average. SSB and recruitment in 2012 are predicted values.

Management plans

The International Baltic Sea Fishery Commission (IBSFC) long-term management plan for the sprat stock was terminated in 2006 and has not been replaced.

Biology

Sprat biomass is strongly dependent on the overlap with the cod stock through predator–prey interactions. Sprat biomass was low in the 1980s when the cod stock was high. A decline in cod biomass and favorable conditions for sprat recruitment led to the development of sprat to a record high in the 1990s. High stock size resulted in a marked decline in sprat mean weights (density-dependent effects). After the 1990s the sprat stock size increased mainly in the northern areas (Subdivisions 27–29 and 32), where cod decreased the most, exacerbating the decrease in mean weights especially in these areas. The decline of the stock in numbers may to some extent be compensated by an expected increase in weights-at-age because of density-dependent effects on growth.

Environmental influence on the stock

Since the 1990s, trends in Baltic sprat have been driven mainly by reduced predation by cod and variable, but high recruitment. Recently, a strong increase of cod has occurred in the southern Baltic (especially in Subdivision 25 and, to a minor extent, in Subdivision 26), whereas no significant increase has been noticed in the northern areas (Subdivisions 27–32). The increase of cod in Subdivision 25 will have a strong effect on sprat in this area, but very limited effect on the whole Baltic sprat population which is currently out of reach for cod, at least in some seasons.

The fisheries

The mesh size (minimum of 16 mm) and TAC are the main regulatory measures adopted for the Baltic sprat fishery. Landings usually do not exceed the TAC, and in 2010 the EU TAC was not taken. Discarding of herring and sprat in the Baltic has been prohibited in the EU fisheries since 2010.

Catch distribution	Total landings (2011) are 268 kt. Most of the catch is taken by pelagic trawlers, discards are negligible.

Effects of the fisheries on the ecosystem

Because sprat and herring are the major prey for cod, the mixed pelagic fishery can indirectly affect the cod stock. On the other hand, a smaller stock size of sprat would release its pressure on the consumption of cod eggs that in some areas and periods may be substantial.

Quality considerations

The assessment shows a historical retrospective pattern, with a tendency to underestimate the SSB and overestimate the F. In some fisheries the species composition of catches in the mixed industrial fishery is imprecise which may add additional uncertainty to the assessment.

Collection of cod stomach contents data would improve the data basis for application in multispecies stock assessment models.

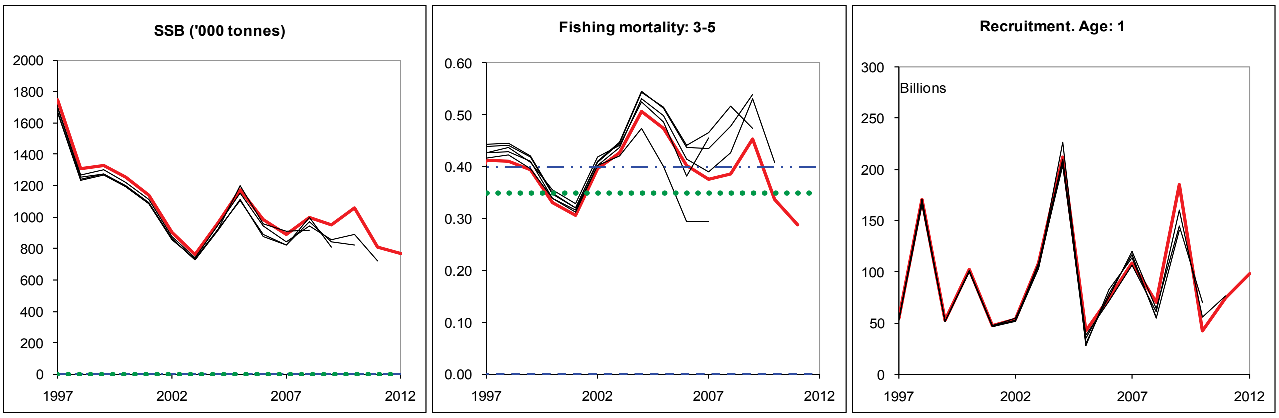


Figure 8.4.8.2 Sprat in Subdivisions 22–32 (Baltic Sea). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Three survey indices from two acoustic surveys (BASS: May; BIAS: October, BIAS for age 0).
Discards and bycatch	Discards are not included and are considered to be negligible.
Indicators	None.
Other information	The latest benchmark was performed in 2005; the next one is planned for 2013.
Working group report	WGBFAS

8.4.8 Supporting information May 2012

ECOREGION **Baltic Sea**
STOCK **Sprat in Subdivisions 22–32 (Baltic Sea)**

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	not defined*	
	F_{MSY}	0.35	Stochastic simulations, including S–R relationship and HCR.
Precautionary Approach	B_{lim}	not defined*	
	B_{pa}	not defined*	
	F_{lim}	not defined	
	F_{pa}	0.40**	F_{med} estimate in 1998, allowing for variable natural mortality.

(unchanged since 2011)

*An integrated ecosystem assessment (ICES, 2008) showed a major shift in foodweb composition and in environmental drivers in the central Baltic basin, and therefore the previously defined precautionary biomass reference points are no longer considered appropriate and were not used in assessing stock status.

**There are doubts about the validity of the F_{pa} reference point in the light of the increased natural mortality which at present cannot be determined accurately.

Outlook for 2013

Basis: F_{2012} = (2009–2011 scaled) = 0.29; SSB (2012) = 770; Recruitment (2012) = 98 billion; Catches (2012) = 230.

Rationale	**Catch 2013**	**Basis**	**F Total (2013)**	**SSB (2013)**	**SSB (2014)**	**%SSB change** [1)]	**%TAC change** [2)]
MSY framework	278	F_{MSY}	0.35	815	789	-3	+9
Precautionary approach	312	F_{pa}	0.4	801	751	-6	+22
Zero catch	0	0	0	919	1128	23	-100
Other options	169	$0.7*F_{sq}$	0.20	857	916	+7	-34
	191	$0.8*F_{sq}$	0.23	849	890	+5	-25
	202	$0.85*F_{sq}$	0.24	845	878	+4	-21
	213	$0.9*F_{sq}$	0.26	840	865	+3	-16
	217	−15%TAC ($0.92*F_{sq}$)	0.27	838	860	+3	-15
	234	F_{sq}	0.29	832	840	+1	-8
	255	0%TAC ($1.1*F_{sq}$)	0.32	824	816	-1	0
	265	$1.15*F_{sq}$	0.33	820	805	-2	+4
	293	+15%TAC ($1.29*F_{sq}$)	0.37	809	772	-5	+15

Weights in thousand tonnes.
[1)] SSB 2014 relative to SSB 2013.
[2)] Catches 2013 relative to TAC 2012 (EU and Russia).

MSY approach

As no MSY $B_{trigger}$ has been identified for this stock, the ICES MSY framework has been applied with F_{MSY} without considering SSB in relation to MSY $B_{trigger}$.

Following the ICES MSY framework implies a fishing mortality at 0.35, resulting in catches of no more than 278 000 tonnes in 2013. This is expected to lead to an SSB of more than 790 000 tonnes in 2014.

No transition is needed as the current fishing mortality is below F_{MSY}.

Precautionary approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to catches of 312 000 tonnes. This is expected to bring SSB to 750 000 tonnes in 2014.

Additional considerations

Management considerations

Sprat is taken with a bycatch of 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 Baltic herring stock, as they overlap in distribution and fishing area. From 2005, EU 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. This is thought to have led to a reduction in the amount of misreported species.

The future catch opportunities will very much depend on the strength of the 2012–2013 year classes. 16% of the predicted yield for 2013 and 45% of the 2014 SSB result from the assumption of average recruitment (1991–2010) in the projections.

The highest yield which this stock can sustain in the long term depends on natural mortality, which is linked to the abundance of cod. Strong recruitment of sprat and low predation contributed to the high SSB in the mid-1990s and 2000s. The exploitation of sprat will have to be reduced as the cod stock recovers, especially in Subdivision 25 where most of the cod biomass is presently distributed.

The sprat stock development is related to cod. However, the present distribution pattern of the two species implies that an increase in F on cod will not necessarily result in increasing Baltic-wide sprat stock size. Conversely, a decrease in F on cod will not necessarily result in a decrease of the Baltic sprat stock size if it is not accompanied by a cod expansion into northern areas.

A higher F on sprat in northern areas (Subdivisions 27–32) would likely reduce density dependence and improve the individual growth and condition of both sprat and herring stocks. An increase in sprat F in these northern areas will not have a negative effect on cod, given that this will not affect the stock that is now mainly distributed in southern areas (Subdivisions 25–26). On the other hand, a reduction of sprat F in Subdivision 25 will likely improve the growth and condition of cod as well as reducing cod cannibalism in this area.

To optimize the growth potential and yield of cod, sprat, and herring, a spatially explicit management plan needs to be developed.

Factors affecting the fisheries and the stock

Sprat in the Baltic Sea is located at 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, and higher temperatures might support increased recruitment. 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, where retention vs. dispersion in the Baltic deep basins have a strong influence on the recruitment success of sprat. The sprat stock development is related to cod through predation.

The mean weights-at-age for this stock decreased by about 40% in 1992–1998 (Figure 8.4.8.4), after which the weights fluctuated without clear trend. The decrease in weight-at-age has been more pronounced in the northern areas (Subdivisions 27–29) where the majority of the sprat stock has been concentrated since the mid-1990s. This could result from density-dependent effects operating both in time and space.

High stock size resulted in a marked decline in sprat mean weights (density-dependent effects) (Figure 8.4.8.4). After the 1990s the sprat stock size increased mainly in the northern areas (Subdivisions 27–29 and 32), where cod decreased the most (Figures 8.4.8.4 and 8.4.8.5), exacerbating the decrease in mean weights especially in these areas (Figure 8.4.8.6).

Information from the fishery industry

The industry reports a recent shift in distribution of sprat in the autumn: sprat seems to be distributed much closer to the coast in early October than in previous years. As this is the time when the autumn acoustic survey is conducted, this behavioural change might lead to an underestimation of the stock size in the acoustic survey.

Data and methods

The age-structured assessment is based on catch data and three age-structured acoustic survey indices. Natural mortality is derived from a multispecies model that takes cod predation into account.

The recruitment estimate for the 2011 year class used in the predictions is derived from an acoustic survey. Average recruitment is used for younger year classes.

Uncertainties in assessment and forecast

Uncertainties exist with regard to the imprecise historical (pre-2005) catch data, due to inaccurate catch composition data caused by mixed landings of herring and sprat.

The historical performance of the assessment (Figure 8.4.8.2) shows quite a large variation, to some extent caused by changes in natural mortality estimates (depending on cod predation) and revisions in the acoustic data used for tuning. The revised survey data for the years 1991 to 2008 are now consistently based on area-corrected estimates.

Comparison with previous assessment and advice

The assessment shows estimates of SSB and fishing mortality that differ about 20% from the 2011 assessment. The estimate of SSB in 2010 is 19% higher than in the previous assessment and the F in 2010 has been revised downwards by 17%. The changes in natural mortality (up to 10% difference) resulting from a downwards revision of cod SSB, contribute to these deviations. As the F has declined below F_{MSY} , the basis for the advice is now the ICES MSY framework.

Sources

ICES. 2008. Report of the Working Group on Integrated Assessments of the Baltic Sea. Öregrund, Sweden, 25–29 March 2008. ICES CM 2008/BCC:04.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group. Copenhagen, 12–19 April 2012. ICES CM 2012/ACOM:10.

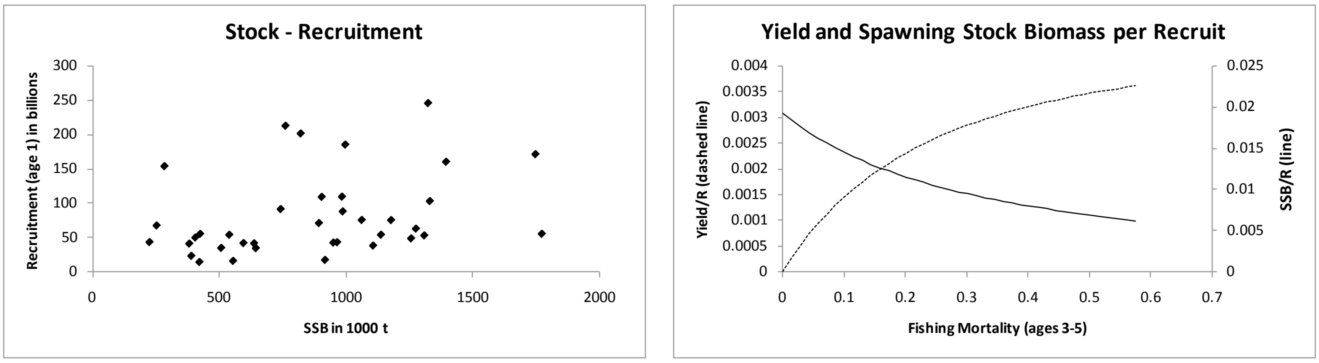


Figure 8.4.8.3 Sprat in Subdivisions 22–32 (Baltic Sea). Stock–recruitment plot and yield-per-recruit analysis.

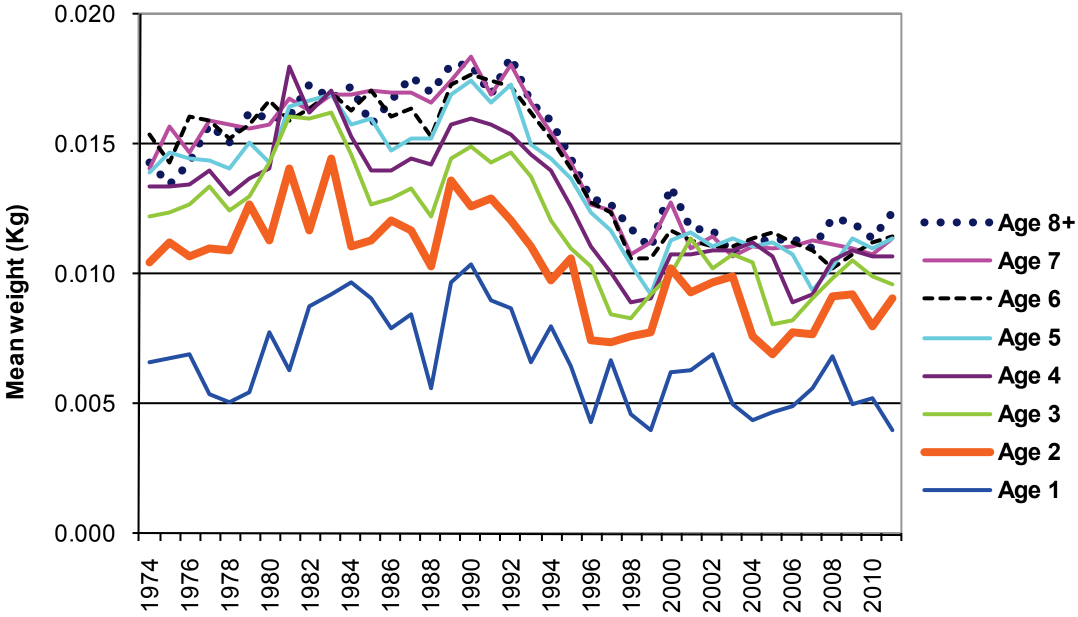


Figure 8.4.8.4 Sprat in Subdivisions 22–32 (Baltic Sea). Mean weight-at-age in the catch (age 1 to age 8+).

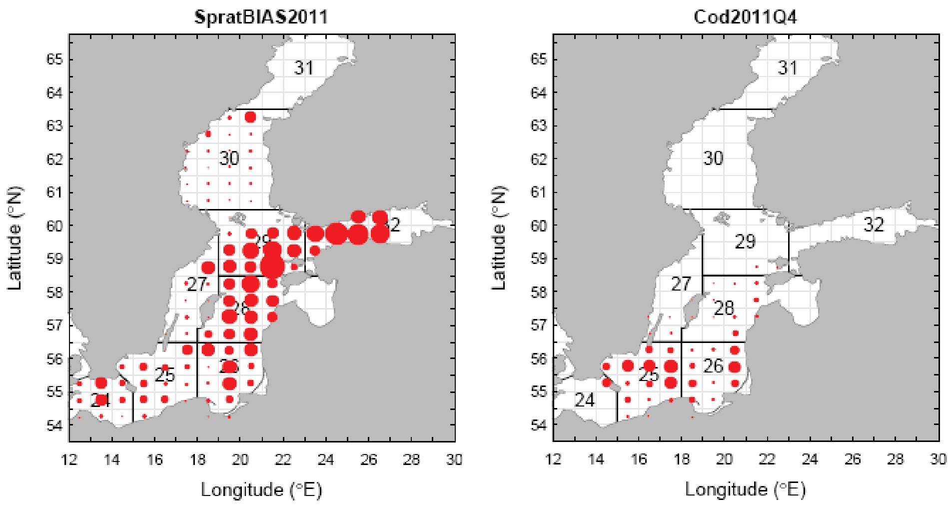


Figure 8.4.8.5 Sprat in Subdivisions 22–32 (Baltic Sea). Distribution of Baltic sprat (left panel) and eastern Baltic cod (Subdivisions 25–32, right panel) from acoustic surveys (BIAS, sprat) and bottom trawl surveys (BITS, cod) in the 4th quarter 2011.

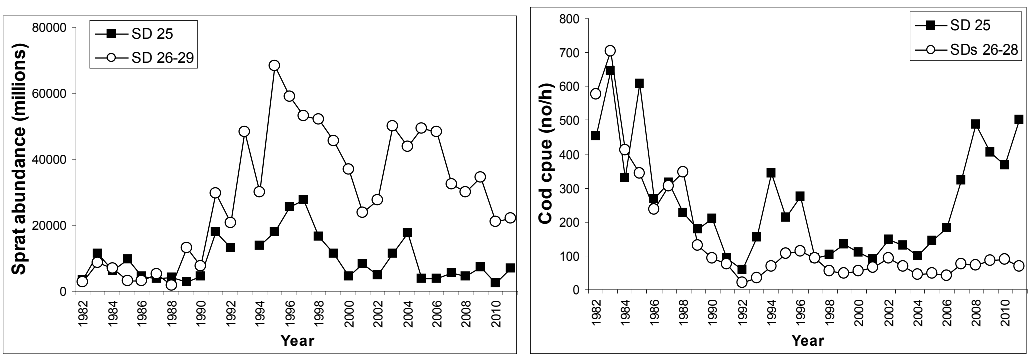


Figure 8.4.8.6 Sprat in Subdivisions 22–32 (Baltic Sea). Trends of average sprat abundance (left panel) and cod cpue (right panel) in the southwest (Subdivision 25) and northeast (Subdivisions 26–28) Baltic Sea, from acoustic and BITS surveys. Subdivision 29 is not well covered by the BITS survey.

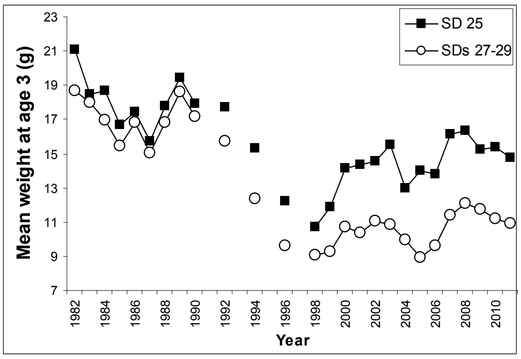


Figure 8.4.8.7 Sprat in Subdivisions 22–32 (Baltic Sea).Trends of sprat mean weight-at-age 3 in the southwest (Subdivision 25) and northeast (Subdivisions 27–29) Baltic, from Swedish acoustic surveys in the 4th quarter.

Table 8.4.8.1 Sprat in Subdivisions 22–32 (Baltic Sea). ICES advice, management, and catch.

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC	ICES catch
1987			117.2	88
1988	Catch could be increased in Subdivisions 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 F_{pa}	304	467.5	421
2000	Proposed F_{pa}	192	400	389
2001	Proposed F_{pa}	314	355	342
2002	Proposed F_{pa}	369	380	343
2003	Below proposed F_{pa} (TAC should be set on Central Baltic Herring considerations)	300	310	308
2004	Below proposed F_{pa} (TAC should be set on Central Baltic Herring considerations)	474	420	374
2005	TAC should be set on Central Baltic Herring considerations	< 614	550	405
2006	Agreed Management Plan	439	468	352
2007	$< F_{pa}$	<477	454*	388
2008	$< F_{pa}$	<432	454*	381
2009	$< F_{pa}$	<291	399*	407
2010	$< F_{pa}$	<306	380*	342
2011	$< F_{pa}$	<242	289*	268
2012	MSY transition scheme	<242	225*	
2013	$F<F_{msy}$	<278		

Weights in thousand tonnes.
*EU autonomous quota, not including Russian catches.

Table 8.4.8.2 Sprat in Subdivisions 22–32 (Baltic Sea). Landings by country (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
2006	42.1	46.8	19.0	30.8	54.6	7.5	54.3	28.2	68.7	352.1
2007	37.6	51.0	24.6	30.8	60.5	20.3	58.7	24.8	80.7	388.9
2008	45.9	48.6	24.3	30.4	57.2	18.7	53.3	21.0	81.1	380.5
2009	59.7	47.3	23.1	26.3	49.5	18.8	81.9	25.2	75.3	407.1
2010	43.6	47.9	24.4	17.8	45.9	9.2	56.7	25.6	70.4	341.5
2011	31.4	35.0	15.8	11.5**	33.1	9.9	55.3	19.5	56.2	267.6

* Sum of landings by Estonia, Latvia, Lithuania, and Russia.
** The landing value of 7.7 kt, which was used in the final assessment, was corrected after the assessment meeting.

Table 8.4.8.3 Sprat in Subdivisions 22–32 (Baltic Sea). Landings by country and Subdivision (thousand tonnes).

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	0.005	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**

Year: 2006

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**42.1**	19.4	1.7	6.9	9.9	0.3	2.6	1.2	-	-	-
Estonia	**46.8**	-	-	0.1	-	0.3	5.5	19.2	-	-	21.6
Finland	**19.0**	-	0.2	0.5	1.1	1.9	2.0	6.8	3.5	0.007	3.0
Germany	**30.8**	1.2	0.01	1.3	8.2	12.0	4.6	3.4	-	-	-
Latvia	**54.6**	-	-	1.1	6.0	-	47.5	-	-	-	-
Lithuania	**7.5**	-	-	-	7.5	-	-	-	-	-	-
Poland	**54.3**	-	0.8	16.7	36.8	-	-	-	-	-	-
Russia	**28.2**	-	-	-	27.9	-	-	-	-	-	0.3
Sweden	**68.7**	0.0	0.7	4.6	25.3	13.7	16.6	7.6	0.0	0.0	0.2
Total	**352.1**	**20.5**	**3.4**	**31.3**	**122.8**	**28.3**	**78.9**	**38.3**	**3.5**	**0.007**	**25.1**

Year: 2007

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**37.6**	9.6	0.7	6.4	17.0	-	3.0	0.8	-	-	-
Estonia	**51.0**	-	-	2.2	0.8	0.1	4.3	15.3	-	-	28.3
Finland	**24.6**	0.0	0.0	1.9	4.2	0.3	2.6	4.5	7.2	0.002	3.8
Germany	**30.8**	0.8	0.46	1.8	12.2	5.8	4.8	4.9	-	-	-
Latvia	**60.5**	-	-	5.1	7.4	1.4	46.5	-	-	-	-
Lithuania	**20.3**	-	-	1.7	11.8	-	3.6	3.2	-	-	-
Poland	**58.7**	-	0.8	21.4	36.4	0.04	0.06	-	-	-	-
Russia	**24.8**	-	-	-	24.8	-	-	-	-	-	-
Sweden	**80.7**	-	1.8	10.0	30.8	11.0	14.9	11.9	0.1	-	0.2
Total	**388.9**	**10.4**	**3.8**	**50.5**	**145.4**	**18.7**	**79.8**	**40.6**	**7.3**	**0.002**	**32.4**

Year: 2008

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	**45.9**	5.6	1.0	5.6	4.0	7.1	13.2	0.3	-	-	9.2
Estonia	**48.6**	-	-	0.3	0.0	-	5.3	15.6	-	-	27.3
Finland	**24.3**	-	-	2.1	2.1	0.2	2.3	8.6	5.2	0.0002	3.8
Germany	**30.4**	1.3	0.07	1.8	6.0	4.0	13.7	3.6	-	-	-
Latvia	**57.2**	-	-	2.1	6.3	0.2	48.6	0.005	-	-	-
Lithuania	**18.7**	-	0.01	5.5	6.0	0.7	4.6	1.8	-	-	-
Poland	**53.3**	-	3.9	25.4	23.8	0.02	0.15	-	-	-	-
Russia	**21.0**	-	-	-	21.0	-	-	-	-	-	-
Sweden	**81.1**	-	2.0	13.3	13.2	9.1	27.4	15.4	0.00005	-	0.7
Total	**380.5**	**6.9**	**7.1**	**56.0**	**82.4**	**21.4**	**115.2**	**45.3**	**5.2**	**0.0002**	**41.0**

Table 8.4.8.3 continued

Year: 2009

Country	Total	22	23	24	25	26	27	28	29	30	31	32
Denmark	**59.7**	3.8	0.5	0.7	9.7	14.3	0.3	22.1	8.3	-	-	-
Estonia	**47.3**	-	-	-	0.6	-	-	2.5	13.7	-	-	30.5
Finland	**23.1**	-	-	-	0.0	2.7	0.3	2.9	7.7	4.4	0.0001	5.2
Germany	**26.3**	1.4	-	0.24	1.9	3.7	6.2	9.0	4.0	-	-	-
Latvia	**49.5**	-	-	0.0	6.0	5.0	0.5	38.0	0.008	-	-	-
Lithuania	**18.8**	-	-	0.45	3.3	6.4	0.5	7.2	0.9	-	-	-
Poland	**81.9**	-	0.3	2.1	25.4	33.9	6.60	8.40	5.2	-	-	-
Russia	**25.2**	-	-	-	-	25.2	-	-	-	-	-	-
Sweden	**75.3**	-	-	2.4	7.9	13.5	10.5	28.2	12.6	0.0014	-	0.2
Total	**407.1**	**5.2**	**0.9**	**5.9**	**54.8**	**104.6**	**24.9**	**118.3**	**52.3**	**4.4**	**0.0001**	**35.9**

Year: 2010

Country	Total	22	23	24	25	26	27	28	29	30	31	32
Denmark	**43.6**	8.0	-	0.7	5.2	12.3	2.4	9.6	5.3	-	-	-
Estonia	**47.9**	-	-	-	-	-	-	2.6	16.9	-	-	28.3
Finland	**24.4**	-	-	-	-	1.9	0.3	5.3	6.8	3.3	0.002	6.9
Germany	**17.8**	1.8	-	0.05	1.3	4.7	2.8	4.5	2.7	-	-	-
Latvia	**45.9**	-	-	-	5.2	5.0	-	35.7	-	-	-	-
Lithuania	**9.2**	-	-	-	0.03	4.6	-	4.6	-	-	-	-
Poland	**56.7**	-	0.02	0.1	14.3	32.8	6.1	2.9	0.6	-	-	-
Russia	**25.6**	-	-	-	-	25.6	-	-	-	-	-	-
Sweden	**70.4**	-	-	1.6	5.3	8.8	22.5	19.9	12.2	0.003	-	-
Total	**341.5**	**9.8**	**0.02**	**2.5**	**31.2**	**95.7**	**34.1**	**85.0**	**44.5**	**3.3**	**0.002**	**35.2**

Year: 2011

Country	Total	22	23	24	25	26	27	28	29	30	31	32
Denmark	**31.4**	7.1	-	0.4	2.4	4.0	0.1	8.9	8.1	-	-	0.3
Estonia	**35.0**	-	-	-	0.2	0.2	0.042	2.5	11.9	-	-	20.2
Finland	**15.8**	-	-	-	-	0.6	0.3	1.2	4.5	3.5	-	5.7
Germany	**11.5***	1.2	-	0.061	0.4	2.8	0.011	3.8	3.3	-	-	-
Latvia	**33.1**	-	-	0.003	2.1	4.2	0.1	26.6	-	-	-	-
Lithuania	**9.9**	-	-	0.021	1.8	5.8	0.053	1.7	0.6	-	-	-
Poland	**55.3**	-	-	0.7	9.5	38.0	0.2	6.0	1.0	-	-	-
Russia	**19.5**	-	-	-	-	19.5	-	-	-	-	-	-
Sweden	**56.2**	-	-	1.2	5.9	8.9	11.0	15.4	11.9	0.077	-	1.8
Total	**267.6**	**8.3**	**0.00**	**2.4**	**22.3**	**83.8**	**11.8**	**66.1**	**41.2**	**3.6**	**0.000**	**28.0**

*The landing value of 7.7 kt, which was used in the final assessment, was corrected after the assessment meeting.

Table 8.4.8.4 Sprat in Subdivisions 22–32 (Baltic Sea). Summary of the assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3–5
1974	83816000	1106000	242000	0.3140
1975	37663000	820000	201000	0.3523
1976	201070000	636000	195000	0.3588
1977	40979000	916000	181000	0.3278
1978	16778000	643000	132000	0.3188
1979	33913000	388000	77000	0.2407
1980	22657000	251000	58000	0.2668
1981	66951000	223000	49000	0.1551
1982	42748000	282000	49000	0.2554
1983	153429000	423000	37000	0.1224
1984	54684000	594000	53000	0.1727
1985	41317000	553000	70000	0.1738
1986	15351000	506000	76000	0.2225
1987	34276000	420000	88000	0.2826
1988	13738000	380000	80000	0.2499
1989	40580000	404000	86000	0.2233
1990	49467000	538000	86000	0.1410
1991	53405000	741000	103000	0.1787
1992	90834000	986000	142000	0.2063
1993	87483000	1275000	178000	0.1653
1994	62302000	1323000	289000	0.2671
1995	245321000	1394000	313000	0.3485
1996	159806000	1772000	441000	0.3017
1997	54861000	1747000	529000	0.4119
1998	170889000	1308000	471000	0.4108
1999	52482000	1330000	421000	0.3935
2000	102519000	1256000	389000	0.3311
2001	48171000	1137000	342000	0.3070
2002	53488000	903000	343000	0.3972
2003	108657000	760000	308000	0.4269
2004	212273000	964000	374000	0.5057
2005	42534000	1177000	405000	0.4733
2006	74805000	983000	352000	0.4019
2007	108969000	892000	388000	0.3755
2008	70507000	996000	381000	0.3856
2009	184832000	949000	407000	0.4528
2010	42094000	1061000	342000	0.3368
2011	74977000	809000	264000*	0.2876
2012	97951000**	770000***		
Average	80732744	861949	235316	0.3038

* Total landings in 2011 were 267 600 tonnes.
** Output from recruitment prediction model (RCT3) using acoustic survey.
*** Predicted estimate.

ECOREGION Baltic Sea

STOCK Flounder in Subdivisions 22–32 (Baltic Sea)

Advice for 2013

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 15 100 tonnes.

This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		
	2009–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown

SSB (Spawning-Stock Biomass)		
	2007–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	↘	Decreasing

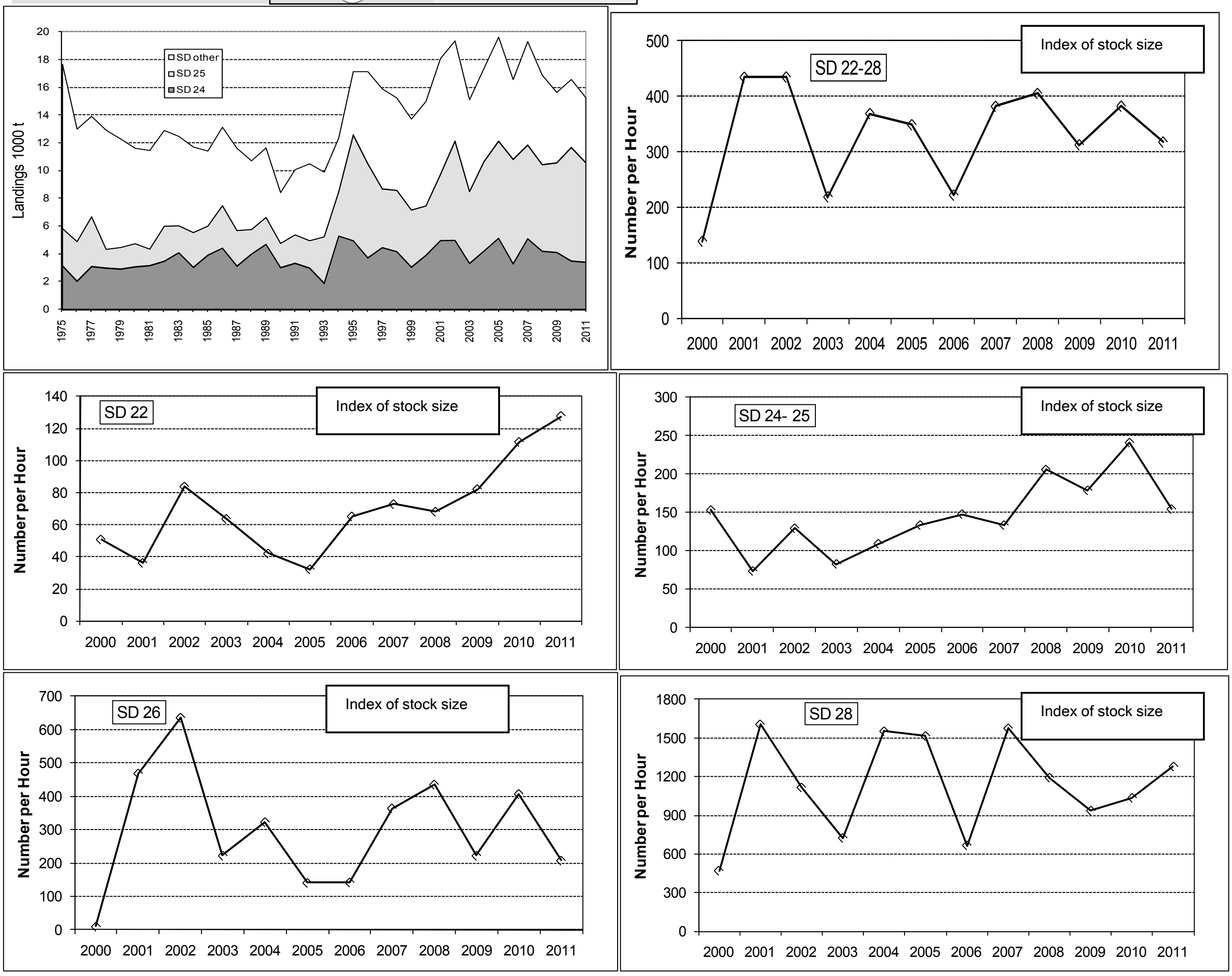


Figure 8.4.9.1 Flounder in Subdivisions 22–32 (Baltic Sea). Official landings in Subdivisions (SD) 24, 25, and the remaining subdivisions of the Baltic Sea (in tonnes, upper left panel). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area), of fish equal to or larger than 20 cm, from the BITS in SDs 22–28 (upper right), SD 22 (middle left), SD 24–25 (middle right), SD 26 (lower left), and SD 28 (lower right). Survey data from ICES DATRAS database.

Based on trends from the Baltic International Trawl Survey (BITS), the stock has fluctuated without trend, although there is an increasing trend in SDs 22 and 24–25. The average stock size indicator (number/hour) for the whole distribution area of the survey (SDs 22–28) in the last two years (2010–2011) is 5% lower than the abundance indices in the three previous years (2007–2009). Preliminary model results suggest increasing stock size and decreasing fishing mortality for the most important components.

Management plans

No specific management objectives are known to ICES.

Biology

Flounder (*Platichthys flesus*) is the most widely distributed among all flatfish species in the Baltic Sea. Flounder occurs in all parts of the Baltic except for the eastern part of Gulf of Finland (Subdivision 32) and the Bothnian Bay (Subdivision 31).

Based on egg buoyancy, there are two spawning groups of flounder in the Baltic: Shallow water spawners with the eggs developing in contact to the bottom, and deep-water spawners with eggs floating freely and developing in the water column. In total, there are indications of eleven flounder populations in the Baltic Sea. Deep-sea spawners (five populations) are located in the western and central parts of the Baltic Sea, while shallow water spawners (six populations) are found in the central and northern parts of the Baltic Sea.

Flounder spawning takes place from March to June. Nursery areas are located in shallow coastal waters where juveniles spend their first 2–3 years.

The fisheries

Flounder is taken as bycatch in demersal fisheries and, to a minor extent, in a directed fishery. Discard data were not available for all fleets, but preliminary analyses of Swedish bycatch and discard data shows that the amount discarded in the demersal trawling for cod can be very high and variable. Estimated discards of flounder may be five to ten times greater than the amounts of landed bycatches of flounder in the cod trawl fishery.

Catch distribution	No information on total catch (2011): 15 kt landings (mainly trawl fishery), high percentage of discards, mainly bycatch, no information on unaccounted removals.

Quality considerations

The uncertainty of the discard estimates is of concern. Discarding practices are controlled by factors such as market price and cod catches. The high variability in the discard ratios makes it extremely expensive and difficult to provide an accurate estimate of discards.

The advice is based on a combined abundance index from two surveys, used as an indicator of stock size. The uncertainty associated with the index values is not available.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey trends and preliminary XSA and difference models.
Input data	Commercial landings and survey data from the Baltic International Trawl Survey (BITS-Q1+Q4).
Discards and bycatch	Information incomplete and not used in assessment.
Indicators	None.
Other information	None.
Working group report	WGBFAS

ECOREGION Baltic
STOCK Flounder in Subdivisions 22–32 (Baltic Sea)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment can be presented for this stock. Therefore, detailed management options cannot be presented. ICES is in the process of compiling existing data and testing assessment models.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

The stock has fluctuated without trend, although for the whole distribution area of the survey (SDs 22–28), the abundance is estimated to have decreased by 5% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies a decrease of catches of at most 5% in relation to the last three years' average landings, corresponding to catches of no more than 15 100 tonnes in 2013.

Additional considerations

The assessment models for this stock are under development. Two approaches have been attempted so far: the XSA partly using information on catch and survey age structure derived with the recommended ageing method, and the difference model with F treated as a random walk. Both methods indicate relatively high stock size, decreasing fishing mortality in recent years (Figure 8.4.9.4), and increasing recruitment (Figure 8.4.9.5). However, assessments are uncertain and show a scattered retrospective pattern. Note that the ICES' advice has not applied the precautionary buffer because effort in the demersal cod fishery has recently reduced under the cod management plan, consistent with the indicated decline in fishing mortality.

There are indications of eleven flounder populations in the Baltic Sea. Deep-sea spawners (five populations) are located in the western and central parts of the Baltic Sea (Figure 8.4.9.2), while shallow water spawners (six populations) are found in the central and northern parts of the Baltic Sea (Figure 8.4.9.3).

The advice is based on the entire stock complex that might consist of eleven potentially separate population units. The analysis of the survey data was not yet based on a finer scale than subdivision. The stocks most important for the fishery and best congruent with one or more subdivisions are presented here.

The management of this stock does not include the setting of a TAC and although only incomplete information on discards is available, discarding is of concern.

Data requirements

Discard estimates must be provided from all countries and included into any assessment based on catch data. Fisheries-independent data from areas north of Subdivision 28 are very limited.

Sources

ICES. 2010. Report of the ICES/HELCOM Workshop on Flatfish in the Baltic Sea (WKFLABA), 8–11 November 2010, Öregrund, Sweden. ICES CM 2010/ACOM:68.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group, ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

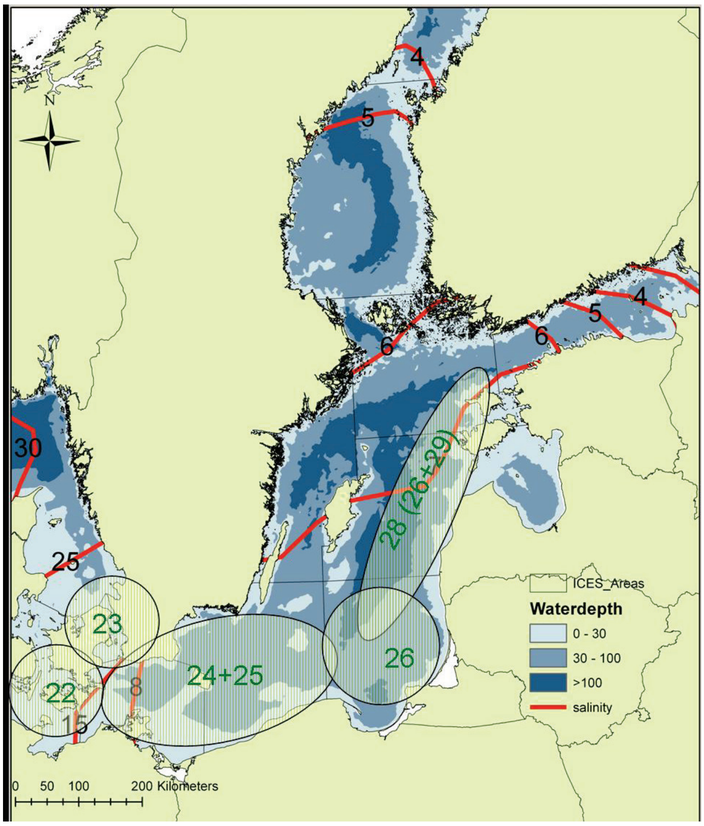


Figure 8.4.9.2 Flounder in Subdivisions 22–32 (Baltic Sea). Approximate location of five identified population units of "pelagic egg"–flounder in the Baltic Sea. Numbers within circles refer to ICES subdivisions.

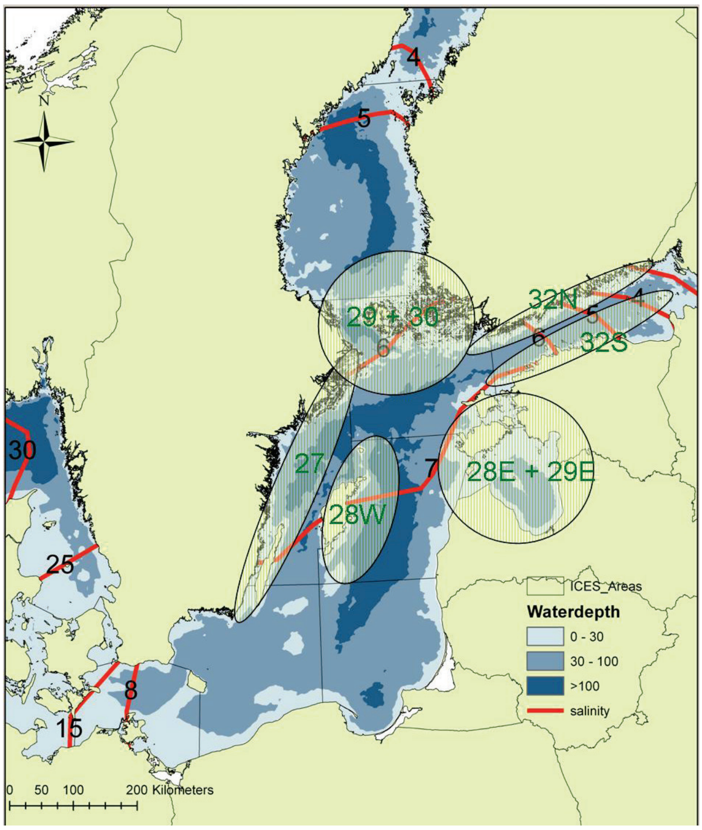


Figure 8.4.9.3 Flounder in Subdivisions 22–32 (Baltic Sea). Approximate location of six identified population units of "demersal egg"–flounder in the Baltic Sea. Numbers within circles refer to ICES subdivision.

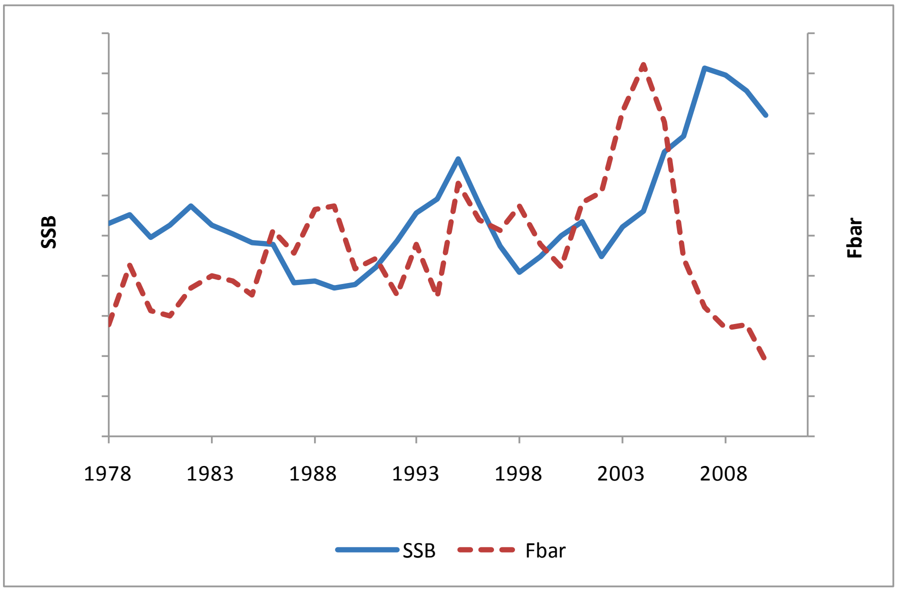


Figure 8.4.9.4 Flounder in Subdivisions 22–32 (Baltic Sea). SSB and fishing mortality (Fbar) trends from a preliminary assessment of flounder in Subdivisions 24–25 using XSA.

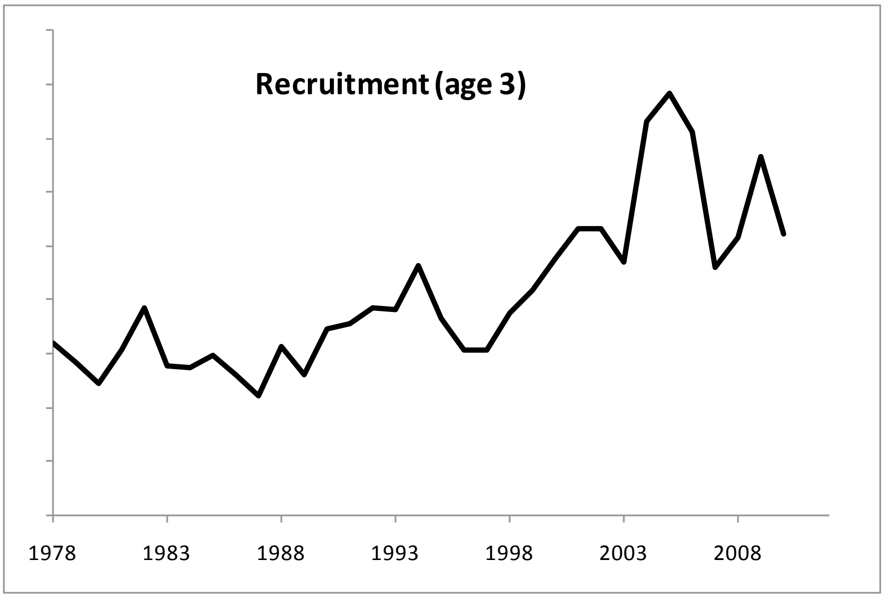


Figure 8.4.9.5 Flounder in Subdivisions 22–32 (Baltic Sea). Recruitment trend from a preliminary assessment of flounder in Subdivisions 24–25 using XSA.

Table 8.4.9.1 Flounder in Subdivisions 22–32 (Baltic Sea). ICES advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings
2000	No advice	-	-	15.0
2001	No advice	-	-	18.1
2002	No advice	-	-	19.4
2003	No advice	-	-	15.1
2004	No advice	-	-	17.4
2005	No advice	-	-	19.6
2006	No advice	-	-	16.6
2007	No advice	-	-	19.3
2008	No advice	-	-	16.9
2009	No advice	-	-	15.7
2010	No advice	-	-	16.6
2011	No advice	-	-	15.3
2012	Reduce catches	-		
2013	Catches should be reduced by 5%	<15.1		

Weights in thousand tonnes.

Table 8.4.9.2 Flounder in Subdivisions 22–32 (Baltic Sea). Total landings (tonnes) 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
1973	Denmark	1.983		386									2.369
	Finland												0
	Gem. Dem. Rep.	181		1.624	1.516								3.321
	Gem. Fed. Rep.	349		4									353
	Poland				1.580	2.070							3.650
	Sweden				502								502
	USSR							2.610					2.610
	Total	2.513	0	2.014	3.598	2.070	0	2.610	0	0	0	0	12.805
1974	Denmark	2.097		2.578									4.675
	Finland												0
	Gem. Dem. Rep.	165		1.482	654								2.301
	Gem. Fed. Rep.	304		3									307
	Poland				1.635	2.473							4.108
	Sweden				470								470
	USSR							2.510					2.510
	Total	2.566	0	4.063	2.759	2.473	0	2.510	0	0	0	0	14.371
1975	Denmark	1.992		1.678									3.670
	Finland								113	22		47	182
	Gem. Dem. Rep.	163		1.469	406								2.038
	Gem. Fed. Rep.	469		1									470
	Poland				1.871	2.585							4.456
	Sweden				400								400
	USSR							6.455					6.455
	Total	2.624	0	3.148	2.677	2.585	0	6.455	113	22	0	47	17.671
1976	Denmark	2.038		482									2.520
	Finland								118	23		59	200
	Gem. Dem. Rep.	174		1.556	901								2.631
	Gem. Fed. Rep.	392		2									394
	Poland				1.549	2.289							3.838
	Sweden				400								400
	USSR					471		1.779	409			359	3.018
	Total	2.604	0	2.040	2.850	2.760	0	1.779	527	23	0	418	13.001
1977	Denmark	1.974		389									2.363
	Finland								115	32		56	203
	Gem. Dem. Rep.	555		2.708	1.096								4.359
	Gem. Fed. Rep.	393		4									397
	Poland				2.071	2.089							4.160
	Sweden				416								416
	USSR					210		1.081	321			414	2.026
	Total	2.922	0	3.101	3.583	2.299	0	1.081	436	32	0	470	13.924
1978	Denmark	2.965		415									3.380
	Finland								174	61		155	390
	Gem. Dem. Rep.	348		2.572									2.920
	Gem. Fed. Rep.	477		1									478
	Poland				996	2.106							3.102
	Sweden				346								346
	USSR					288		1.290	334			395	2.307
	Total	3.790	0	2.988	1.342	2.394	0	1.290	508	61	0	550	12.923
1979	Denmark	2.451		405									2.856
	Finland								192	54		153	399
	Gem. Dem. Rep.	189		2.509									2.698
	Gem. Fed. Rep.	259		3									262
	Poland				1.230	1.860							3.090
	Sweden				315								315
	USSR					158		1.170	330			1.012	2.670
	Total	2.899	0	2.917	1.545	2.018	0	1.170	522	54	0	1.165	12.290
1980	Denmark	2.185		286									2.471
	Finland								194	69		165	428
	Gem. Dem. Rep.	138		2.775									2.913
	Gem. Fed. Rep.	212		1									213
	Poland				1.613	1.380							2.993
	Sweden			16	46		20	181	32				295
	USSR					93		798	334			1.080	2.305
	Total	2.535	0	3.078	1.659	1.473	20	979	560	69	0	1.245	11.618

* Denmark: Catches of SD 23 are included in SD 22 & catches of SDs 28&29 are included in SD 27
Sweden: Catches of SDs 24-29 of the years 1973-1979 are included in SD 25
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 continued

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 continued

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 8.4.9.2 continued

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 8.4.9.2 continued

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
2006	Denmark	620	182	517	1.517	4							2.840
	Finland			2	2				12	4	1	2	23
	Germany	34		974	7								1.015
	Poland			1.779	5.950	1.681							9.410
	Sweden		30	23	61	1	33	20					168
	Estonia							83	165			129	377
	Latvia					317		838					1.155
	Lithuania					355							355
	Russia					1.231							1.231
	Total	654	212	3.295	7.537	3.589	33	941	177	4	1	131	16.574
2007	Denmark	585	233	623	622	2							2.065
	Finland			2	8	1			5	1	0	2	19
	Germany	406		1.432	217	0							2.055
	Poland			3.016	5.837	1.836							10.690
	Sweden		26	27	59	1	39	18	0	0	0		171
	Estonia							92	125			111	328
	Latvia			8	7	166		877					1.058
	Lithuania				11	268							279
	Russia					2.650							2.650
	Total	991	259	5.109	6.761	4.925	39	987	130	1	0	113	19.315

* Finland: Where not given separately,catches of SDs 27&28 are included in SD 29 and catches of SD 31 are included in SD 30

Poland/Latvia Where not given separately,catches of SD 24 are included in SD 25

Germany Where not given separately,catches of SD 25 are included in SD 24

Table 8.4.9.2 continued

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
2008	Denmark	554	199	427	313								1.492
	Finland				0				5	1	0	3	9
	Germany	627		1.608	238								2.473
	Poland*			2.094	5.569	1.456							9.119
	Sweden	0	47	29	66	0	47	18	0	0			207
	Estonia							91	125			103	319
	Latvia			44	29	203		374					651
	Lithuania				31	601		27					660
	Russia					1.960							1.960
	Total	1.180	246	4.202	6.247	4.221	47	511	130	1	0	105	16.891
2009	Denmark	505	113	326	199								1.142
	Finland			44	0				6	1	0	4	56
	Germany	521		1.181	29	1							1.731
	Poland			2.540	5.985	1.671							10.195
	Sweden		37	27	65	0	43	17	0	0			189
	Estonia				0			79	119			121	319
	Latvia				154	52		312					518
	Lithuania				31	472		27					530
	Russia					969							969
	Total	1.026	149	4.118	6.464	3.164	43	435	124	1	0	125	15.650
2010	Denmark	557	91	332	385	0							1.364
	Finland			14	2		0		5	0	0	2	23
	Germany	376		957	31								1.364
	Poland			2.173	7.665	1.731							11.569
	Sweden	0	29	21	64	0	36	15	0	0			165
	Estonia							93	94			117	305
	Latvia				31	25		225					281
	Lithuania				19	407		55					481
	Russia					1.030							1.030
	Total	933	120	3.497	8.196	3.193	36	388	100	0	0	119	16.582
2011**	Denmark	441	78	311	224	1							1.055
	Finland			3	2	1	0	0	4	1	0	2	13
	Germany	497	0	1.504	147								2.147
	Poland			1.567	6.666	1.437							9.670
	Sweden	0	28	26	60	1	34	20	0	0	1		170
	Estonia				20	15	0	74	116	0	0	105	331
	Latvia				39	114	0	156					309
	Lithuania				15	418	0	0					434
	Russia					1.139							1.139
	Total	938	106	3.410	7.174	3.127	34	250	121	1	1	107	15.269

* Poland 2008 corrected

** provisional

Table 8.4.9.3 Flounder in Subdivisions 22–32 (Baltic Sea). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area) from the Baltic International Trawl Survey (BITS-Q1+Q4) of fish equal to or larger than 20 cm in Subdivisions 22–28 (from ICES DATRAS database).

Year	SD 22-28	SD 22	SD 24- 25	SD 26	SD 28
2000	138.6	50.9	153.0	10.4	468.6
2001	434.8	36.3	73.1	468.4	1605.5
2002	435.2	83.7	129.2	635.2	1114.9
2003	218.7	63.6	82.3	222.4	722.6
2004	369.1	42.1	108.9	322.9	1551.7
2005	349.0	32.4	133.3	141.2	1515.0
2006	222.0	65.2	147.7	142.6	665.0
2007	382.2	72.8	133.2	364.1	1574.3
2008	405.5	68.1	206.1	435.2	1191.4
2009	312.8	82.1	178.8	222.2	934.9
2010	382.6	111.4	241.5	407.0	1034.2
2011	317.8	127.6	154.2	207.8	1277.8

8.4.10 Advice June 2012

ECOREGION **Baltic Sea**

STOCK **Plaice in Subdivisions 24-32 (Baltic Sea)**

Advice for 2013

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 900 tonnes.

This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)	
	2009–2011
MSY (F_{MSY})	Unknown
Precautionary approach (F_{pa},F_{lim})	Unknown
SSB (Spawning-Stock Biomass)	
	2007–2011
MSY ($B_{trigger}$)	Unknown
Precautionary approach (B_{pa},B_{lim})	Unknown
Qualitative evaluation	Increasing

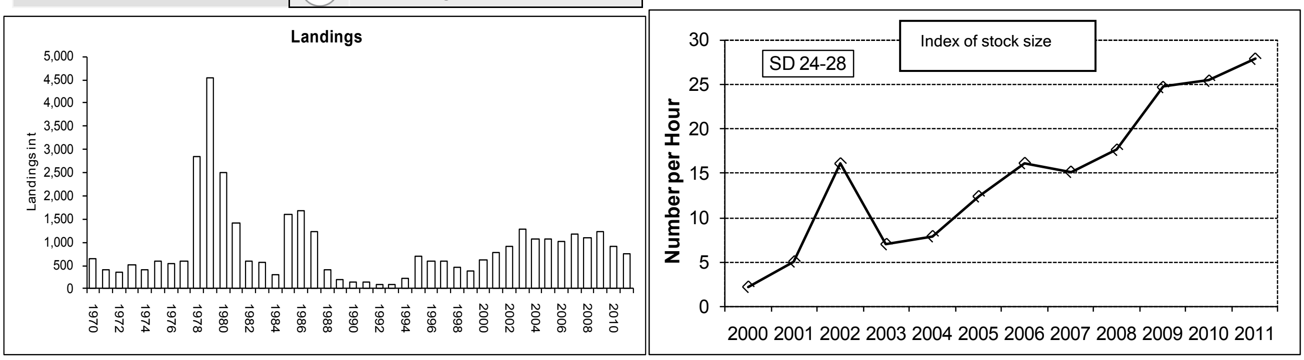


Figure 8.4.10.1 Plaice in Subdivisions 24–32 (Baltic Sea). Official landings (Subdivisions 24–32, in tonnes, left panel). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area), of fish equal to or larger than 20 cm, from the Baltic International Trawl Survey (BITS-Q1+Q4) in Subdivisions 24–28 (right panel, from ICES DATRAS database).

Survey trends have increased steadily since the early 2000s by about five times. The average stock size indicator (number/hour) in the last two years (2010–2011) is 39% higher than the abundance indices in the three previous years (2007–2009).

The stock definition has changed; plaice in Subdivisions 22–23 are considered in Section 8.4.11.

Management plans

No specific management objectives are known to ICES.

Biology

Distribution of plaice in the Baltic Sea extends eastwards to the Gulf of Gdansk and northwards to the Gotland area, but it is also found sporadically farther north. The distribution of this species is dependent on salinity.

Based on information on biology and fishery of plaice ICES decided that the plaice from Subdivisions 22 (the Belts) and 23 (the Sound), which were previously assumed to be part of the Baltic Sea stock, should be considered a separate stock unit together with Subdivision 21 (Kattegat) (ICES, 2012a).

There are indications that the spawning areas are likely to be located in the southern part of Subdivision 25 and 26, but the exact spawning locations are not known. Nursery areas are located in shallow waters down to 10 m depth.

Plaice spawn in February–March in the basins.

The fisheries

The fishery is mainly concentrated around Bornholm (Subdivisions 24 and 25) and is dominated by Denmark.

Catch distribution	No information on total catch, 748 t landings (mainly trawl gear).

Quality considerations

Data collection, especially on the amount of discards, needs to be improved in order to get a better estimate of plaice catches in the Baltic Sea.

The advice is based on a combined abundance index from two surveys, used as an indicator of stock size. The uncertainty associated with the index values is not available.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey trends.
Input data	Commercial landings and survey data from Baltic International Trawl Survey (BITS-Q1+Q4).
Discards and bycatch	Discard data not used.
Indicators	None.
Other information	None.
Working group report	WGBFAS

ECOREGION Baltic
STOCK Plaice in Subdivisions 24–32 (Baltic Sea)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment can be presented for this stock. Therefore, detailed management options cannot be presented.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have increased by more than 20% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies an increase of catches of at most 20% in relation to last year's average landings, corresponding to catches of no more than 900 t in 2013.

Considering that the abundance has increased continually since 2003, no additional precautionary reduction is needed.

Additional considerations

Landings are mainly from bycatch in the cod fishery and in a mixed flatfish fishery. Quotas have been restrictive for some nations, but the TAC has not been fished.

Comparison with previous assessment and advice

A new stock definition was considered this year. Plaice from Subdivisions 22 and 23 are no longer considered as being part of the Baltic Sea stock (i.e. Subdivision 24–32).

Assessment and management area

Due to the new stock definition, the advice (Subdivisions 24–32) and the management (Subdivisions 22–32) areas are different.

Sources

ICES. 2012a. Report of the Baltic Fisheries Assessment Working Group, ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

ICES. 2012b. Report of the Workshop on the Evaluation of Plaice Stocks (WKPESTO), 28 February–1 March 2012, ICES Headquarters, Copenhagen. ICES CM 2012/ACOM:32. 59 pp.

Table 8.4.10.1 Plaice in Subdivisions 24–32 (Baltic Sea). ICES advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice[1]	Agreed TAC[2]	Official landings
2000	No advice	-	-	0.63
2001	No advice	-	-	0.79
2002	No advice	-	-	0.92
2003	No advice	-	-	1.28
2004	No advice	-	-	1.08
2005	No advice	-	-	1.08
2006	No advice	-	-	1.01
2007	No advice	-	-	1.17
2008	No advice	-	-	1.10
2009	No advice	-	-	1.23
2010	No advice	-	-	0.90
2011	No advice	-	3.041	0.75
2012	No increase in catches	-	2.889	
2013	No more than 20% catch increase	≤0.9		

Weights in thousand tonnes.

[1] Before 2013 the advice was for Subdivisions 22–32.

[2] For Subdivisions 22–32.

Table 8.4.10.2 Plaice in Subdivisions 24–32 (Baltic Sea). Total landings (tonnes) by subdivision.

	Total by SD						Total
Year	24[1]	25	26	27	28	29	SD 24-32
1970	659						659
1971	423						423
1972	370						370
1973	323	174	30				527
1974	198	114	86				398
1975	297	158	142				597
1976	307	164	76				547
1977	300	265	26				591
1978	1914	633	290				2837
1979	3751	555	224				4530
1980	2073	383	53				2509
1981	1138	239	27				1404
1982	464	49	64	7	1		585
1983	456	84	12	24	2		578
1984	199	109		4	1		313
1985	1429	123	49	5	1		1607
1986	1446	178	59	9	1		1693
1987	1020	198	5	12	1		1236
1988	389	16	1	9	1		416
1989	188	15		6	1		210
1990	152	6					158
1991	126	4	1	2			133
1992	81	7		1			89
1993	76	4					80
1994	163	50	4				217
1995	447	243	3		1		694
1996	368	206	15	1			590
1997	264	316	3	1			584
1998	325	118	14	1			458
1999	234	155	1				390

Table 8.4.10.2 (cont) Plaice in Subdivisions 24–32 (Baltic Sea). Total landings (tonnes) by subdivision.

	Total by SD						Total
Year	24[3]	25	26	27	28	29	SD 24-32
2000	207	420	3				630
2001	225	562	3				790
2002	309	603	3				915
2003	438	830	13	0	0		1281
2004	289	781	11	0	0		1081
2005	289	781	11	0	0		1081
2006	284	725	3				1012
2007	617	550	0	0	0		1167
2008	665	437	0		0		1102
2009	744	481	0	0			1226
2010	473	420	9	0			903
2011[2]	437	309	1	0			748

[2] Preliminary data

Table 8.4.10.3 Plaice in Subdivisions 24–32 (Baltic Sea). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area) from the Baltic International Trawl Survey (BITS-Q1+Q4) of fish equal to or larger than 20 cm in Subdivisions 24–28, data from ICES DATRAS database.

Year	**SD 24–28 (no./hr)**
2000	2.22
2001	5.07
2002	16.09
2003	7.02
2004	7.91
2005	12.40
2006	16.14
2007	15.16
2008	17.64
2009	24.69
2010	25.40
2011	27.87

ECOREGION Baltic Sea
STOCK Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound)

Advice for 2013

This is the first time ICES advises on plaice in the Kattegat, the Belt Sea, and the Sound; previously advice was given for Kattegat and Skagerrak combined and for the Baltic Sea (Subdivisions 22–32). Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 1800 tonnes.

This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

	F (Fishing Mortality)	
	2009–2011	
MSY (F_{MSY})		Unknown
Precautionary approach (F_{pa},F_{lim})		Unknown
Qualitative evaluation		Decreasing, at historic low

	SSB (Spawning-Stock Biomass)	
	2008–2012	
MSY ($B_{trigger}$)		Unknown
Precautionary approach (B_{pa},B_{lim})		Unknown
Qualitative evaluation		Increasing

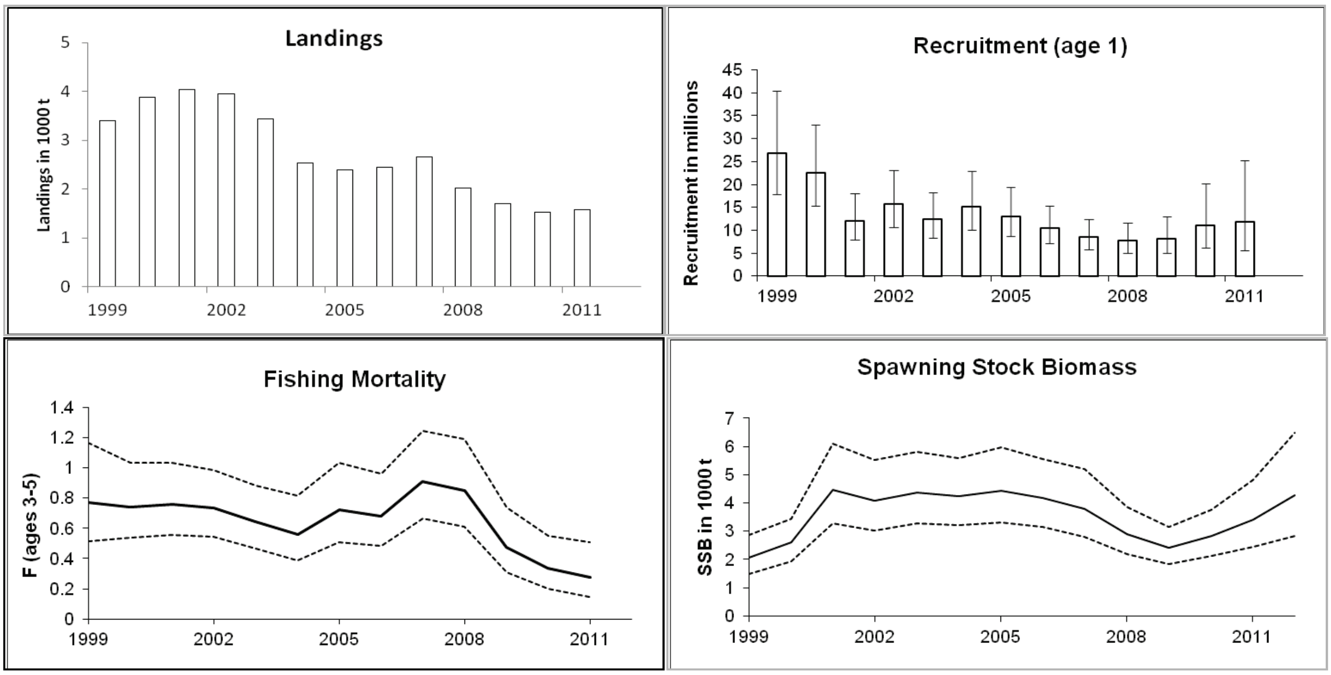


Figure 8.4.11.1 Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound). Summary of stock assessment (weights in thousand tonnes).

An exploratory assessment is presented, which is considered highly uncertain because of the short time-series available. The exploratory assessment shows that fishing mortality has dropped since 2006, and SSB has been increasing since 2009.

Management plans

No specific management objectives are known to ICES.

Biology

Plaice aggregate at spawning grounds in the first quarter of the year. Stock boundaries are not completely clear, due to potentially large connectivity between areas occurring through spawning migration, larval drift, and juvenile homing.

Environmental influence on the stock

Growth patterns for plaice in this area are highly variable, likely because of the great diversity of the local hydrographical conditions in the Skagerrak and Kattegat.

The fisheries

Plaice is caught all year round mainly from winter to spring. In Subdivision (SD) 22 plaice is mostly taken in mixed fisheries together with cod. In SD 21 plaice is almost exclusively a bycatch in the combined *Nephrops*–sole fishery. Historical information on discard ratio in SDs 20 and 21 (Skagerrak and Kattegat) is around 15–25% in weight.

Catch distribution	Total landings (2011) = 1586 tonnes (87% active gears and 11% passive gears).

Quality considerations

This is the first year ICES presents advice for plaice in the Kattegat separate from the Skagerrak. Uncertainty in the catch-at-age information and inappropriate survey spatial coverage make it difficult to conduct a separate assessment for the local components in this area. This assessment is the first attempt to carry out an assessment on plaice in SDs 21–23. Therefore, it is to be considered as a premature assessment with room for improvements until the data foundation is more complete.

The methods applied to derive quantitative advice for data limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	Age-based analytical assessment (SAM).
Input data	Four survey indices (IBTS Q1, IBTS Q3, KASU Q4, KASU Q1);
Discards and bycatch	Not included in the assessment yet, but some data are available.
Indicators	None.
Other information	Before 2012, advice was given for Division IIIa plaice; this advice is now split into plaice in Kattegat, Belts, and Sound and plaice in Skagerrak (Advice Section 6.4.6).
Working group report	WGNSSK, WKPESTO

8.4.11 Supporting information June 2012

ECOREGION **Baltic Sea**
STOCK **Plaice in Subdivisions 21, 22 and 23 (Kattegat, Belts and Sound)**

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Undefined.	
	F_{MSY}	0.25	F_{MSY} for neighbouring North Sea stock. Since selectivity in Kattegat is towards larger fish (discards are considerably lower) this proxy is considered conservative and in the range of other possible proxies.
Precautionary approach	Not defined		

(unchanged since: 2012)

Preliminary yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 3-5	Yield/R	SSB/R
$F_{0.1}$	0.15	0.23	1.51
F_{max}	0.38	0.26	0.60
$F_{SPR30\%}$	0.16	0.24	1.37

Outlook for 2013

Due to uncertainty in the assessment, reliable predictions cannot be presented.

ICES approach to data-limited stocks

For data-limited stocks with abundance and fishing mortality information, ICES uses as harvest control rule an index-adjusted *status quo* catch, further modified so as to reach the F_{MSY} proxy in 2015. The advice is based on a comparison of the two most recent biomass index values with the three preceding values, combined with recent catch or landings data, and subsequently multiplied by the appropriate ratio of values of F.

For this stock, the biomass is estimated to have increased by 42% in 2008–2010 (average of three years) and 2011–2012 (average of two years), whereas the current fishing mortality should be reduced by 18% in 2013 as a first step to reach the F_{MSY} proxy by 2015. Since the product of 1.42 and 0.82 is 1.16, this implies an increase in catches of 16% in relation to last three years' average landings, corresponding to catches of no more than 1800 t.

Additional considerations

Management considerations

The flatfish benchmark group (ICES, 2010) recommended exploring the potential to perform an integrated assessment of the continuum of plaice stocks from the Baltic to the English Channel. ICES evaluated the stock identity of plaice in the Skagerrak and Kattegat (ICES, 2012a, 2012b), for which combined advice has been given until now. Adjacent waters, such as the North Sea in the West and the Belts and Sound in the East are taken into account, based on known migration of local components between their spawning and feeding grounds. Although work on stock identity is still under development, the collected information on biology and fishery of plaice in Division IIIa and adjacent waters is considered to imply changes in assessment units as well as in management areas. This assessment is the first attempt to carry out an assessment on plaice in SDs 21–23. Therefore, it is to be considered as a premature assessment with room for improvements until the data foundation is more complete.

Kattegat has different area names depending on the point of view. Seen from the Baltic the Kattegat is called "Subdivision 21", originally based on the area classification of the International Baltic Sea Fishery Commission. Seen from the Atlantic, however, Kattegat is classified as "Division IIIaS", based on the NEAFC system. In this assessment Kattegat is called SD 21 (Figure 8.4.11.2).

The surveys are not in full agreement, but they tend to indicate that there have been a number of large year classes over the period 2000–2006, but that the recent year classes have been lower.

The effects of regulations

Landings declined dramatically in the late seventies in the whole area. Implementation of a number of changes in the regulatory systems in the Kattegat between 2007 and 2008 as well as continuous reductions in the allowed days-at-sea to protect Kattegat cod have also significantly changed the fishing patterns of the Danish and Swedish fleets since the early 2000s. In SD 23 (the Sound) catches have been low over the whole period.

TACs are set for Kattegat separately, based on a combined advice for Kattegat and Skagerrak. There is a single TAC for plaice in the whole Baltic area SDs 22–32.

Uncertainties in assessment and forecast

Due to time constraints, only biological information from Denmark was made available for SDs 22 and 23 and it was therefore applied to both Swedish and German landings. No discard information was readily available this year, but will be available in the future.

The surveys are not in full agreement, but they tend to indicate that there have been a number of large year classes over the period 2000–2006, but that the recent year classes have been lower.

Comparison with previous assessment and advice

The stock structure of plaice in the Skagerrak and Kattegat area is revised (ICES, 2012b). This is the first time an assessment is produced for plaice in the Kattegat, Sound, and Belts. The assessment is based on an exploratory assessment.

Last year, the advice was based on precautionary considerations to reduce catches of plaice in the Skagerrak and Kattegat. This year the advice is based on ICES approach to data-limited stocks for Skagerrak separately.

Assessment and management area

The stock is managed by a TAC for Division IIIaEast (Kattegat), and a TAC for plaice in the Baltic (SDs 22–32). The advice is valid for Kattegat, the Sound, and the Belts.

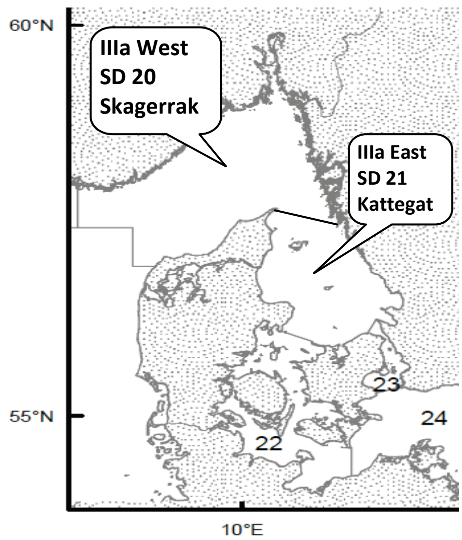


Figure 8.4.11.2 Plaice in the Skagerrak and Kattegat. Subareas in the region.

Sources

ICES. 2010. Report of the Benchmark Workshop on Flatfish (WKFLAT), 25 February–4 March 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:37.

ICES. 2012a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

ICES. 2012b. Report of the Workshop on the Evaluation of Plaice Stocks (WKPESTO). 28 February–1 March 2012, ICES Headquarters, Copenhagen. ICES CM 2012/ACOM:32.

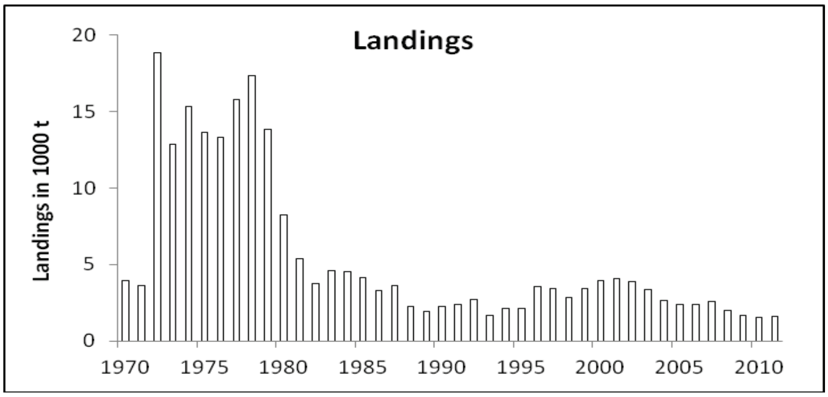


Figure 8.4.11.3 Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound). ICES estimates of landings (full time-series, the exploratory assessment starts in 1999).

Table 8.4.11.1 Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound). ICES advice, management, and landings. **NB up until 2012, advice was given for Skagerrak and Kattegat combined.**

Year	ICES Advice	Predicted catch corresp. to advice Kattegat, Belts, and Sound	Predicted catch corresp. to advice for Skagerrak and Kattegat combined	TAC Kattegat (SD 21)	TAC Baltic Sea (SDs 22–32)	ICES landings
1992	TAC		14.0	2.8		2.7
1993	Precautionary TAC		-	2.8		1.7
1994	If required, precautionary TAC		-	2.8		2.1
1995	If required, precautionary TAC		-	2.8		2.1
1996	If required, precautionary TAC		-	2.8		3.5
1997	No advice		-	2.8		3.4
1998	No increase in F from the present level		11.9	2.8		2.9
1999	No increase in F from the present level		11.0	2.8		3.4
2000	$F < F_{pa}$		11.8	2.8		3.9
2001	$F < F_{pa}$		9.4	2.35		4.1
2002	$F < F_{pa}$		8.5[1]	1.6[2]		3.9
2003	$F < F_{pa}$		18.4	3.0		3.4
2004	$F < F_{pa}$[3]		[3]	1.8		2.6
2005	$F < F_{pa}$		< 9.5	1.9		2.4
2006	No increase in F		< 9.6	1.9		2.4
2007	Maintain current TAC		<9.6	2.1		2.6
2008	No increase in catch		<9.4	2.3		2.0
2009	Same advice as last year		<9.4	2.3		1.7
2010	Same advice as last year		<9.4	2.3		1.5
2011	Last three years average landings (2007–2009)		<8.0	2.0	3.041	1.6
2012	Reduce catch		-		2.889	
2013	Increase catch by 16%, transition to F_{MSY} proxy for data-limited stocks by 2015	<1.8				

Weights in thousand tonnes.
1) In March 2002 ACFM revised its advice to 11.6 for both areas combined.
2) The TAC for the two areas combined was adjusted to 11 200 tonnes in mid-2002.
3) The exploitation of this stock should be conducted in the context of mixed fisheries.

Table 8.4.11.2 Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound). ICES estimates of landings by country in tonnes.

Year/SD	Denmark	Germany	Sweden	Denmark	Germany	Sweden	Sweden	Denmark	Total
	21	21	21	22	22	22	23	23	21-23
1970				3 757	202				3959
1971				3 435	160				3595
1972	15 504	77	348	2 726	154				18809
1973	10 021	48	231	2 399	165				12864
1974	11 401	52	255	3 440	202				15350
1975	10 158	39	296	2 814	313				13620
1976	9 487	32	177	3 328	313				13337
1977	11 611	32	300	3 452	353				15748
1978	12 685	100	312	3 848	379				17324
1979	9 721	38	333	3 554	205				13851
1980	5 582	40	313	2 216	89				8240
1981	3 803	42	256	1 193	80				5374
1982	2 717	19	238	716	45				3735
1983	3 280	36	334	901	42				4593
1984	3 252	31	388	803	30				4504
1985	2 979	4	403	648	94				4128
1986	2 470	2	202	570	59				3303
1987	2 846	3	307	414	18				3588
1988	1 820	0	210	234	10				2274
1989	1 609	0	135	167	7				1918
1990	1 830	2	202	236	9				2279
1991	1 737	19	265	328	15				2364
1992	2 068	101	208	316	11				2704
1993	1 294	0	175	171	16		2		1658
1994	1 547	0	227	355	1		6		2136
1995	1 254	0	133	601	75		12	64	2139
1996	2 337	0	205	859	43	1	13	81	3539
1997	2 198	25	255	902	51		13		3444
1998	1 786	10	185	642	213		13		2849
1999	1 510	20	161	1 456	244	1	13		3405
2000	1 644	10	184	1 932	140		26		3936
2001	2 069		260	1 627	58		39		4053
2002	1 806	26	198	1 759	46		42		3877
2003	2 037	6	253	1024	35	0	26		3381
2004	1 395	77	137	911	60		35		2615
2005	1 104	47	100	908	51		35	145	2390
2006	1 355	20	175	600	46		39	166	2401
2007	1 198	10	172	894	63		69	193	2599
2008	866	6	136	750	92	0	45	116	2011
2009	570	5	84	633	194	0	42	139	1668
2010	428	3	66	748	221	0	17	57	1541
2011[1]	328	0	40	851	310		11	46	1586

Table 8.4.11.3 Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound). Summary of the assessment: Estimated recruitment (in thousands), total stock biomass (TBS), spawning-stock biomass (SSB), and average fishing mortality for ages 3 to 5 (F3–5). (weights in tonnes). Low = 5% confidence limit, High = 95% confidence limit.

Year	Recruits	Low	High	TSB	Low	High	SSB	Low	High	F35	Low	High
1999	26903	17917	40396	2990	2199	4065	2063	1487	2862	0.774	0.515	1.165
2000	22516	15312	33110	3899	2914	5219	2593	1949	3448	0.744	0.536	1.033
2001	11986	7983	17997	6272	4595	8562	4468	3271	6102	0.761	0.559	1.035
2002	15670	10624	23113	5334	3968	7170	4088	3025	5523	0.734	0.547	0.984
2003	12328	8319	18268	5696	4304	7538	4378	3295	5818	0.644	0.469	0.884
2004	15183	10093	22838	5326	4046	7010	4238	3207	5599	0.562	0.388	0.814
2005	12944	8619	19439	5681	4245	7602	4446	3313	5966	0.723	0.507	1.033
2006	10515	7175	15410	5293	3987	7026	4185	3151	5559	0.683	0.486	0.96
2007	8505	5836	12395	4732	3479	6437	3809	2785	5211	0.91	0.665	1.247
2008	7672	5081	11584	3595	2718	4757	2911	2188	3873	0.853	0.611	1.19
2009	8101	5021	13070	2994	2295	3905	2402	1835	3144	0.475	0.307	0.736
2010	11126	6144	20145	3551	2655	4750	2824	2112	3776	0.334	0.202	0.553
2011	11830	5537	25278	4288	3042	6044	3423	2435	4811	0.275	0.148	0.509
2012				5276	3450	8068	4277	2817	6493			

8.4.12 Advice June 2012

ECOREGION **Baltic Sea**

STOCK **Dab in Subdivisions 22–32 (Baltic Sea)**

Advice for 2013

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 1400 tonnes.

This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		
		2009–2011
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown

SSB (Spawning-Stock Biomass)		
		2007–2011
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	↗	Increasing

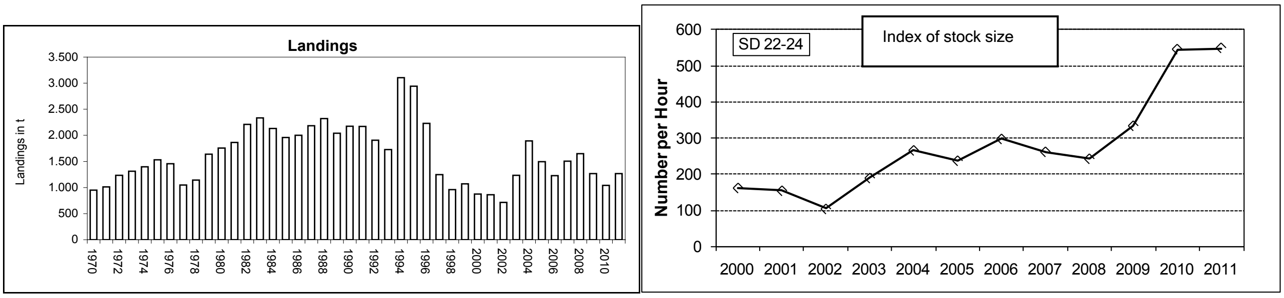


Figure 8.4.12.1 Dab in Subdivisions 22–32 (Baltic Sea). Official landings (in tonnes, left panel). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area), of fish equal to or larger than 20 cm, from the Baltic International Trawl Survey (BITS-Q1+Q4) in Subdivisions 22, 23, and 24 (right panel, from ICES DATRAS database).

Survey trends show an increasing trend since the early 2000s. The average stock size indicator (number/hour) in the last two years (2010–2011) is 96% higher than the abundance indices in the three previous years (2007–2009).

Management plans

No specific management objectives are known to ICES.

Biology

Dab (*Limanda limanda*) is distributed mainly in the western part of the Baltic Sea. The eastern border of its occurrence is not clearly described. There are indications of three dab populations in the Baltic Sea: One in the Belt Sea (Subdivisions 22 and 24W), one in the Sound (Subdivision 23), and a joint one in the Arkona and Bornholm basins (Subdivisions 24E and 25). Nursery grounds are located in shallow coastal areas and spawning only takes place in the western Arkona basin.

The fisheries

The main dab landings are taken by Denmark (Subdivisions 22 and 24) and Germany (mainly in Subdivision 22). The German landings of dab are mostly bycatches of the directed cod fishery. In 2003 a trawl fishery targeting dab was started in Subdivision 22.

Catch distribution	No information on total catch (2011), 13 kt landings (mainly trawl fishery).

Quality considerations

Data collection, especially regarding stock structure and stock identification and on the amount of discards, needs to be improved in order to get a better understanding of the state of dab in the Baltic Sea.

Survey data for Subdivisions 22–24 only are presented. These subdivisions are considered to contain the bulk of the stock. The advice is based on a combined abundance index from two surveys, used as an indicator of stock size. The uncertainty associated with the index values is not available.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey trends.
Input data	Commercial landings and survey data from the Baltic International Trawl Survey (BITS-Q1+Q4).
Discards and bycatch	Information not available.
Indicators	None.
Other information	None.
Working group report	WGBFAS

8.4.12 Supporting information June 2012

ECOREGION **Baltic Sea**
STOCK **Dab in Subdivisions 22–32 (Baltic Sea)**

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment can be presented for this stock. Therefore, detailed management options cannot be presented.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have increased by more than 20% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies an increase of catches of at most 20% in relation to the last three years' average landings of 1200 tonnes. This corresponds to catches of no more than 1400 tonnes.

Considering that the abundance has increased more than 50%, no additional precautionary reduction is needed.

Additional considerations

During the years 1994 to 1996 the total landings of dab were over-reported due to bycatch misreporting in the cod fishery.

There are indications of three dab populations in the Baltic Sea: One in the Belt Sea (Subdivisions 22 and 24W), one in the Sound (Subdivision 23), and a joint one in the Arkona and Bornholm basins (Subdivisions 24E and 25, Figure 8.4.12.2) (ICES, 2010).

Data requirements

Data collection, especially regarding population structure, needs to be improved in order to get a better understanding of the state of dab in the Baltic Sea.

Sources

ICES. 2010. Report of the ICES/HELCOM Workshop on Flatfish in the Baltic Sea (WKFLABA), 8–11 November 2010, Öregrund, Sweden. ICES CM 2010/ACOM:68.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group, ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

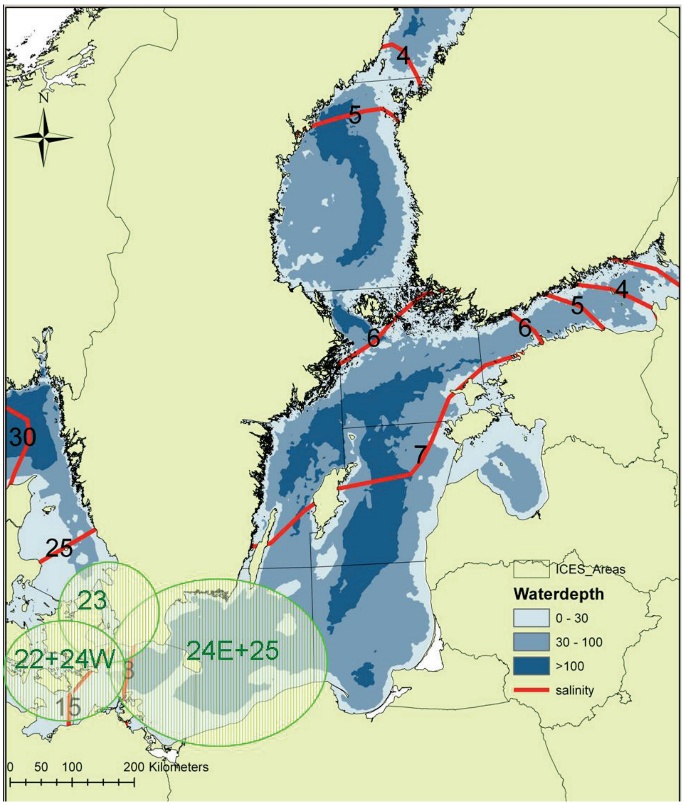


Figure 8.4.12.2 Dab in Subdivisions 22–32 (Baltic Sea). Approximate location of three potential population units of dab in the Baltic Sea (from ICES, 2010). Numbers within circles refer to ICES subdivision (SD).

Table 8.4.12.1 Dab in Subdivisions 22–32 (Baltic Sea). ICES advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings
2000	No advice	-	-	0.876
2001	No advice	-	-	0.861
2002	No advice	-	-	0.715
2003	No advice	-	-	0.1233
2004	No advice	-	-	1.894
2005	No advice	-	-	1.495
2006	No advice	-	-	1.228
2007	No advice	-	-	1.504
2008	No advice	-	-	1.648
2009	No advice	-	-	1.268
2010	No advice	-	-	1.041
2011	No advice	-	-	1.268
2012	Catches should not be increased	-	-	
2013	No more than 20% catch increase	≤1.4	-	

Weights in thousand tonnes.

Table 8.4.12.2 Dab in Subdivisions 22–32 (Baltic Sea). Total landings (tonnes) by subdivision and country.

Year/SD	Denmark				Ger. Dem. Rep.[1]		Germany, FRG				Sweden[2]								Total									Total
	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	1.110		30		9		63						23						1.182		53							1.235
1973	1.087		58		18		118						30						1.223		88							1.311
1974	1.178		51		18		118						34						1.314		85							1.399
1975	1.273		74		20		131						32						1.424		106							1.530
1976	1.238		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	1.413		50		18	25	123	1					9						1.554		85							1.639
1980	1.593		21		15	25	101						3						1.709		49							1.758
1981	1.601		32		24	39	164						5						1.789		76							1.865
1982	1.863		50		46	38	182	4					6	5	8	6		1	2.091		98	5		8	6		1	2.209
1983	1.920		42		46	28	198						24	20	32	22		2	2.164		94	20		32	22		2	2.334
1984	1.796		65		30	47	175	2					4	3	5	4		1	2.001		118	3		5	4		1	2.132
1985	1.593		58		52	51	187	2					3	3	5	3		1	1.832		114	3		5	3		1	1.958
1986	1.655		85		36	35	185	1					1	1	1	1			1.876		122	1		1	1			2.001
1987	1.706		93		14	87	276	4					1	1	1	1			1.996		185	1		1	1			2.184
1988	1.846		75		22	91	281	1					1	1	1	1			2.149		168	1		1	1			2.320
1989	1.722		48		26	19	218	1					1	1	2	1			1.966		69	1		2	1			2.039
1990	1.743		146		14	11	252	1					8						2.009		166							2.175
1991	1.731		95				340	5					1						2.071		101							2.172
1992	1.406		81				409	6						1	1		4		1.815		87	1		1		4		1.908
1993	996		155				556	10				7	1	1			1		1.552	7	166	1				1		1.727
1994	1.621		163				1.190	80	45			5	1	1					2.811	5	244	46						3.106
1995	1.510	47	127	10			1.185	49	3			5	1	5		1			2.695	52	177	18			1			2.943
1996	913	37	128				991	134	13	2	3		3	4	1				1.907	37	265	17	2	1				2.229
1997	728		60				413	21	2			5	5	10	3	1			1.141	5	86	12		3	1			1.248
1998	569		89				280	6	2			7	3	3	1				849	7	98	5		1				960
1999	664		59				339	4				3	1	1					1.003	3	64	1						1.071
2000	612		46				212	3				2		1					824	2	49	1						876
2001	586		72				191	5				4	1	2					777	4	78	2						861
2002	502		31				173	5				4							675	4	36							715
2003	559		171				494	7	0			1	0						1.053	1	179	0						1.233
2004	953		185				745	10	0			1	1	0					1.698	1	196	0						1.894
2005	752	34	163	16			474	45	9			1	1	0					1.226	35	209	25						1.495
2006	400	23	112	161			494	24	11			1	2						894	24	138	172						1.228
2007	860	40	108	7			472	18	0			0	0	0					1.332	40	126	7						1.504
2008	757	36	86	222			507	33	0			3	0	1	1	2			1.264	39	119	223		1	2			1.648
2009	521	25	97	0			587	32	0			2	0	0	1	3			1.108	27	129	1		1	3			1.268
2010	552	18	51	0			398	17	2			1	0	0					950	19	69	2						1.041
2011[4]	544	20	39	0			647	15	0			1	0	1	0	0			1.192	21	53	1		0	0			1.268

[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.

Table 8.4.12.3 Dab in Subdivisions 22–32 (Baltic Sea). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area) from the Baltic International Trawl Survey (BITS-Q1+Q4) of fish equal to or larger than 20 cm in Subdivisions 22, 23, and 24 (from ICES DATRAS database).

Year	SD 22-24 (no./hr)
2000	163
2001	155
2002	105
2003	190
2004	266
2005	238
2006	298
2007	262
2008	243
2009	334
2010	545
2011	549

ECOREGION **Baltic Sea**
STOCK **Turbot in Subdivisions 22–32 (Baltic Sea)**

Advice for 2013

Based on the ICES approach for data-limited stocks, ICES advises that catches should be less than 220 tonnes.

This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		
	2009–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown

SSB (Spawning-Stock Biomass)		
	2007–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation		Decreasing

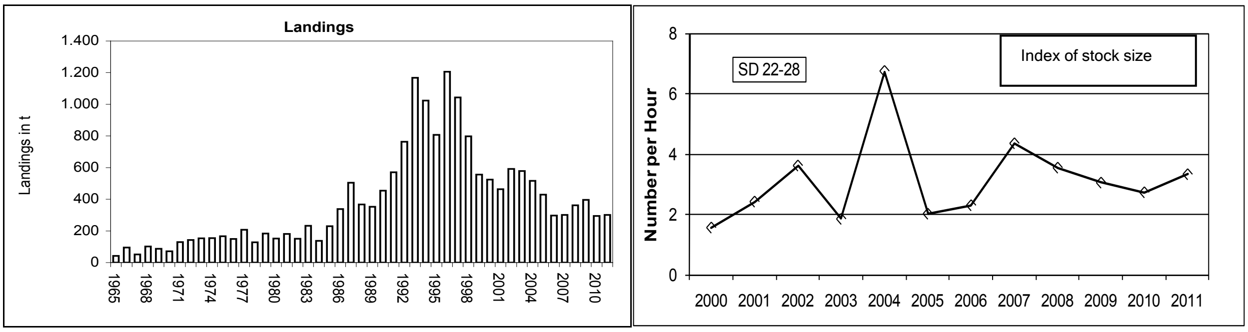


Figure 8.4.13.1 Turbot in Subdivisions 22–32 (Baltic Sea). ICES estimates of landings (in tonnes, left panel). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area), of fish equal to or larger than 20 cm, from the Baltic International Trawl Survey (BITS-Q1+Q4) in Subdivisions (SD) 22–28 (data from ICES DATRAS database, right panel).

The average stock size indicator (number/hour) in the last two years (2010–2011) are 17% lower than the abundance indices in the three previous years (2007–2009). There are indications that turbot should be treated as several local stocks, but there are not enough data to identify these stocks.

Management plans

No specific management objectives are known to ICES.

Biology

In the Baltic Sea turbot (*Psetta maxima*) occurs in the western and southern area up to the Sea of Åland. Turbot mainly feeds on sandeel, herring, and gobies. Turbot spawn in shallow waters and the metamorphosing post-larvae migrate close to shore into shallow water for feeding. Female growth and size-at-age are significantly higher than for males. This leads to higher exploitation of females.

The fisheries

Turbot are caught as a bycatch in trawling and gillnetting and in some years as a target species in a gillnet fishery.

Catch distribution	No information on total catch (2011), 301 t landings (recently mainly from trawl fishery).

Quality considerations

Almost all aspects of data collection need to be improved to get a better understanding of the state of turbot in the Baltic.

The advice is based on a combined abundance index from two surveys, used as an indicator of stock size. The uncertainty associated with the index values is not available.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey trends.
Input data	Commercial landings and survey data from the Baltic International Trawl Survey (BITS-Q1+Q4).
Discards and bycatch	Information not available.
Indicators	None.
Other information	None.
Working group report	WGBFAS

8.4.13 Supporting information June 2012

ECOREGION Baltic Sea
STOCK Turbot in Subdivisions 22–32 (Baltic Sea)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment can be presented for this stock. Therefore, detailed management options cannot be presented.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have decreased by 17% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies a decrease of catches of at most 17% in relation to the last three years' average landings, corresponding to catches of no more than 278 tonnes in 2013.

Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by a further 20% as a precautionary buffer. This results in catches of no more than 220 t in 2013.

Additional considerations

A turbot gillnet fishery started at the beginning of the 1990s in Subdivisions 26 and 28. This development was caused by fishers showing more interest in turbot. In all eastern Baltic countries since 1990 turbot has been sorted out from the flatfish catches due to the better price. For example, from 1999 to 2003 the Polish landings of turbot increased from 33 t to 360 t. Swedish landings are taken mainly in a gillnet fishery that reached a maximum of 250 t in 1996. Since then landings have decreased and been under 50 t for the last five years. Denmark and Germany landed turbot from Subdivisions 22 and 24. Due to the low turbot availability in the EEZ of Latvia and Lithuania, fisheries targeting turbot have been totally closed for the past 10 years.

Genetic information does not reveal any stock structure, while tagging data indicated the existence of small local stocks. Further investigations on stock structure are recommended, especially in the eastern part of the Baltic Sea.

Age determination is uncertain. Some data from Subdivision 28 indicate that fishing mortality is moderate to high.

Turbot is now believed to be taken almost exclusively as valuable bycatch. This limits the possibility to reduce catch of turbot without reducing the much bigger fisheries on other flatfish and cod. The value of the fish suggests it is rarely discarded, which is likely to change if the TAC becomes very restrictive.

Sources

ICES. 2010. Report of the ICES/HELCOM Workshop on Flatfish in the Baltic Sea (WKFLABA), 8–11 November 2010, Öregrund, Sweden. ICES CM 2010/ACOM:68.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group, ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

Table 8.4.13.1 Turbot in Subdivisions 22–32 (Baltic Sea). ICES advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings
2000	No advice	-	-	0.53
2001	No advice	-	-	0.46
2002	No advice	-	-	0.59
2003	No advice	-	-	0.58
2004	No advice	-	-	0.52
2005	No advice	-	-	0.43
2006	No advice	-	-	0.30
2007	No advice	-	-	0.30
2008	No advice	-	-	0.36
2009	No advice	-	-	0.40
2010	No advice	-	-	0.30
2011	No advice	-	-	0.30
2012	Reduce catch	-		
2013	Reduce catches by 17% (and an additional 20%)	< 0.22		

Weights in thousand tonnes.

Table 8.4.13.2 Turbot in Subdivisions 22–32 (Baltic Sea). Total landings (tonnes) by subdivision and country.

Year/SD	Denmark					Germ. Dem. Rep.		Germany, FRG				Poland		Sweden[2]							Latvia		Lithuania	Russia	Finland						Estonia	
	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	24	25	29	30	31	32	29	32
1965						3	39																									
1966	16		21			5	53																									
1967	14		20			7	10																									
1968	14		18			3	67																									
1969	13		13			4	57																									
1970	11		13			5	40									2																
1971	11		26			4	86									2																
1972	10		26			3	100									3																
1973	11		30			3	33					58	13			5																
1974	14		40			2	23					34	36			6																
1975	27		48			3	38	15				23	6			7																
1976	29		24				52	11				14	12			7																
1977	32		37				55	9				12	55			8																
1978	33		37			2	27	9				7	3			10																
1979	23		38			3	39	6				29	34			12																
1980	28		38				30	9				12	20			15																
1981	28		62			1	46	8				10	19			7																
1982	31		51			1	27	7				2	17			3	4		4	3												
1983	33		40			3	9	8				5	4			31	41		35	24												
1984	41		45			4	8	12				13	2			3	4		3	2												
1985	56		34			5	22	15				67	15			4	5		4	3												
1986	99		81			6	32	25				32	37			6	8		7	5												
1987	134		93			4	34	30				155	21			8	11		9	6												
1988	117		117			3	28	34				7	10			12	16		14	9												
1989	135		109			7	22	20					11			11	15		13	9												
1990	178		181			4	2	26				24	25			14																
1991	228		137					44	39			73	20			2	12		16													
1992	267		127					55	68			80	55			12	12		21	36				30								
1993	159	29	152					74	56			520	72		2	4	14		13	38				34								
1994	211	18	166					52	57	10		380	30		2	3	18	1	17	44				15								
1995	257	11	94					65	53	4		30	15		2	3	54	9	31	83	34	27	15	20								
1996	207	12	95					36	47	4	1	288	92	1	3	15	100	5	54	104	42	3	72	25								
1997	151		68					60	52	3		290	70		2	6	70	1	53	86	33	14	59	25								
1998	138		80					44	55	1		66	68		2	4	58	1	18	69	12	24	62	96								
1999	106		59					23	48			18	15		2	4	41	3	17	60	20	34	58	48								
2000	97		58					23	54			90	12		2	3	39		16	39	7	9	23	53								
2001	76		53					19	31			121	10		2	5	16		9	29	5	1	18	69								
2002	73		22	4	0			20	32	2		245	65		5	2	15		7	21	2	8	18	50								
2003	48		28	5	0			10	39	1		184	178		1	2	18		3	14	7	2	13	28								
2004	61		27	7				12	27	1		225	96		1	1	8		3	14	3	8	7	15								
2005	57	5	36	12				14	35	1		123	57		1	3	6		5	21	1	6	18	28								
2006	30	5	16	33				19	45	1		87	11		1	2	5	0	4	19	3	3	9	18								
2007	60	5	26	5	0			22	34	0		83	8		0	5	5		2	15	0	1	12	30								
2008	79	5	33	6				24	30	0		95	15		1	7	11		8	17			10	21								
2009	111	6	35	7	0			33	50	1		92	11		1	6	10	0	5	6	0	0	11	10								
2010	102	6	31	4	0			24	35	0		38	1		1	4	16	0	4	8	3	7	9	2								
2011[4]	84	3	24	3	0			26	31	0		66	11	0	0	8	23	0	2	4	3	6	15	5	0	0	0	0	0	0	0	0

continued

Table 8.4.13.2 continued

Year	Total by SD								Total
	22	23	24[3]	25	26	27	28(+29)	30-32	SD 22-32
1965	3		39						42
1966	21		74						95
1967	21		30						51
1968	17		85						102
1969	17		70						87
1970	16		55						71
1971	15		114						129
1972	13		129						142
1973	14		68	58	13				153
1974	16		69	34	36				155
1975	45		93	23	6				167
1976	40		83	14	12				149
1977	41		100	12	55				208
1978	44		74	7	3				128
1979	32		89	29	34				184
1980	37		83	12	20				152
1981	37		115	10	19				181
1982	39		81	6	17	4	3		150
1983	44		80	46	4	35	24		233
1984	57		56	17	2	3	2		137
1985	76		60	72	15	4	3		230
1986	130		119	40	37	7	5		338
1987	168		135	166	21	9	6		505
1988	154		157	23	10	14	9		367
1989	162		142	15	11	13	9		352
1990	208		197	24	25				454
1991	272		178	85	20	16			571
1992	322		207	92	85	21	36		763
1993	233	31	212	534	106	13	38		1.167
1994	263	20	226	408	46	17	44		1.024
1995	322	13	150	88	93	31	110		807
1996	244	15	157	392	236	55	107		1.206
1997	211	2	126	363	188	53	100		1.043
1998	182	2	139	125	239	18	93		798
1999	129	2	111	59	144	17	94		556
2000	120	2	115	129	95	16	48		525
2001	95	2	89	137	102	9	30		464
2002	93	5	56	266	135	7	29		591
2003	58	1	69	208	225	3	16		579
2004	73	1	55	241	121	3	22		516
2005	72	5	74	143	104	5	27		429
2006	49	5	61	126	30	4	22		297
2007	83	5	60	94	42	2	16		301
2008	103	6	70	113	46	8	17		362
2009	144	7	91	110	33	5	6		396
2010	126	7	70	58	15	4	15		295
2011[4]	110	4	82	74	34	2	10	0	316

[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

Table 8.4.13.2 Turbot in Subdivisions 22–32 (Baltic Sea). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area) from the Baltic International Trawl Survey (BITS-Q1+Q4) of fish equal to or larger than 20 cm in Subdivisions (SDs) 22–24, SDs 25–28, and SDs 22–8. Data from ICES DATRAS database.

Year	Cpue (no./hr)		
	SD 22-24	SD 25-28	SD 22-28
2000	3.7	0.4	1.6
2001	6.4	1.1	2.4
2002	4.6	3.3	3.6
2003	4.2	1.2	1.9
2004	5.4	7.2	6.7
2005	3.7	1.5	2.0
2006	5.0	1.5	2.3
2007	6.5	3.7	4.4
2008	6.4	2.7	3.6
2009	7.8	1.6	3.1
2010	8.1	1.1	2.7
2011	8.4	1.8	3.3

ECOREGION **Baltic Sea**

STOCK **Brill in Subdivisions 22–32 (Baltic Sea)**

Advice for 2013

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 68 tonnes.

This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		
	2009–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
SSB (Spawning-Stock Biomass)		
	2007–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	↗	Increasing

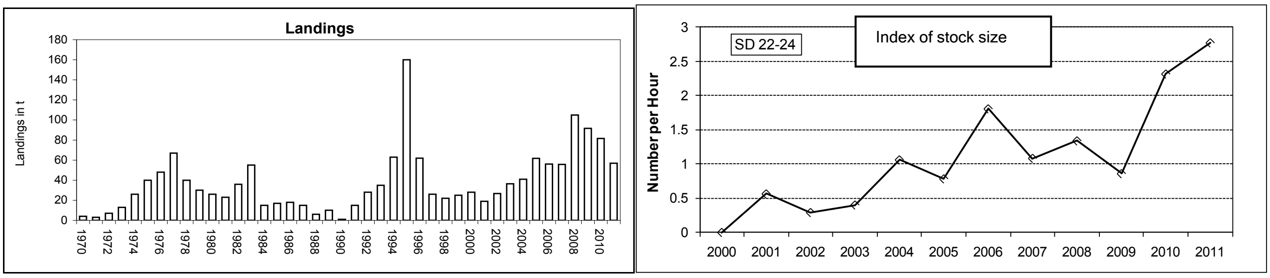


Figure 8.4.14.1 Brill in Subdivisions 22–32 (Baltic Sea). Official landings (in tonnes, left panel). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area), of fish equal to or larger than 20 cm, from the Baltic international trawl survey (BITS-Q1+Q4) in Subdivisions 22, 23, and 24 (right panel, from ICES DATRAS database).

The survey data suggest an increasing trend in stock size. The average stock size indicator (number/hour) in the last two years (2010–2011) is 132% higher than the average of the three previous years (2007–2009).

Management plans

No specific management objectives are known to ICES.

Biology

Brill (*Scophthalmus rhombus*) is distributed mainly in the western part of the Baltic Sea. The easterly border of its occurrence is not clearly described, but brill is very rare in Subdivisions 26–32. Brill is a predator on small fish. Spawning takes place at depths of 5 to 40 m from March to August only in the western part of the Baltic Sea. Nursery areas are located in shallow coastal waters.

There is no information on the stock identity of this species: it is therefore not known if there is one or more stocks in the Baltic Sea or if brill in the Baltic is part of a larger stock complex.

The fisheries

Brill in the Baltic Sea are mainly taken as a bycatch in trawl and gillnet fisheries.

Catch distribution	No information on total catch (2011), 57 t landings (mainly trawl fishery, substantially under-reported), no information on discards is available.

Quality considerations

Data collection, especially regarding stock structure and stock identification and on the amount of discards, needs to be improved in order to get a better understanding of the state of brill in the Baltic Sea.

The advice is based on a combined abundance index from two surveys, used as an indicator of stock size. The uncertainty associated with the index values is not available.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey trends.
Input data	Commercial landings and survey data from the Baltic International Trawl Survey (BITS-Q1+Q4).
Discards and bycatch	Information not available.
Indicators	None.
Other information	None.
Working group report	WGBFAS

8.4.14 Supporting information June 2012

ECOREGION Baltic Sea
STOCK Brill in Subdivisions 22–32 (Baltic Sea)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment is available for this stock. Therefore, detailed management options cannot be presented.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have increased by more than 20% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies an increase of at most 20% in relation to last year's landings, corresponding to catches of no more than 68 tonnes. Considering that the abundance has increased more than 50%, no additional precautionary reduction is needed.

Additional considerations

No studies (tagging, genetic, or other) that could be used to infer population structure within the Baltic Sea are known to ICES. Consequently, there is no basis to suggest potential stock assessment units based on biological information.

In the period from 1970 to 2011 the total reported landings varied between 1 and 160 t. It can be assumed that the total landings of brill reported for 1994–1996 are over-reported due to species misreporting in the landings of the directed cod fishery. Excluding these years, the landings average is about 25 t. A moderate increase of total landings was observed in 2001–2008 (from 19 t in 2001 to 105 t in 2008), but landings have subsequently declined to 57 t in 2011.

Brill are mostly taken as a bycatch in other fisheries. Total catches are small and it may be impractical to do an analytical assessment.

Data requirements

Due to the rare occurrence in the catch, data on brill are very scarce.

Sources

ICES. 2010. Report of the ICES/HELCOM Workshop on Flatfish in the Baltic Sea (WKFLABA), 8–11 November 2010, Öregrund, Sweden. ICES CM 2010/ACOM:68.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group, ICES Headquarters, 12–19 April 2012. ICES CM 2012/ACOM:10.

Table 8.4.14.1 Brill in Subdivisions 22–32 (Baltic Sea). ICES advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings
2000	No advice	-	-	0.028
2001	No advice	-	-	0.019
2002	No advice	-	-	0.027
2003	No advice	-	-	0.036
2004	No advice	-	-	0.041
2005	No advice	-	-	0.062
2006	No advice	-	-	0.056
2007	No advice	-	-	0.056
2008	No advice	-	-	0.105
2009	No advice	-	-	0.092
2010	No advice	-	-	0.082
2011	No advice	-	-	0.057
2012	Catches should not be increased	-		
2013	No more than 20% catch increase	<0.068		

Weights in thousand tonnes.

Table 8.4.14.2 Brill in Subdivisions 22–32 (Baltic Sea). Total landings (tonnes) by Subdivision and country.

Year	Denmark			Germany, FRG	Sweden		Total			Total
	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		0		1		25	1	0	27
2003	35		1		0		35	0	1	36
2004	39		1		1	0	39	1	1	41
2005	50	9	3		0	0	50	9	3	62
2006	42	9	2	3			45	9	2	56
2007	50			5	0	0	55	0	0	56
2008	81	9	3	11	1	1	92	10	3	105
2009	70	7	2	11	1	0	82	8	3	92
2010	65	4	1	10	0	0	76	5	1	82
2011[1]	46	5	1	4	1	0	50	6	1	57

[1] Preliminary data

Table 8.4.14.3 Brill in Subdivisions 22–32 (Baltic Sea). Combined 1st and 4th quarters cpue (no./hr) (weighted average per depth stratum area) from the Baltic International Trawl Survey (BITS-Q1+Q4) of fish equal to or larger than 20 cm in Subdivisions 22, 23, and 24 (from ICES DATRAS database).

Year	**SD 22-24** (no./hr)
2000	0
2001	0.6
2002	0.3
2003	0.4
2004	1.1
2005	0.8
2006	1.8
2007	1.1
2008	1.3
2009	0.9
2010	2.3
2011	2.8

ECOREGION Baltic Sea
STOCK Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia)

Advice for 2013

ICES advises on the basis of the MSY approach a TAC of not more than 54 000 individuals of salmon. As the perception of the stock status has not changed markedly since last year's assessment, the advice for the fishery in 2013 is the same as the advice given in 2011 for the 2012 fishery and, therefore, a decrease in exploitation with respect to the TAC implemented in 2012 is required.

The share of the total catch that is mis- and un-reported was estimated to be about 30% in 2011. Reducing these unaccounted removals would allow a higher TAC recommendation.

Salmon management should be based on the assessments of the status of individual stocks in the rivers. Fisheries on mixed stocks that cannot direct fishing only to those stocks that are close to or above their targets, present particular threats, and effort in such fisheries should be reduced. Fisheries in open-sea areas or coastal waters are more likely to pose these problems than fisheries in estuaries and rivers.

Salmon stocks in the rivers Rickleån and Öreälven in the Gulf of Bothnia, Emån in southern Sweden, and in a majority of the rivers in the southeastern Main Basin are especially weak and need longer-term stock rebuilding measures, including fisheries restrictions, habitat restoration, and removal of physical barriers. In order to maximize the potential recovery of these stocks, further decreases in exploitation are required along their feeding and spawning migration routes. The offshore fishery in the Main Basin catches all weak salmon stocks on their feeding migration. The coastal fishery catches weak stocks from northern rivers when the salmon pass the Åland Sea and Gulf of Bothnia on their spawning migration.

Stock status

To evaluate the current status of the wild stocks, ICES uses the smolt production relative to the potential smolt production capacity (PSPC) on a river-by-river basis. Of the 27 assessed rivers, the probability of having reached 50% of the PSPC in 2011 is above 70% for seven rivers, between 30% and 70% for seven rivers, and below 30% for 13 rivers (Table 8.4.15.2). The probability of having reached 75% of PSPC in 2011 is above 70% for only one of the 27 rivers. With a few exceptions, the rivers in the Northern Baltic Sea area are more likely to have reached 50% or 75% of PSPC, while the status of southern wild stocks is more variable and in many cases much poorer as compared to the northern rivers. The current smolt production is a result of the spawning run several years ago. The relatively weak spawning migrations in both 2010 and 2011 will most likely result in reduced smolt production levels in the near future.

The total wild smolt production has increased, from very low levels, almost tenfold in assessment units 1–2 since the Salmon Action Plan was adopted in 1997 (Figure 8.4.15.1). In assessment unit 3 the smolt production has remained at the same level, and in assessment unit 4 a slightly decreasing trend in smolt production has been observed during the period. Smolt production in assessment unit 5 has been low and without any signs of improvement. Since 2003, the total wild smolt production of all the assessment units combined has increased by about 60%, but has now levelled off and is predicted to peak in 2012. The current smolt production of all the assessment units combined is estimated to be around 70% of the PSPC. However, smolt production is still low in a few of the northern and a majority of the southern small streams, particularly in the 'potential' rivers, i.e. rivers where salmon were extirpated and are now being reintroduced.

The harvest rate (catch relative to abundance) of salmon has decreased considerably since the beginning of the 1990s (Figure 8.4.15.2). In 2008, when the driftnet ban was implemented, the offshore harvest rate went down to a record low level. However, the exploitation in the longline fishery has increased rapidly since 2008 and the current offshore harvest rate is close to the combined harvest rate for longlines and driftnets in the early and mid-2000s.

Post-smolt survival has declined during the last 15 years and has remained very low since 2005 (Figure 8.4.15.3). The post-smolt survival is a key factor influencing salmon abundance at sea, and the decline in survival has suppressed recovery of wild salmon stocks. Although the exploitation rate has declined considerably since the 1990s, which has resulted in increased wild smolt production, the decline in natural survival has had an overriding effect on the abundance of salmon at sea (here illustrated as pre-fishery abundance); the combined wild and reared salmon pre-fishery abundance is currently less than half of what it was in the beginning of the 2000s (Figure 8.4.15.4). The decline in pre-fishery abundance has reduced fishing possibilities considerably.

Management plans

No explicit management objectives have been agreed for Baltic salmon since the International Baltic Sea Fishery Commission (IBSFC) ceased to exist after 2006. In 2011, the EU Commission presented a proposal for the establishment of a multiannual plan for the Baltic salmon stock (COM/2011/0470 final), but the plan has not yet been accepted.

Biology

The Atlantic salmon *Salmo salar* colonized the Baltic Sea by at least three glacial lineages, today represented by salmon in the Gulf of Bothnia, southern Sweden, and the southeastern Baltic Sea including the Gulf of Finland. The salmon reproduce in rivers across the whole Baltic Sea, but the most productive rivers are found in the Gulf of Bothnia. Juvenile salmon stay in the freshwater stream for one to four years and then spend one to several years at sea on a feeding migration before they return to spawn in the natal river. Salmon from different rivers (populations) are mixed in the southern Baltic during the feeding migration, but they become gradually segregated on their migration routes back to the home rivers. The Baltic salmon feed mainly on herring and sprat during the sea migration.

Environmental influence on the stock

Environmental conditions in both freshwater and marine environments have a marked effect on the status of salmon stocks. In many rivers in the southern Baltic, a range of problems in the freshwater environment play a significant role in explaining the poor status of stocks. In many cases river damming and habitat deterioration have had devastating effects on freshwater environmental conditions.

The reasons for the decrease in post-smolt survival are still unclear, but the post-smolt survival has been found to be negatively correlated with seal and smolt abundance, and positively correlated with herring recruitment in the Gulf of Bothnia.

The reason behind the relatively weak spawning runs in 2010 and 2011 is not clear, but cold winter conditions in 2009/2010 and 2010/2011 may be of significance. Previous studies of wild and reared Baltic salmon have found a correlation between spawner run size and spring sea surface temperatures in the Main Basin; following a cold winter and late spring, the salmon tended to arrive in lower numbers and vice versa. Such a correlation can also be seen in recent years for data on spawning run strength from several rivers in the Baltic Sea. Cold winters have also been shown to delay the timing of the spawning run in the subsequent summer.

The fisheries

The nominal catch in the whole Baltic Sea (Subdivisions 22–32), including rivers, has declined from 5636 tonnes in 1990 to 934 tonnes in 2011 (Table 8.4.15.1). The nominal catch in numbers is presented in Tables 8.4.15.1 and 8.4.15.3. Only 49% of the TAC of salmon in Subdivisions 22–31 was utilized in 2011 (Table 8.4.15.4). The nominal catch in the offshore fishery in 2011 was similar to 2010. Preliminary data for 2011 indicate that catches in the coastal fishery were also similar to 2010, whereas river catches increased compared to 2010, particularly when expressed in weight (Table 8.4.15.4). The share of different fisheries (including also discard, unreporting, and misreporting) in the total catch during 2001–2011 is illustrated in Figure 8.4.15.5.

The salmon fishery has changed considerably since the beginning of the 1990s. The very high exploitation rate in the offshore and coastal fisheries has decreased successively due to e.g. 1) regulatory measures such as closed areas and changes in the opening time of fishery, 2) marketing restrictions on large salmon in certain countries due to high dioxin level, and 3) increased seal damage to catches and gear. The driftnet ban in 2008 decreased offshore catches in 2008 to the lowest value recorded since 1972. However, changes in the application of dioxin regulations in 2009, increases in market price for salmon, and reduced opportunities for income in other fisheries have resulted in an increase in offshore fishing effort after 2008. Despite the changes in dioxin regulations, the existing marketing rules probably still suppress some of the fisheries, particularly in Denmark.

Catch distribution	Total catch (2011) is 1.617 kt (whole Baltic Sea), where 60% are landings, 11% discards, and 29% unaccounted removals.

Effects of the fisheries on the ecosystem

The current salmon fishery probably has no or minor influence on the marine ecosystem. However, the exploitation rate on salmon may affect the riverine ecosystem through changes in species compositions. There is limited knowledge on the magnitude of these effects.

Quality considerations

A considerable amount of total catches consists of estimated unreported catches (Table 8.4.15.3), which introduces uncertainties in the assessment. Catch per unit effort in the Polish offshore fishery and deviations in the reported species composition between Polish and other countries' longline fisheries indicate large-scale misreporting of salmon as sea trout in the Polish fishery, and this misreporting constitutes a significant amount of the unreported catches (Table 8.4.15.3). However, there are some indications that the presented misreporting in the Polish fishery may be overestimated, especially in recent years. Internationally coordinated landing inspections are probably necessary to minimize the presumed substantial mis- and unreporting of catches in the offshore longline fishery.

Scientific basis

The assessment uses a Bayesian estimation procedure. This technique allows an explicit incorporation of prior knowledge (from previous studies, literature, and/or expert opinions) about parameters in the assessment. With this approach uncertainties about estimated quantities are formulated as probability distributions.

The estimation of potential smolt production capacity is based on expert knowledge (prior information) and the spawner/smolt estimates (river-specific stock–recruit relationships) which are derived by fitting the assessment model with various data. The model incorporates new information annually and, thus, updates both smolt production historically and the potential smolt production capacity for each river. Inclusion of new information causes annual changes in these as well as in other parameter estimates.

Working group report: WGBAST

8.4.15 Supporting information May 2012

ECOREGION Baltic Sea
STOCK Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia)

Reference points

To evaluate the current state of the stock ICES uses the smolt production in 2011 relative to the 50% and 75% level of the natural production capacity on a river-by-river basis. To evaluate the effects of fisheries in 2013 ICES focuses on the smolt production in 2017–2018 relative to 75% of the natural production capacity on a river-by-river basis. The 75% level is based on the MSY framework.

Outlook for 2013

Following a decision made by Sweden the Swedish longline fishery will cease to exist from 2013. Stock projections were thus made based on five different fishing effort scenarios: other fisheries deploy the same effort as in 2011 (scenario 1), or reduce their 2011 effort by 20% (scenario 2), 40% (scenario 3), 60% (scenario 4), or 80% (scenario 5), see Figure 8.4.15.6. Evaluations by experts were used to set effort for the interim year of 2012. However, the development of stocks following the expert opinion scenario was not projected beyond 2012. Projection assumptions are described in Table 8.4.15.5.

Total sea catch, reported commercial sea catch (total and divided into offshore and coastal fisheries), river catches, and total number of spawners (in thousands) in 2013 under the five effort scenarios are shown in the following table. The proportion of the total sea catch that is reported in 2013 is assumed to be the same as in 2011 (Figure 8.4.15.5).

Effort	Total sea catch		Reported commercial sea catch				River catch		No. spawners	
Scenario	Median	95%PI	Median	% of TAC in 2012	Offshore	Coast	Total	95%PI	Total	95%PI
1	223	(150,427)	107	(87%)	47	60	30	(12,69)	84	(47,138)
2	185	(124,354)	89	(73%)	39	51	33	(14,76)	93	(52,153)
3	144	(97,276)	70	(57%)	30	41	37	(15,84)	103	(58,170)
4	100	(68,191)	49	(40%)	20	29	40	(16,93)	116	(65,189)
5	52	(35,99)	26	(21%)	10	16	44	(18,103)	129	(73,211)

MSY approach

Reaching at least 75% of the potential smolt production capacity (PSPC) has been suggested by ICES if the objective is to recover salmon populations to MSY (ICES, 2008a, 2008b). The PSPC estimates therefore form the basis of the current reference points for the assessment of the Baltic salmon stocks and for evaluation of the effects of fisheries on future development of the stocks.

Figure 8.4.15.7a–c presents the river-specific annual probabilities of meeting the 75% of PSPC objective under each effort scenario. Due to cyclic fluctuations in population abundances, it is difficult to interpret the long-term outcome of the different scenarios from these illustrations.

Table 8.4.15.6 presents the river-specific probabilities of meeting the 75% of PSPC objective in 2011, and in 2017 or 2018 (depending on assessment unit), one full generation ahead from 2011. For three stocks (rivers) the probability of achieving the objective in 2017/2018 is less than or equal to the probability in 2011, i.e. their status does not improve or even worsens, under all scenarios. The following discussion considers the remaining twelve stocks in the table. In effort scenario 1, several stocks have lower probabilities of achieving the objective in 2017/2018 than in 2011. Effort scenario 2 leads to improved status (higher probability of meeting the objective in 2017/2018 than in 2011) for all twelve stocks. However, only scenarios in which effort is reduced by 40% or more (scenarios 3–5) show notable possibility of recovery for a majority of the stocks, although not even these scenarios indicate recovery of every assessed stock.

As the perception of stock status has not changed markedly since last year's assessment, the advice for the fishery in 2013 is the same as the advice given in 2011 for the 2012 fishery, i.e. a TAC of no more than 54 000 individuals. This value is close to the reported commercial sea catch for 2013 estimated under effort scenario 4, a scenario which is expected to result in a clearly positive development for a majority of the assessed stocks (Table 8.4.15.6).

Additional considerations

ICES points out the substantial discrepancy between the biological advice and the agreed TAC in the last few years (Table 8.4.15.1). To correct the situation a major reduction in the TAC for 2013 would be needed. Reducing mis- and unreporting of catches would allow for less extensive TAC reductions (Figure 8.4.15.5).

The ban of the driftnet fishery in 2008 abruptly decreased offshore catches from 2007 to 2008, which contributed to an increase in the number of spawners in 2008. However, a pronounced increase in the longline effort after 2008 has changed the situation. The harvest rate in the longline fishery is now almost at the same level as the combined longline and driftnet harvest rate in the early and mid-2000s. In addition, there are indications of pronounced misreporting in the Polish offshore fishery and internationally coordinated fishery inspections are needed to give a reliable estimate of the salmon catch in this fishery.

Exploitation in the Main Basin offshore fisheries affects possibilities for recovery of the Gulf of Finland salmon stocks as 10–40% of catches of Gulf of Finland salmon have been taken in the Main Basin. The recent increase in the longline fishery in the Main Basin will most likely reduce possibilities for recovery of the Gulf of Finland salmon.

The M74 syndrome is a reproduction disorder disease of Baltic salmon, affecting mixed and wild stocks, and it can cause high mortality rates in yolk-sac fry. The prevalence of M74 has been decreasing since the mid-1990s to a low level from the mid-2000s. The present advice has taken into account this pattern of incidence of M74.

Recent efforts to re-establish self-sustaining salmon stocks in ‘potential’ rivers, where salmon stocks existed in the past but have been extirpated, present exceptional challenges to management. The numbers of spawners in the ‘potential rivers’ are likely to be particularly low following the initial re-introductions, and productivity is likely to be lower than average. The considerations presented in this advice for the existing weak salmon stocks (e.g. habitat restorations, fishery restrictions, etc.) also apply to re-established stocks. Even small mortality rates in fisheries may be enough to prevent the re-establishment and recovery of salmon in these ‘potential’ rivers. Exploitation presents a particularly high risk at low levels of post-smolt survival.

The estimated population parameters for rivers in the southern Baltic suggest low productivity. This implies that mixed-stock fisheries pose a special problem in managing these stocks. In the absence of explicit management objectives a precautionary approach would be to move fisheries towards stock-specific harvesting, i.e. fishing mainly in estuaries and rivers. The reasons for the low productivity may, at least partly, be tracked down to special problems in the freshwater environment. For instance, in the river Emån the poor functioning of a fish ladder is likely the main reason for the limited response of the stock to the management measures. Tagging results from reared salmon indicate that post-smolt survival of the southern stocks is even lower than that of the northern stocks.

Management plans

The management of salmon in the Baltic Sea has been subjected to the Salmon Action Plan (SAP) adopted by the IBSFC in 1997. Since the time period covered by SAP ended in 2010, the European Commission has decided to develop options for a new management plan for Baltic salmon. In 2011, the European Commission presented a proposal for the establishment of a multiannual plan for the Baltic salmon stock (COM/2011/0470 final), but the plan had not yet been accepted when this advice was formulated.

The HELCOM Ministerial Meeting, Krakow, Poland, 15 November 2007, agreed a Baltic Sea Action Plan (BSAP), which includes development of long-term management plans for salmon by 2010, as well as short-term plans. The short-term plans include safeguarding the genetic variability, monitoring issues, “…the active conservation of at least ten endangered/threatened wild salmon river populations in the Baltic Sea region as well as the reintroduction of native Baltic Sea salmon in at least four potential salmon rivers, by 2009,…”, and “By 2015, as the short-term goal, to reach production of wild salmon at least 80%, or 50% for some very weak salmon river populations, of the best estimate of potential production, and within safe genetic limits, based on an inventory and classification of Baltic salmon rivers,…”. ICES has not specifically evaluated these in relation to the precautionary approach (PA) or the maximum sustainable yield (MSY) approach, but notes that the target suggested by ICES in recent years of 75% of potential production is broadly in accordance with the BSAP short-term targets.

Data and methods

The main information on the abundance and exploitation of wild salmon in the Baltic comes from electrofishing surveys, smolt-trapping, tag returns from the fisheries, catch and effort data from the fisheries, spawner counts, and data on the proportion of wild and reared salmon in catches.

Uncertainties in assessment and forecast

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 been fully explored. Post-smolt survival has major implications for both the fisheries and predictions of the development of the stocks. It should be noted that post-smolt survival estimates are partly based on tag recapture data, and are therefore expected to be sensitive to changes in tag reporting rates. The decreased exploitation of salmon has resulted in fewer tag returns. This year, data on spawner counts from the rivers Tornionjoki and Simojoki and trap catches of reared salmon in river Dalälven have been incorporated in the assessment model, improving the estimation of total survival of both wild and reared salmon at sea.

Adjustments for the misreporting of salmon as trout in the Polish offshore fishery, based on Polish longline effort and catch per unit effort data from other countries, have improved the assessment. However, it causes additional uncertainty in the modelling.

The current EU Data Collection Framework requires establishment of at least one index river in each assessment unit. In these rivers, parr density data, smolt trapping data, and spawner abundance data must be collected. More data from assessment unit 5 are needed to improve the quality of the assessment. Furthermore, a tagging programme should be implemented in 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 in the Baltic Sea.

The weaker than expected spawning migrations in 2010 and 2011 will not necessarily have longer-term negative effects on the development of the stocks if the reason is low winter temperatures. On the other hand, should the poor spawning runs in 2010 and 2011 turn out to mirror a further decline in natural survival and/or underestimation of the most recent exploitation, this may have severe consequences for the wild stocks.

Comparison with previous assessment and catch options

A few changes in the assessment procedure were made in 2012:

1) The work to include data from the recently established index rivers has continued. In this year assessment, spawner counts in the rivers Tornionjoki/Torneälven and Simojoki have been included in the model, which is expected to have improved estimation of e.g. survival rates at sea considerably.
2) The model has been fitted to trap catches of reared spawners in the river Dalälven in 2004–2011, using the results of mark–recapture experiments in formulation of a prior for the catchability of the trap. The inclusion of data on the return rate of reared salmon is expected to have improved estimates of, e.g. sea survival and abundance of reared salmon.
3) To increase the use of available data on the relative abundance of wild versus reared salmon, the model was fitted to a time-series of wild/reared proportions (estimated from scale readings) in catch samples from the offshore fishery in the southern Main Basin. In combination with other information, this update is expected to have improved the estimation of e.g. survival and abundance estimates of wild and reared salmon.

The latest information about recent spawner and smolt abundances together with the latest changes in the model structure have resulted in some changes in the updated estimates of the potential smolt production capacities (PSPCs) compared to last year. The largest decreases are in the PSPC of the Sävarån river. The PSPC estimates of Tornionjoki/Torneälven, Simojoki, and Piteälven rivers also decreased. The largest increases are in the estimates of Ume/Vindelälven and Rickleån rivers. The PSPC estimate of all assessment units combined increased slightly (9%) compared to last year. It is important to note that updates in PSPCs are usually accompanied by updated levels of smolt abundance, which means that the assessment of stock status does not necessarily change when PSPCs are updated.

Overall, the perception of the status of stocks has not changed compared to last year's assessment and the advised maximum catch level for 2013 is, therefore, the same as the advice given in 2011 for the fishery in 2012. This advice is based on the MSY approach.

Assessment and management area

In order to better support the management of wild salmon stocks, ICES has established five assessment units for the Baltic Main Basin and the Gulf of Bothnia (Figure 8.4.15.8). 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 subject 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 ICES Subdivisions 25–29.
5	Eastern Main Basin stocks	Estonian, Latvian, Lithuanian, and Polish rivers.

Sources of information

ICES. 2008a. Report of the ICES Advisory Committee, 2008. ICES Advice, 2008, Book 8. 133 pp.

ICES. 2008b. Report of the Workshop on Baltic Salmon Management Plan Request (WKBALSAL), 13–16 May 2008, ICES, Copenhagen, Denmark. ICES CM 2008/ACOM:55.

ICES. 2012. Report of the Baltic Salmon and Trout Assessment Working Group 2012 (WGBAST), 15–23 March 2012, Uppsala, Sweden. ICES CM 2012/ACOM:08.

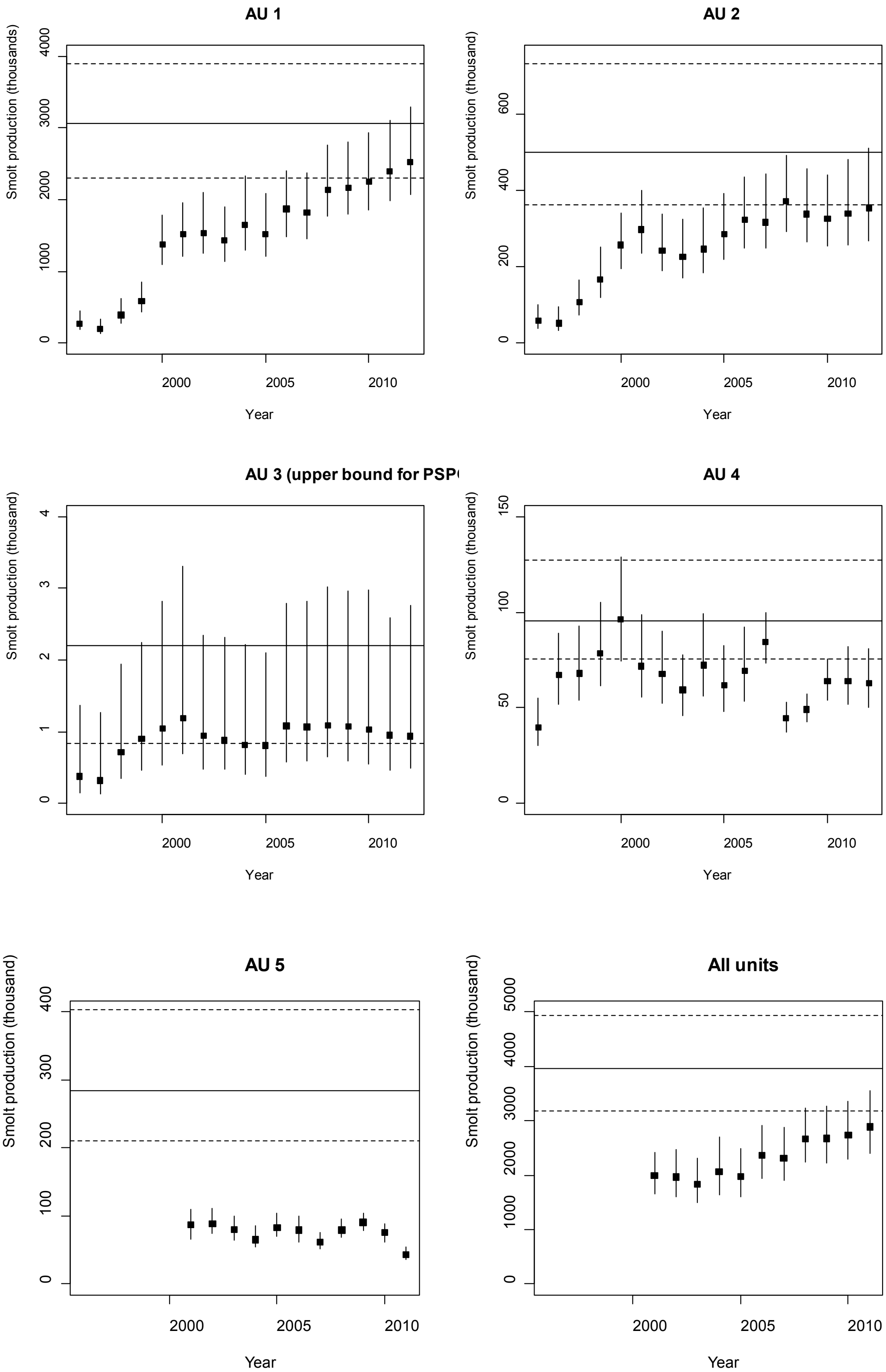


Figure 8.4.15.1 Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Posterior probability distribution (median and 95% PI (probability interval)) of the total smolt production (expressed in thousands of fish) within assessment units 1–5 and in total. Horizontal lines show the median (solid line) and 95% PI (dashed lines) for potential smolt production capacity (PSPC).

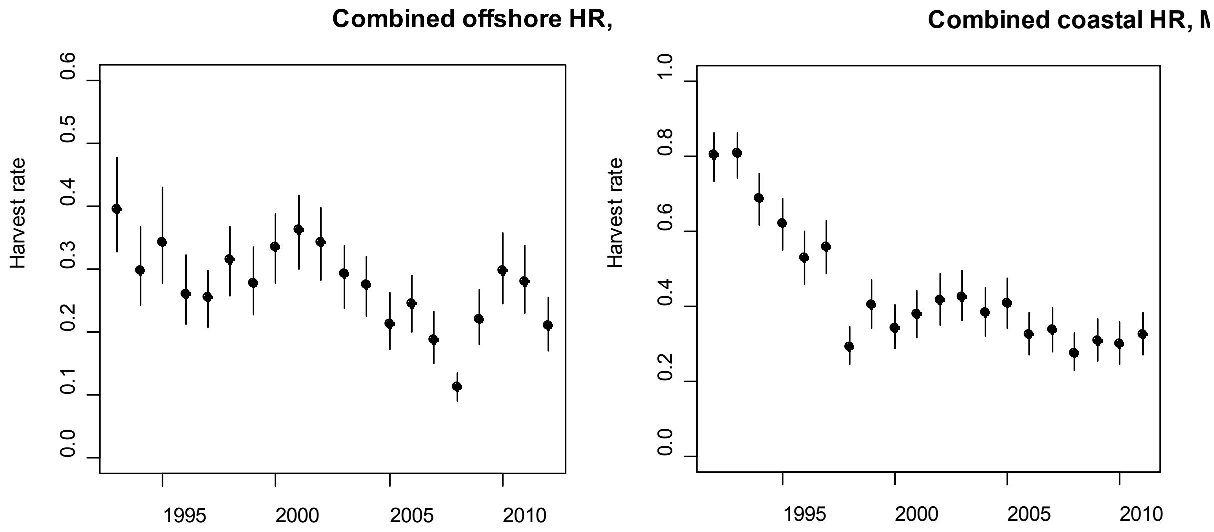


Figure 8.4.15.2 Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Annual harvest rates for wild multi sea-winter (MSW) salmon. Left panel: offshore fishery which affects all stocks (all gears combined, estimates correspond to fishing season, e.g. 2012 corresponds to combined autumn 2011 and spring 2012 fisheries); Right panel: coastal fishery for stocks in assessment unit (AU) 1 (all gears combined, estimates refer to calendar year). Posterior probability distribution (median and 95% PI).

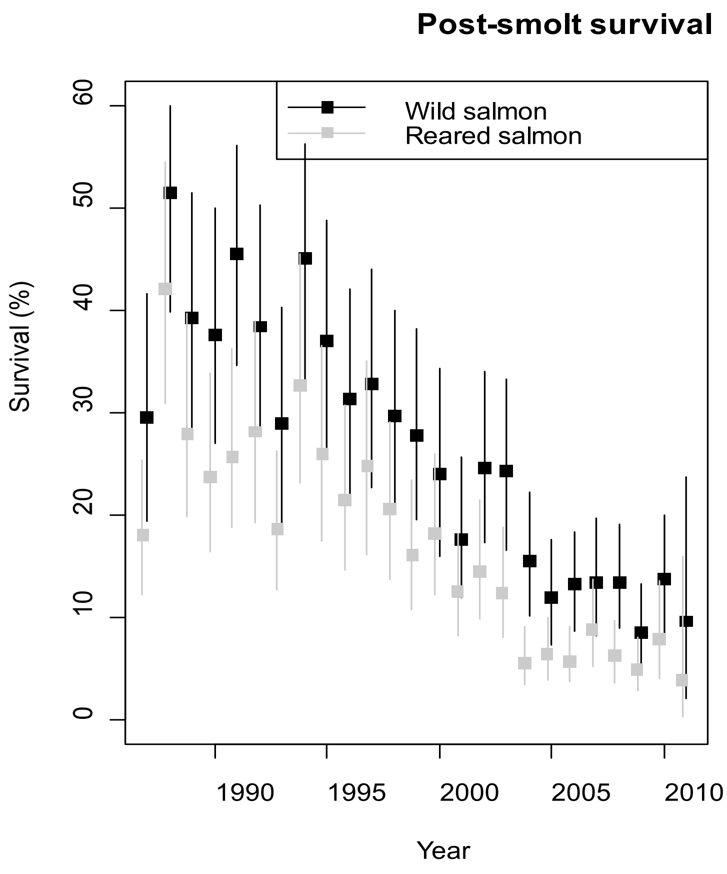


Figure 8.4.15.3 Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Post-smolt survival for wild and hatchery-reared salmon. Posterior probability distribution (median and 95% PI).

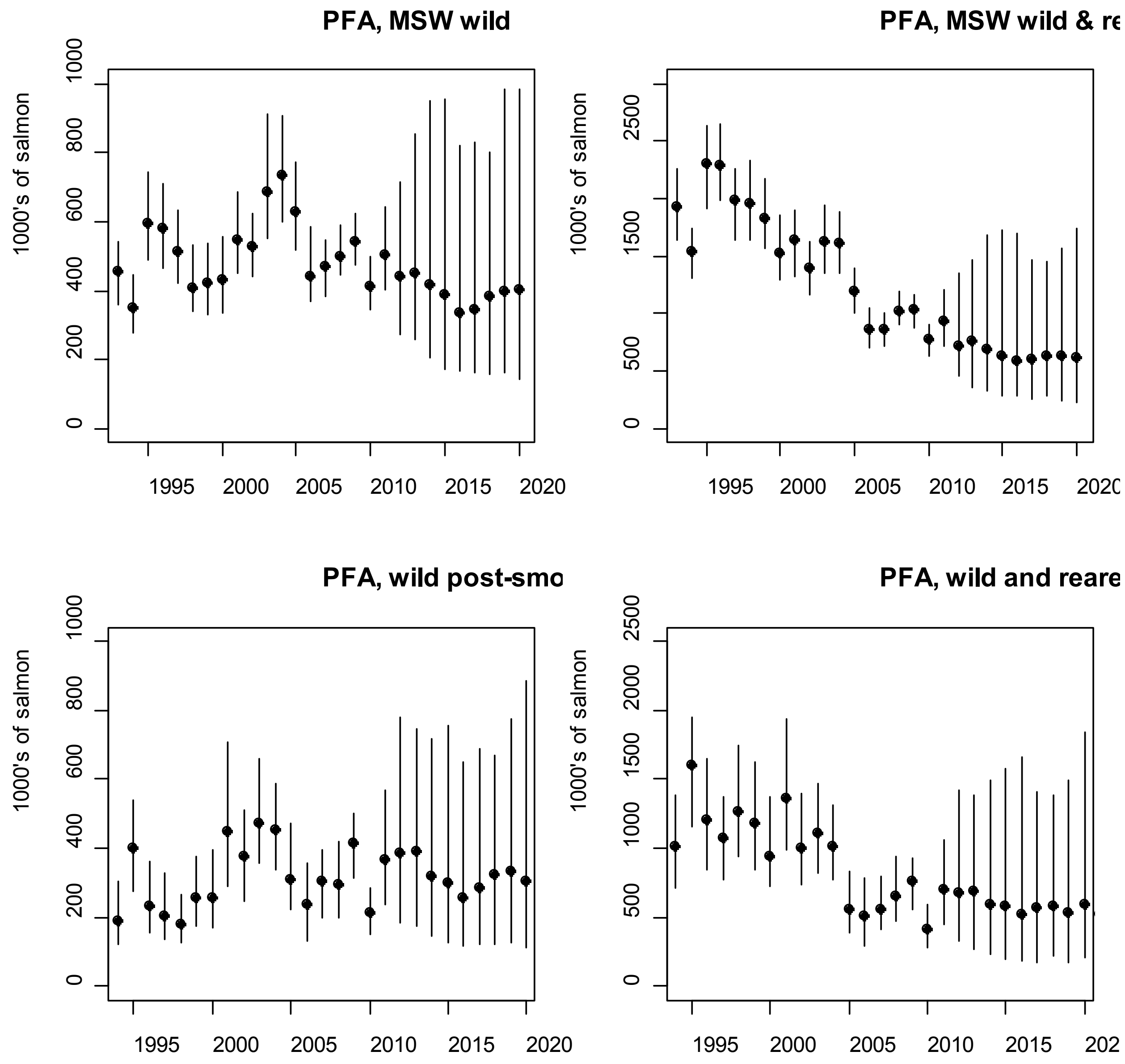


Figure 8.4.15.4 Pre-fishery abundance (PFA) of multi sea-winter salmon (MSW) before the offshore fishery season starts in autumn, and PFA of post-smolts in spring after one winter at sea. The left panels are for wild salmon and the right panels for wild and reared salmon together. The predicted development in PFA assuming the same fishing effort as in 2011 (effort scenario 1, see supporting information) is also indicated.

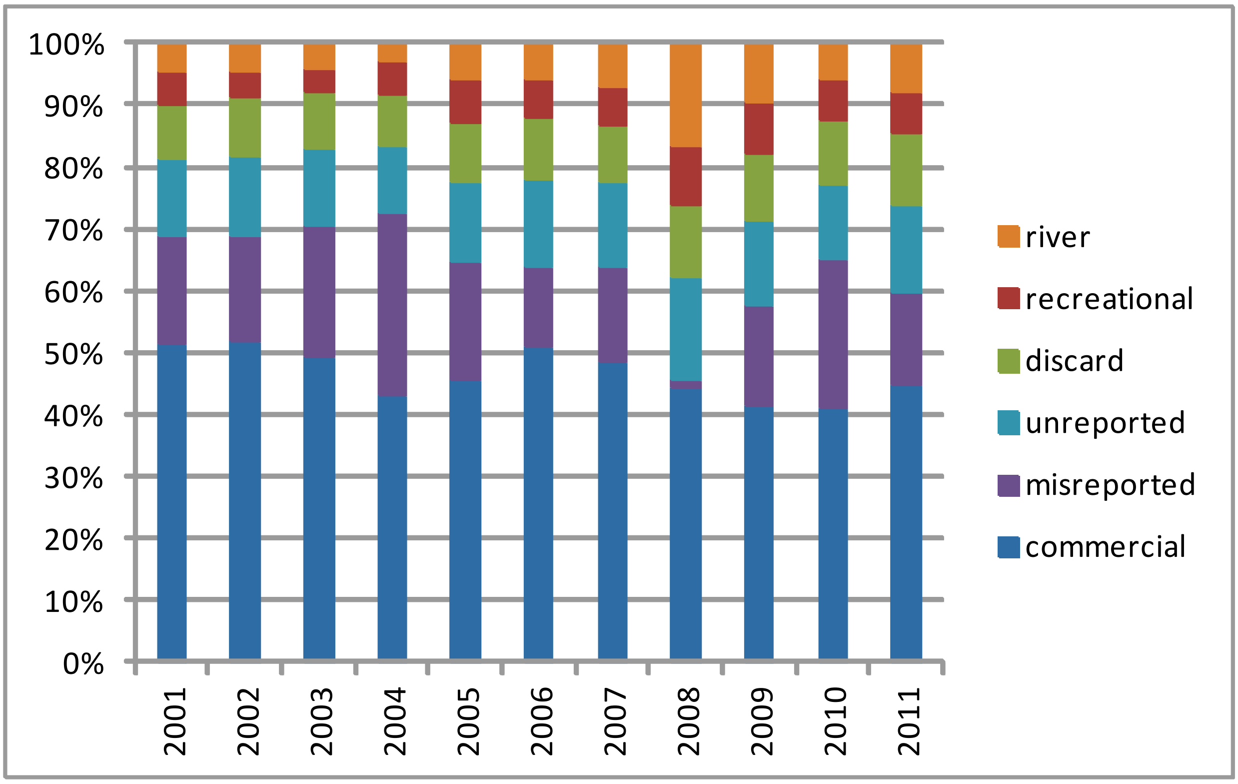


Figure 8.4.15.5 Share of commercial and recreational catches at sea, river catches (including also some commercial fishing), and discard/unreporting/misreporting of total catches in years 2001–2011.

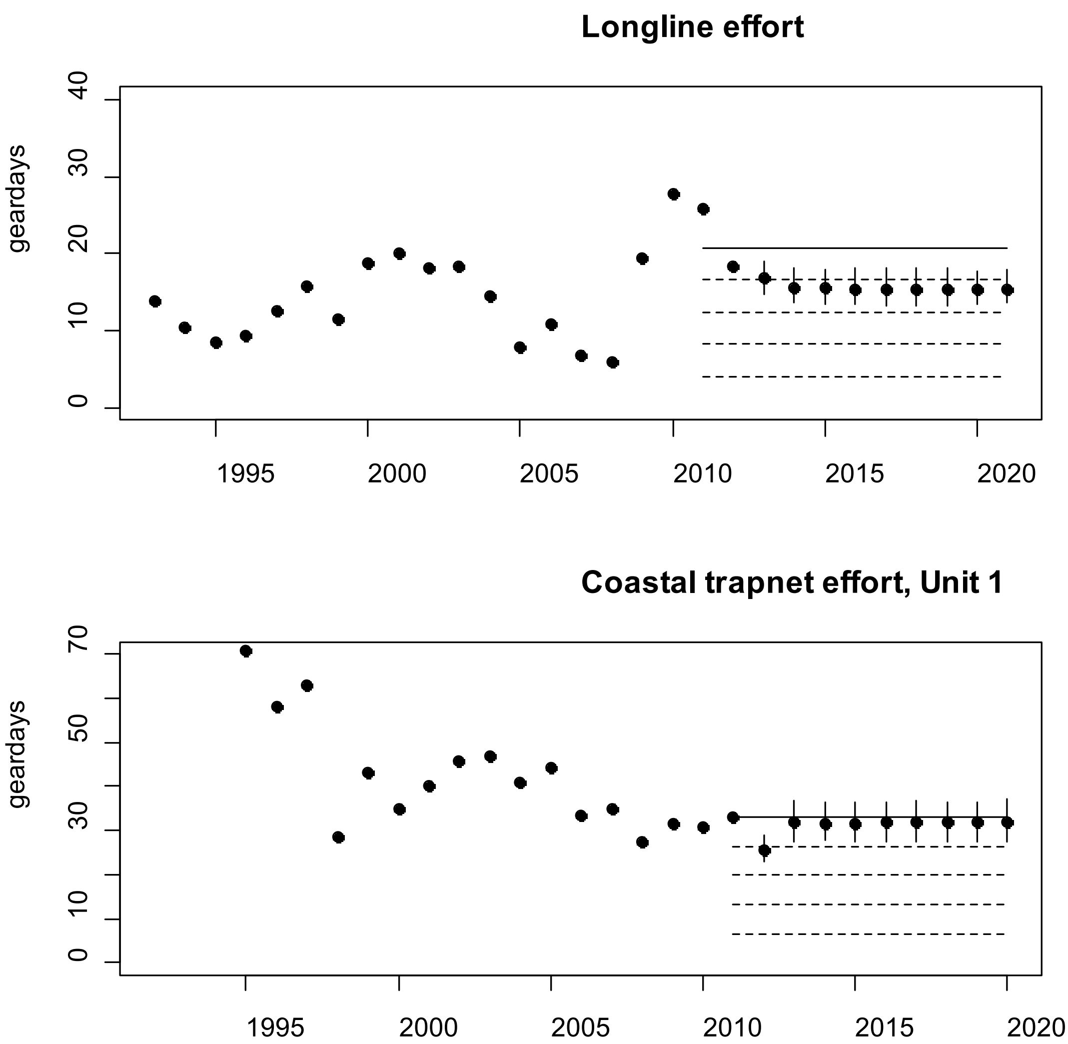


Figure 8.4.15.6 Fishing effort in the offshore longline fishery (top panel, x 100 000 geardays) and coastal trapnet fishery affecting assessment unit 1 stocks (bottom panel, x 1000 geardays). Observed effort in historical years (1992–2011) and effort scenarios in future years (2012–2020). Effort in 2012 is based on evaluations by experts. Five effort scenarios starting from 2013, as follows: starting from the 2012/2013 winter the Swedish longline fishery will cease to exist; other fisheries deploy the same effort as in 2011 (scenario 1, solid line), or reduce their 2011 effort by 20% (scenario 2, dashed line), 40% (scenario 3, dashed line), 60% (scenario 4, dashed line) or 80% (scenario 5, dashed line). The coastal trapnet effort before 1996 was much higher than afterwards and, for illustrative purposes, effort from those early years is not presented.

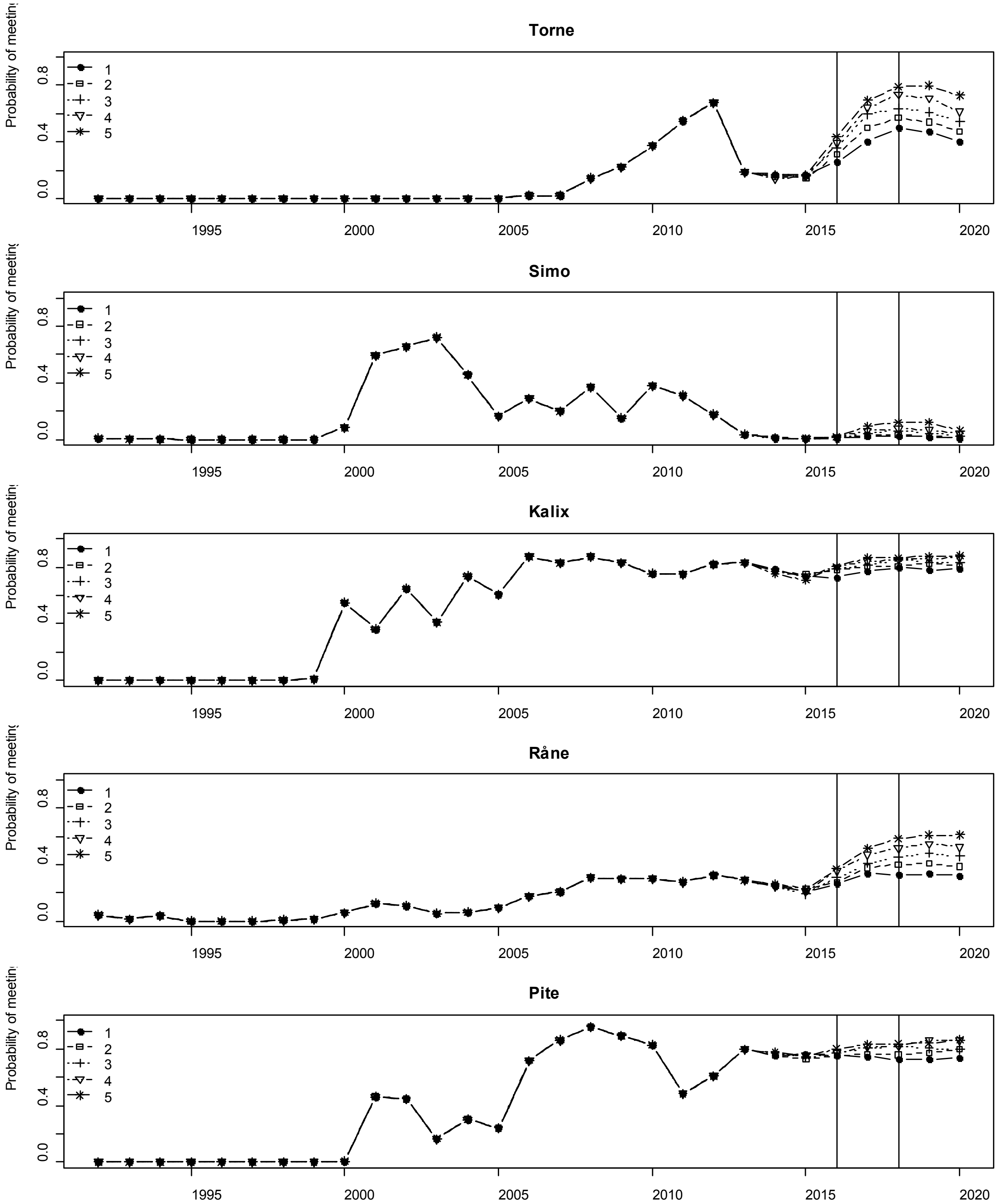


Figure 8.4.15.7a Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of different stocks meeting an objective of 75% of potential smolt production capacity under different effort scenarios. Fishing in 2013 will primarily affect smolt production in years 2016–2018. Effort scenarios from 2013 onwards: (1) 2011 effort in all fisheries except Swedish longlining, which will cease in the 2012/2013 winter, (2) 20%, (3) 40%, (4) 60%, and (5) 80% effort reduction compared to scenario 1.

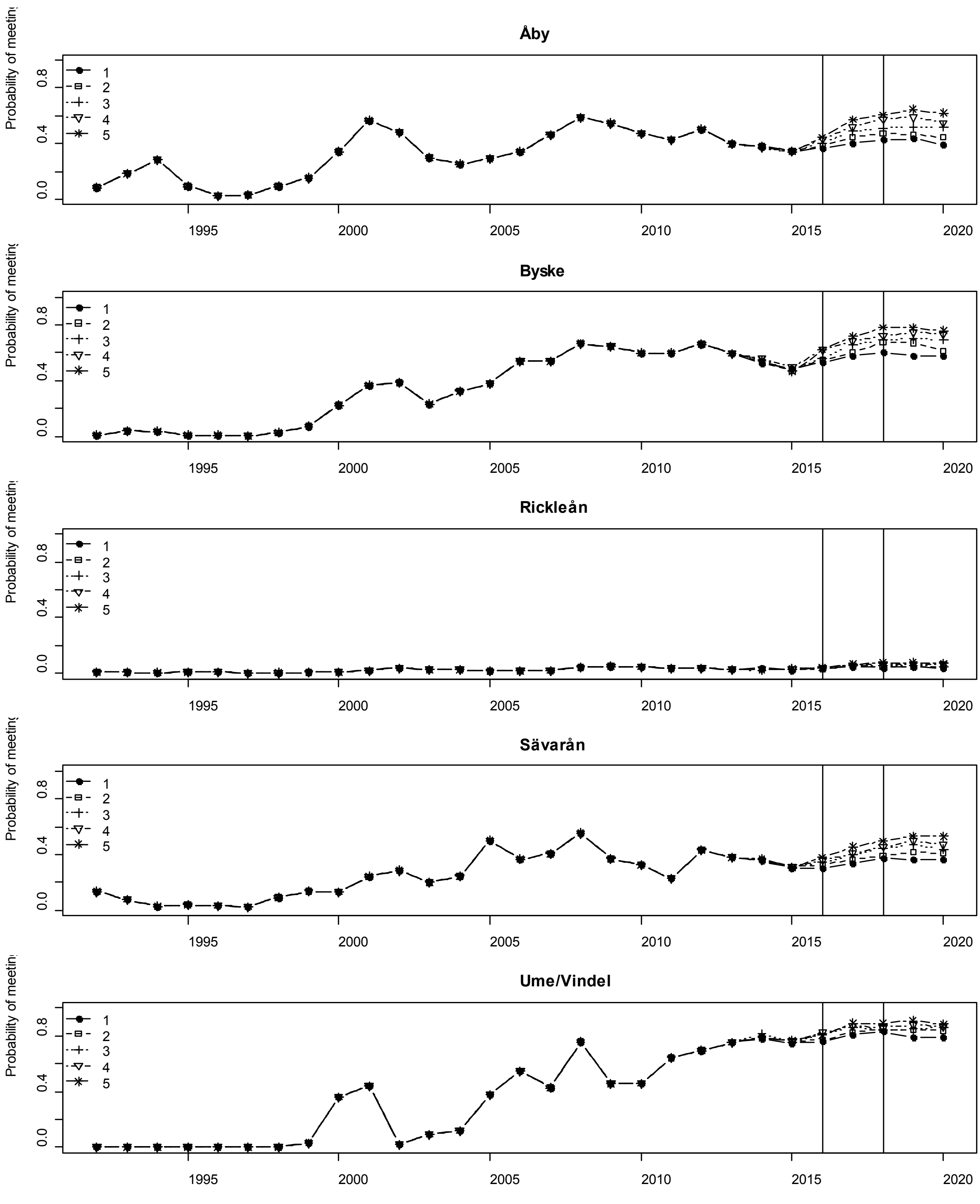


Figure 8.4.15.7b Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of different stocks meeting an objective of 75% of potential smolt production capacity under different effort scenarios. Fishing in 2013 will primarily affect smolt production in years 2016–2018. Effort scenarios from 2013 onwards: (1) 2011 effort in all fisheries except Swedish longlining, which will cease in the 2012/2013 winter, (2) 20%, (3) 40%, (4) 60%, and (5) 80% effort reduction compared to scenario 1.

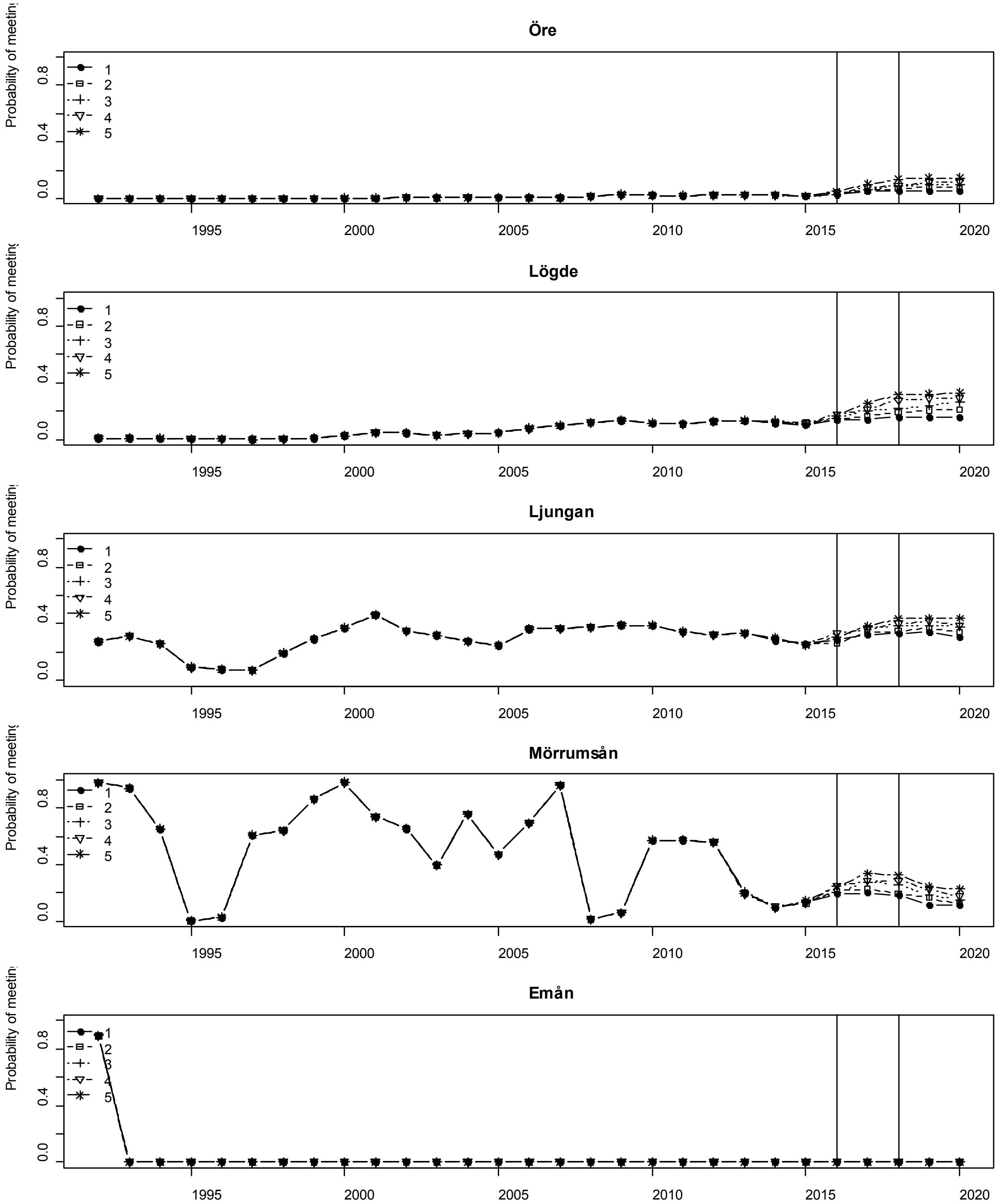


Figure 8.4.15.7c Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Probabilities of different stocks meeting an objective of 75% of potential smolt production capacity under different effort scenarios. Fishing in 2013 will primarily affect smolt production in years 2016–2018. Effort scenarios from 2013 onwards: (1) 2011 effort in all fisheries except Swedish longlining, which will cease in the 2012/2013 winter, (2) 20%, (3) 40%, (4) 60%, and (5) 80% effort reduction compared to scenario 1.

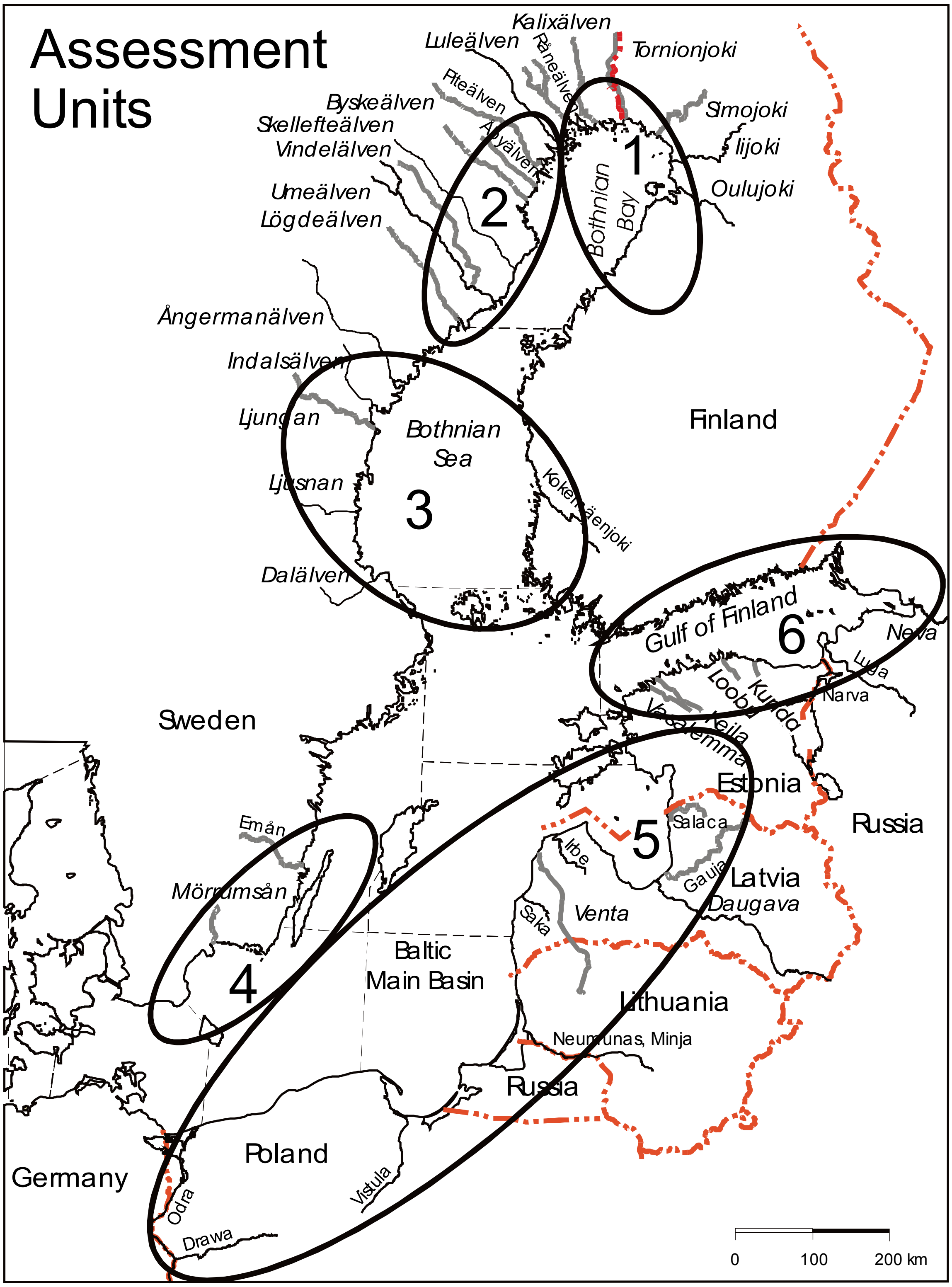


Figure 8.4.15.8 Grouping of salmon stocks in six assessment units in the Baltic Sea. The genetic variability between stocks of an assessment unit is smaller than the genetic variability between stocks of different units. In addition, the stocks of a particular unit exhibit similar migration patterns.

Table 8.4.15.1 Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). ICES advice (Recommended TAC) for Subdivisions 22–31, landings in the whole Baltic, total catches in the whole Baltic, and agreed TACs for the Baltic (Subdivisions 22–31 and 32).

Year	ICES Advice	Rec TAC (22–31) '000 fish	Landings[1] (22–32) tonnes	Landings[1] (22–32) '000 fish	Catch[2] (22–32) tonnes	Catch[2] (22–32) '000 fish	TAC[3] (22–31) '000 fish	TAC[4] (32) '000 fish
1987	No increase in effort	-	3995		5262			
1988	Reduce effort		3177		4226			
1989	TAC	850	4401		5880			
1990	TAC		5636		7745			
1991	Lower TAC	-	4803		6572			
1992	TAC	688	4548		6290			
1993	TAC	500	3966	676	5461	931	650	109
1994	TAC	500	3181	584	4370	805	600	120
1995	Catch as low as possible in offshore and coastal fisheries	-	3040	553	4455	821	500	120
1996	Catch as low as possible in offshore and coastal fisheries	-	3138	650	4658	968	450	120
1997	Catch as low as possible in offshore and coastal fisheries	-	3030	553	4619	858	410	110
1998	Offshore and coastal fisheries should be closed	-	2494	480	3709	721	410	110
1999	Same TAC and other management measures as in 1998	410	2162	421	3614	707	410	100
2000	Same TAC and other management measures as in 1999	410	2342	477	3923	829	450	90
2001	Same TAC and other management measures as in 2000	410	2076	440	3541	735	450	70
2002	Same TAC and other management measures as in 2001	410	1841	406	3207	693	450	60
2003	Same TAC and other management measures as in 2002	410	1627	389	3049	706	460	50
2004	Same TAC and other management measures as in 2003	410	2087	446	4304	899	460	35
2005	Current exploitation pressure will not impair the possibilities for reaching the management objective for the stronger stocks.	-	1736	341	3079	605	460	17
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.	-	1208	227	2019	379	460	15
2007	ICES recommends that catches should not increase.	324	1123	217	1898	369	429	15
2008	ICES recommends that catches should be decreased in all fisheries	-	1039	198	1551	297	364	15
2009	ICES recommends no increase in catches of any fisheries above 2008 level for SD 22–31.	-	1091	217	1898	384	310	15
2010	TAC for SD 22–31	133	881	163	1677	314	294	15
2011	TAC for SD 22–31	120	934	170	1617	298	250	15
2012	TAC for SD 22–31	54					123	15
2013	TAC for SD 22–31	54						

[1]Total reported catches including recreational catches. [2]Estimated total catches including discard, mis- and unreporting.
[3]Agreed TAC for Subdivisions 22–31. [4]Agreed TAC for Subdivision 32.

Table 8.4.15.2 Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Overview of the current status of the Gulf of Bothnia and Main Basin stocks in terms of the probability of their having reached 50% and 75% of the smolt production capacity in 2011. The probabilities are classified into four groups: Above 90%; Between 70% and 90%; Between 30% and 70%; and Below 30%.

	Probability to have reached 50% of PSPC				Probability to have reached 75% of PSPC			
	Above 90%	Between 70% and 90%	Between 30% and 70%	Below 30%	Above 90%	Between 70% and 90%	Between 30% and 70%	Below 30%
Unit 1								
Tornionjoki	X						X	
Simojoki			X					X
Kalixälven	X					X		
Råneälven			X					X
Unit 2								
Piteälven	X						X	
Åbyälven		X					X	
Byskeälven	X						X	
Rickleån				X				X
Sävarån			X				X	
Ume/Vindelälven	X						X	
Öreälven				X				X
Lögdeälven			X					X
Unit 3								
Ljungan			X				X	
Unit 4								
Emån				X				X
Mörrumsån	X						X	
Unit 5								
Pärnu				X				X
Salaca				X				X
Vitrupe				X				X
Peterupe				X				X
Gauja				X				X
Daugava				X				X
Irbe			X					X
Venta			X					X
Saka				X				X
Uzava				X				X
Barta				X				X
Nemunas				X				X

Table 8.4.15.3 Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Nominal catches, discards (incl. seal-damaged salmon), and unreported catches of Baltic salmon in numbers from sea, coast, and river by country in 1993–2011 (mode = most likely value, 95% PI = probability interval). Subdivisions 22–32.

Year	Country									reported total	Discard		Estimated additional Polish catch	Total unreported catches 2)		Total catches	
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden		mode	95% PI		mode	95% PI	mode	95% PI
1993 1)	111840	5400	248790	6240	47410	2320	42530	9195	202390	676115	95162	57550-146900	4100	136604	44110-307000	930761	810200-1088100
1994	139350	1200	208000	1890	27581	895	40817	5800	158871	584404	74979	45150-116300	16572	126716	51191-267771	805001	706471-936071
1995	114906	1494	206856	4418	27080	468	29458	7209	161224	553113	76541	46060-118500	64046	173150	98095-310945	821265	723545-948445
1996	105934	1187	266521	2400	29977	2544	27701	6980	206577	649821	97938	58360-152200	62679	196649	103608-368478	967938	846478-1128678
1997	87746	2047	245945	6840	32128	879	24501	5121	147910	553117	81897	46910-130500	85861	202355	121361-353661	858277	752661-999961
1998	92687	1629	154676	8379	21703	1069	26122	7237	166174	479676	67571	41080-103800	60378	157603	92777-275177	720768	636677-830077
1999	75956	2817	129276	5805	33368	1298	27130	5340	139558	420548	61785	36980-95760	122836	209558	150425-317635	706612	629835-807135
2000	84938	4485	144260	8810	33841	1460	28925	5562	165016	477297	71015	39450-115200	159251	261698	190230-397350	828764	735850-955850
2001	90388	3285	115756	7717	29002	1205	35606	7392	149391	439742	63724	38060-97450	126060	215769	154599-325359	735132	655459-837959
2002	76122	3247	104641	5762	21808	3351	39374	13230	138255	405790	65471	39950-98840	114964	199953	141093-306463	692791	615963-792763
2003	108845	2055	99149	5766	11339	1040	40870	4413	115347	388824	63785	39060-96100	143146	225742	168585-329145	706386	631745-803645
2004	81425	1452	132105	7087	7700	704	17650	5480	192856	446459	71232	40850-111800	254267	349486	280817-478067	898631	807867-1020267
2005	42491	1618	115068	4799	5629	698	22896	3069	144584	340852	53886	30460-85140	110816	185607	132935-284515	605461	536715-697815
2006	33723	1516	64501	3551	3195	488	22207	1002	97285	227468	37238	21850-57490	46899	96589	61909-160999	378857	333699-439099
2007	16145	1378	75072	3086	5318	537	18988	1408	95241	217173	31870	17650-51220	54309	102367	69289-163809	368558	325609-426009
2008	7363	1890	80735	4944	2016	539	8650	1382	90584	198103	32374	15350-56570	3295	49790	14055-122795	296885	249095-365495
2009	16072	2209	77897	1858	2741	519	10085	584	104918	216883	39524	19760-68380	60177	109834	69384-194477	383766	328877-463377
2010	29637	1756	44673	606	1534	427	5774	491	77787	162685	31494	18430-49550	73506	109455	83286-160576	314268	279006-362306
2011	21064	1845	51563	370	1271	546	6204	470	86305	169638	34164	19350-54820	43509	84609	54459-144309	297944	257428-354128

All data from 1993–1994 include Subdivisions 24–32, while it is more uncertain in which years Subdivisions 22–23 are included.
The catches in Subdivisions 22–23 are normally less than one tonnes.
From 1995 data includes Subdivisions 22–32.
Catches from the recreational fishery are included in reported catches as follows: Finland from 1980, Sweden from 1988, Denmark from 1998. Other countries have no, or very low recreational catches.
1) In 1993 fishers from the Faroe Islands caught 3200 individuals , which is included in the total Danish catches.
2) Including both unreporting for all countries and the estimated additional Polish catch.

Table 8.4.15.4 Salmon in Subdivisions 22–31 (Main Basin and Gulf of Bothnia). Nominal landings of Baltic salmon in round fresh weight and in numbers from rivers, coast and sea, commercial catches in numbers from coast and sea, and agreed TAC for Subdivisions 22–31.

Year	Rivers		Coast		Offshore		Total		Coast and Offshore[1]	TAC[2]
	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish	'000 fish	
1993	0.11		0.83		2.57		3.52		676	650
1994	0.10		0.58		2.25		2.93		584	600
1995	0.12		0.67		1.98		2.77		553	500
1996	0.21	35	0.77	168	1.73	366	2.71	570	456	450
1997	0.28	45	0.80	149	1.50	282	2.58	476	396	410
1998	0.19	30	0.59	104	1.52	314	2.30	449	334	410
1999	0.17	30	0.59	104	1.23	256	1.99	391	286	410
2000	0.18	30	0.52	100	1.45	313	2.15	442	312	450
2001	0.16	30	0.57	121	1.19	262	1.92	413	355	450
2002	0.14	28	0.59	126	1.03	234	1.75	388	336	450
2003	0.12	28	0.43	113	1.00	235	1.56	376	327	460
2004	0.13	25	0.77	161	1.11	247	2.01	433	365	460
2005	0.17	31	0.61	118	0.86	175	1.64	323	254	460
2006	0.10	19	0.40	71	0.63	124	1.12	213	172	460
2007	0.14	23	0.35	69	0.55	111	1.04	204	159	429
2008	0.26	45	0.46	92	0.21	43	0.93	180	109	364
2009	0.18	32	0.55	113	0.27	56	1.00	201	138	310
2010	0.11	18	0.37	66	0.35	71	0.84	155	118	294
2011[3]	0.17	20	0.38	68	0.33	73	0.88	160	122	250

[1]For comparison with TAC (includes only commercial catches, except for years 1993–2000 when also recreational catches at sea are included). [2]Agreed TAC for Subdivisions 22–31. [3]Preliminary.

Table 8.4.15.5 Key assumptions underlying the stock projections. The same survival assumptions are made for all effort scenarios. Post-smolt and M74 survival are autocorrelated in time, starting from the most recent reliably estimated values; the values in the table represent the medians to which they are expected to converge in the long run.

Scenario	Fishing effort for year 2013 and onwards
1	2011 level excluding Swedish longlining
2	-20% from level in scenario 1
3	-40% from level in scenario 1
4	-60% from level in scenario 1
5	-80% from level in scenario 1
	Post-smolt survival of wild salmon
	Projection starts from the 2010 survival estimate and is expected to approach the 2009 survival (7.5%) in the long run
	Post-smolt survival of reared salmon
	Same relative difference to wild salmon as on average in history
	M74 survival
	Projection starts from the 2011 survival estimate and is expected to approach the historical median (92%) in the long run

Table 8.4.15.6 River-specific probabilities of meeting 75% of PSPC in 2011 and in 2017/2018 (depending on the assessment unit) under the five effort scenarios in Table 8.4.15.5. Cells which indicate a higher probability of meeting the objective in 2017/2018 than in 2011 are presented in green, whereas those indicating lower probability are presented in red. Cells with values higher than 0.7 are surrounded by frames.

River	2011	Year of comparison	Scen 1	Scen 2	Scen 3	Scen 4	Scen 5
Tornionjoki	0.55	2018	0.50	0.57	0.64	0.73	0.79
Simojoki	0.31	2018	0.03	0.03	0.06	0.07	0.12
Kalixälven	0.75	2018	0.80	0.80	0.85	0.85	0.86
Råneälven	0.28	2018	0.33	0.40	0.45	0.51	0.58
Piteälven	0.48	2018	0.72	0.76	0.82	0.82	0.84
Åbyälven	0.43	2018	0.42	0.48	0.51	0.57	0.61
Byskeälven	0.60	2018	0.61	0.67	0.69	0.72	0.78
Rickleån	0.04	2018	0.04	0.05	0.05	0.06	0.07
Sävarån	0.23	2018	0.37	0.39	0.45	0.46	0.5
Ume/Vindelälven	0.64	2018	0.83	0.85	0.84	0.86	0.89
Öreälven	0.02	2018	0.06	0.07	0.09	0.09	0.14
Lögdeälven	0.11	2018	0.16	0.19	0.22	0.28	0.31
Ljungan	0.34	2018	0.33	0.35	0.38	0.40	0.44
Mörrumsån	0.57	2017	0.20	0.23	0.28	0.29	0.34
Emån	0.00	2017	0	0	0	0	0

8.4.16 **Advice May 2012**

ECOREGION Baltic Sea
STOCK Salmon in Subdivision 32 (Gulf of Finland)

Advice for 2013

ICES advises on the basis of precautionary considerations that catches of wild salmon should be kept to a minimum. To maintain a low bycatch of wild salmon in the coastal salmon fisheries, effort should be reduced in these fisheries. Additional measures to minimize catch of wild salmon in coastal fisheries close to the wild salmon rivers should be considered. Such measures could include relocation of coastal fisheries away from sites likely to be on the migration paths of Gulf of Finland wild salmon, relocating fisheries away from rivers and river mouths supporting wild stocks, and protection of wild salmon (from poaching) when they return to rivers. Also, reduction in exploitation in the fishery in the Main Basin needs to be considered as salmon from the Gulf of Finland to a large extent have the Main Basin as their feeding area.

Stock status

Wild stocks: The only remaining native and self-sustaining salmon populations of the area exist in three Estonian rivers. These wild salmon populations are genetically different from each other, indicating that there are still native salmon stocks left, but there is also some evidence of straying among rivers. In two of the rivers (Kunda and Vasalemma), the estimated smolt production has been clearly below 50% of the potential in the last three years. In the third Estonian river (Keila) smolt production has increased significantly and the estimated smolt production has exceeded 50% of the potential production in the last two years. Electrofishing surveys indicate that parr densities vary considerably over time. In 2011, young-of-the-year parr abundance declined compared to 2010 in the Keila and Vasalemma rivers, but increased somewhat in River Kunda (Figure 8.4.16.1). River Keila is currently not considered to be in a critical state, whereas the situation is more precarious in the rivers Kunda and Vasalemma, where parr densities have remained at low levels and no apparent increasing trend has been observed.

Mixed stocks: The seven Estonian mixed salmon stocks in the Gulf of Finland (Purtse, Selja, Loobu, Valgejõgi, Vääna, Jägala, and Pirita) have been supported by smolt releases to a varying extent. Releases to the Vääna river were stopped in 2005. Since 2007 the river Kunda strain has been used in releases to the Selja, Loobu, Valgejõgi, Jägala, and Pirita rivers. The Narva strain is used only for releases to the Purtse and Narva rivers. From 2010 to 2011, abundance of young-of-the-year wild-born parr decreased in all of these rivers (Figure 8.4.16.2).

In River Luga in Russia, the annual natural smolt production has been estimated to vary between 2000 and 8000 smolts. Surveys also indicate some natural reproduction in the Russian river Gladyschevka. Both these populations are supported by long-term releases and there are no national plans to attain self-sustainable populations in these rivers. Because of pollution and damming of rivers wild salmon production disappeared in the 1950s in rivers on the Finnish side of the Gulf of Finland. Natural reproduction of returning salmon released as smolts has been observed in a suitable habitat in the lowest part of the River Kymijoki.

Reared stocks: Most of the salmon in the Gulf of Finland originate from smolt releases (Figure 8.4.16.3). Despite major releases, the catches have decreased considerably in the last few years, indicating a low post-smolt survival of reared salmon. Tagging results also provide evidence of decreased survival of reared smolts.

Management plans

No explicit management objectives have been agreed for Baltic salmon since the International Baltic Sea Fishery Commission (IBSFC) ceased to exist after 2006. In 2011, the EU Commission presented a proposal for the establishment of a multiannual plan for the Baltic salmon stock (COM/2011/0470 final), but the plan has not yet been accepted.

Biology

Together with other southeastern salmon stocks in the Baltic, the Atlantic salmon *Salmo salar* in the Gulf of Finland forms a stock complex that is genetically distinct from salmon in the western Baltic Sea and the Gulf of Bothnia, differences that mirror the postglacial colonization history. There are only a few small rivers left in the Gulf of Finland which could be defined as purely wild. In addition, natural reproduction exists in a few other rivers where stocking of reared salmon also occurs. The characteristic salmon life history includes spawning in autumn and a juvenile freshwater stage that lasts one to two years. Smolts then leave the rivers for a feeding migration at sea. Salmon from the Gulf of Finland take a great part of their feeding in the Main Basin area and are partly harvested there. Catches in the Gulf of Finland also consist to some extent of salmon originating from the Gulf of Bothnia. The Gulf of Finland salmon feed mainly on herring and sprat during the sea migration.

Environmental influence on the stock

Wild production of salmon in the Gulf of Finland occurs in small rivers. Water level and flow conditions during the time for upstream migration and spawning are of importance for successful reproduction in these rivers. Environmental conditions have a marked effect on the status of salmon stocks. Problems in the freshwater environment play a significant role in explaining the poor status of stocks in many rivers in the southern Baltic Sea and the Gulf of Finland. In many cases, river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions.

The reasons for the decrease in post-smolt survival are still unclear, but the post-smolt survival has been found to be negatively correlated with seal and smolt abundance, and positively correlated with the abundance of herring.

The fisheries

The salmon landings in the Gulf of Finland in 2011 were 47 t in the coastal fishery, less than 1 t in the offshore fishery, and 5 t in the river fishery (Tables 8.4.16.2 and 8.4.16.3). The total catch increased slightly from 44 t in 2010 to 52 t in 2011, but the total catch is still relatively low compared to previous years. The TAC has been gradually reduced since 1996 and is presently 15 thousand fish (Table 8.4.16.1). In 2009, 90% of the TAC was utilized, but in 2010 and 2011 only around 50% of the TAC was utilized. The fishery is also regulated by a number of national and international measures.

The catch distribution between offshore, coastal, and river catches in the Gulf of Finland has changed drastically in recent years. Exploitation has changed from targeting mixed stocks offshore to 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 seals entering the trap are in use in some parts of the coastal fishery and under development in others.

Catch distribution Total catch (2011) is 0.058 kt, where 90% are landings and 10% discards.

Effects of the fisheries on the ecosystem

The current salmon fishery probably has no or only minor influence on the marine ecosystem. However, the exploitation rate on salmon may affect the riverine ecosystem through changes in species composition. There is limited knowledge on the magnitude of these effects.

Quality considerations

Information about the exploitation rate of wild salmon in the mixed-stock fisheries is limited, and there is a lack of knowledge about the level of mixing of stocks during the migrations between the Gulf of Finland, Main Basin, and Gulf of Bothnia.

Establishment of an index river in the Gulf of Finland should be considered, where electrofishing and counting of smolts and spawners is regularly carried out.

Scientific basis

No analytical assessment model has been developed for the Gulf of Finland salmon. The advice is based on a qualitative assessment, taking into account trends in parr densities, smolt production, and exploitation rates.

Working group report: WGBAST

ECOREGION **Baltic Sea**
STOCK **Salmon in Subdivision 32 (Gulf of Finland)**

Reference points

To evaluate the current state of salmon stocks in the Baltic Sea, ICES uses the smolt production in 2011 relative to the 50% and 75% level of the natural production capacity on a river-by-river basis. Preliminary potential smolt production capacity (PSPC) values have been proposed based on expert opinions. No stock–recruit data exist at the moment, precluding validation of these preliminary PSPC values.

Outlook for 2013

No quantitative forecast could be provided.

MSY approach

Reaching at least 75% of the potential smolt production capacity has been suggested by ICES if the objective is to recover salmon populations to MSY (ICES, 2008a, 2008b). For wild salmon in the Gulf of Finland, limited data on wild production levels has precluded a quantitative evaluation of the stock status relative to the preliminary PSPC values. However, the current stock status is most likely well below the MSY levels.

PA considerations

Parr densities in the wild rivers vary considerably between years but are in general low and no increasing trend is visible. Therefore, there should be no fishing targeting wild salmon from the Gulf of Finland, and improved measures to reduce potential bycatch of wild salmon in fisheries targeting other species should be considered. To maintain a low potential for bycatch of wild salmon in the coastal salmon fisheries targeting reared salmon, effort should be reduced.

Additional considerations

In the absence of a quantitative assessment, it is difficult to evaluate the response of the Gulf of Finland wild 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. Rather than merely restricting mixed-stock fisheries through a TAC system, the protection of wild salmon would require the adoption of fishing methods that are highly selective for reared stocks or, alternatively, closures of the fisheries that catch wild Gulf of Finland salmon.

The fact that salmon from the Gulf of Finland also migrate to the Main Basin suggests that effective protection of these wild stocks would need coordinated management of the Main Basin and Gulf of Finland fisheries. The recent increase in the longline fishery in the Main Basin most likely has negative effects on the possibilities for the recovery of Gulf of Finland salmon.

Management plans

The objective of the Salmon Action Plan (SAP), as adopted by the former IBSFC, was 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. Since the time period covered by the SAP ended in 2010, the European Commission has decided to develop options for a new management plan for Baltic salmon. In 2011, the European Commission presented a proposal for the establishment of a multiannual plan for the Baltic salmon stock (COM/2011/0470 final), but the plan had not yet been accepted when this advice was formulated.

The HELCOM Ministerial Meeting, Krakow, Poland, 15 November 2007, agreed a Baltic Sea Action Plan (BSAP), which includes development of long-term management plans for salmon by 2010, as well as short-term plans. The short-term plans include safeguarding the genetic variability, monitoring issues, "…the active conservation of at least ten endangered/threatened wild salmon river populations in the Baltic Sea region as well as the reintroduction of native Baltic Sea salmon in at least four potential salmon rivers, by 2009,…", and "By 2015, as the short-term goal, to reach production of wild salmon at least 80%, or 50% for some very weak salmon river populations, of the best estimate of potential production, and within safe genetic limits, based on an inventory and classification of Baltic salmon rivers,…". ICES has not specifically evaluated these in relation to the precautionary approach (PA) or the maximum sustainable yield (MSY) approach, but notes that the target suggested by ICES in recent years of 75% of potential production is broadly in accord with the BSAP short-term targets.

Data and methods

The main information on the abundance and exploitation of wild salmon in the Gulf of Finland comes from electrofishing surveys, smolt-trapping, tag returns from the fisheries, and catch and effort data from the fisheries.

Uncertainties in assessment and forecast

Estimates of wild smolt production are mainly based on limited electrofishing surveys. Lack of data on the productivity in the freshwater phase, the potential mixed harvest of reared and wild salmon, and the mixing of the stocks during the migrations between the Gulf of Finland, Main Basin, and Gulf of Bothnia, prevents calculation of the appropriate TAC strategy to meet any target based on wild smolt production.

Comparison with previous assessment and catch options

The status of wild salmon stocks and the exploitation rate in the Gulf of Finland has not changed markedly since the last assessment.

Assessment and management area

In order to better support the management of wild salmon stocks, ICES has established six assessment units for the Baltic Sea, where the Gulf of Finland constitutes assessment unit six (Figure 8.4.16.4). 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.

Sources

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ICES. 2008b. Report of the Workshop on Baltic Salmon Management Plan Request (WKBALSAL), 13–16 May 2008, ICES, Copenhagen, Denmark. ICES CM 2008/ACOM:55.

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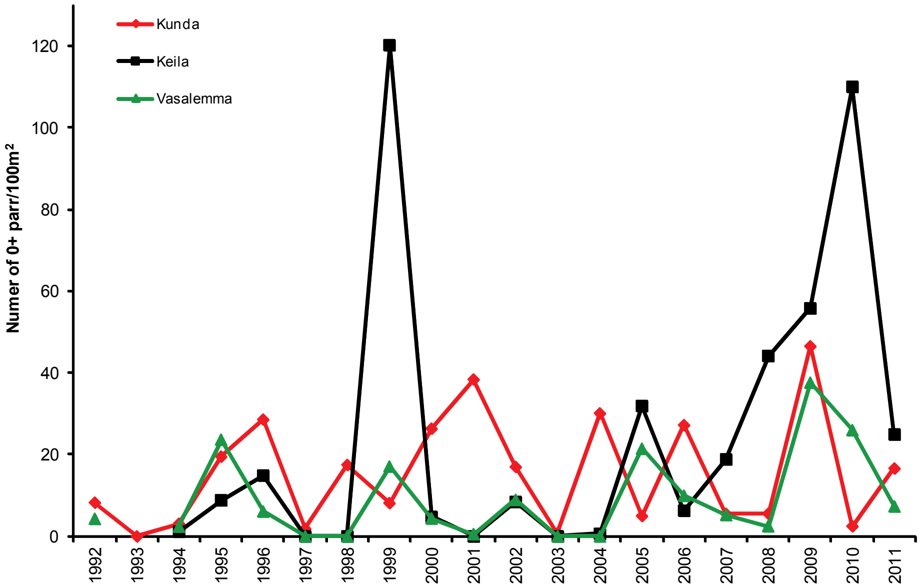

Figure 8.4.16.1 Salmon in Subdivision 32 (Gulf of Finland). Densities of 0+ (one-summer old) salmon parr in the three wild Estonian salmon rivers. In 1999, the exceptionally high parr density was observed in Keila in the conditions of summer drought.

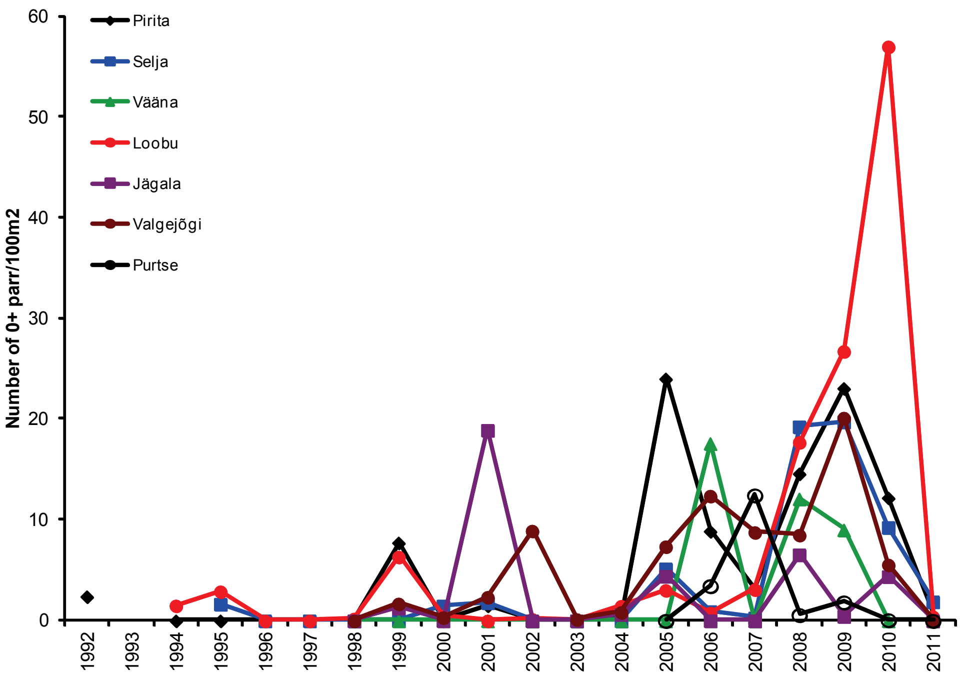

Figure 8.4.16.2 Salmon in Subdivision 32 (Gulf of Finland). Densities of 0+ (one-summer old) salmon parr in the seven Estonian mixed salmon rivers.

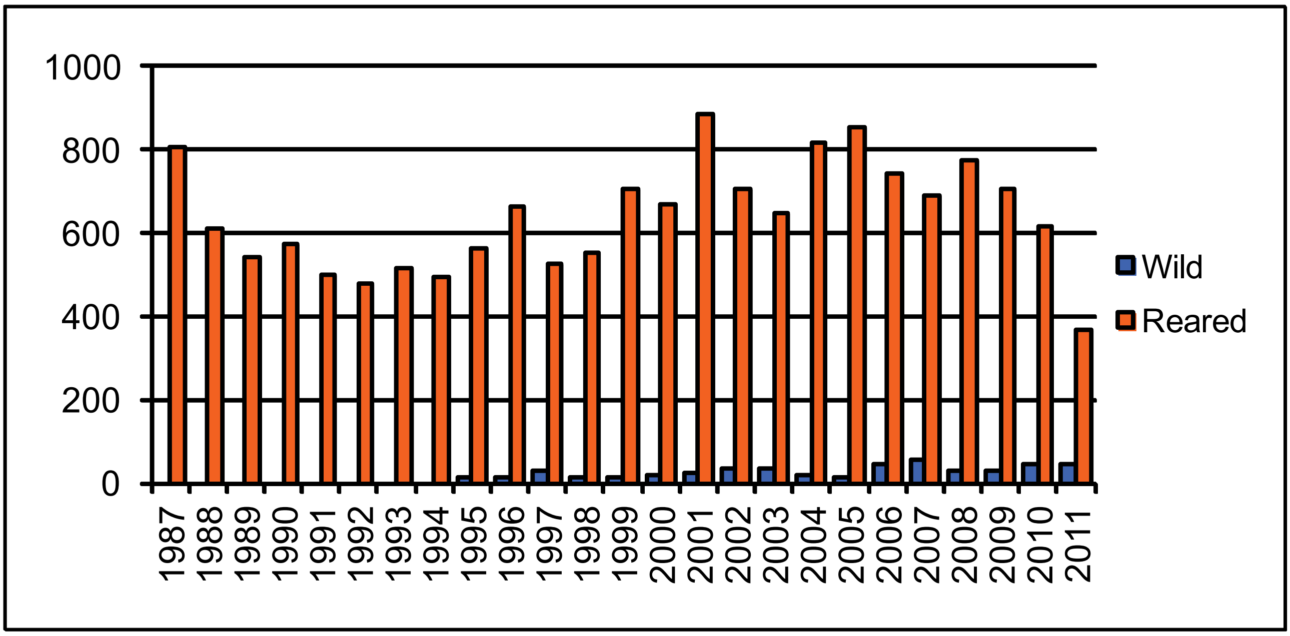

Figure 8.4.16.3 Salmon in Subdivision 32 (Gulf of Finland). Annual production (in thousands) of wild and reared smolts in the Gulf of Finland. No information is available on wild production before 1995.

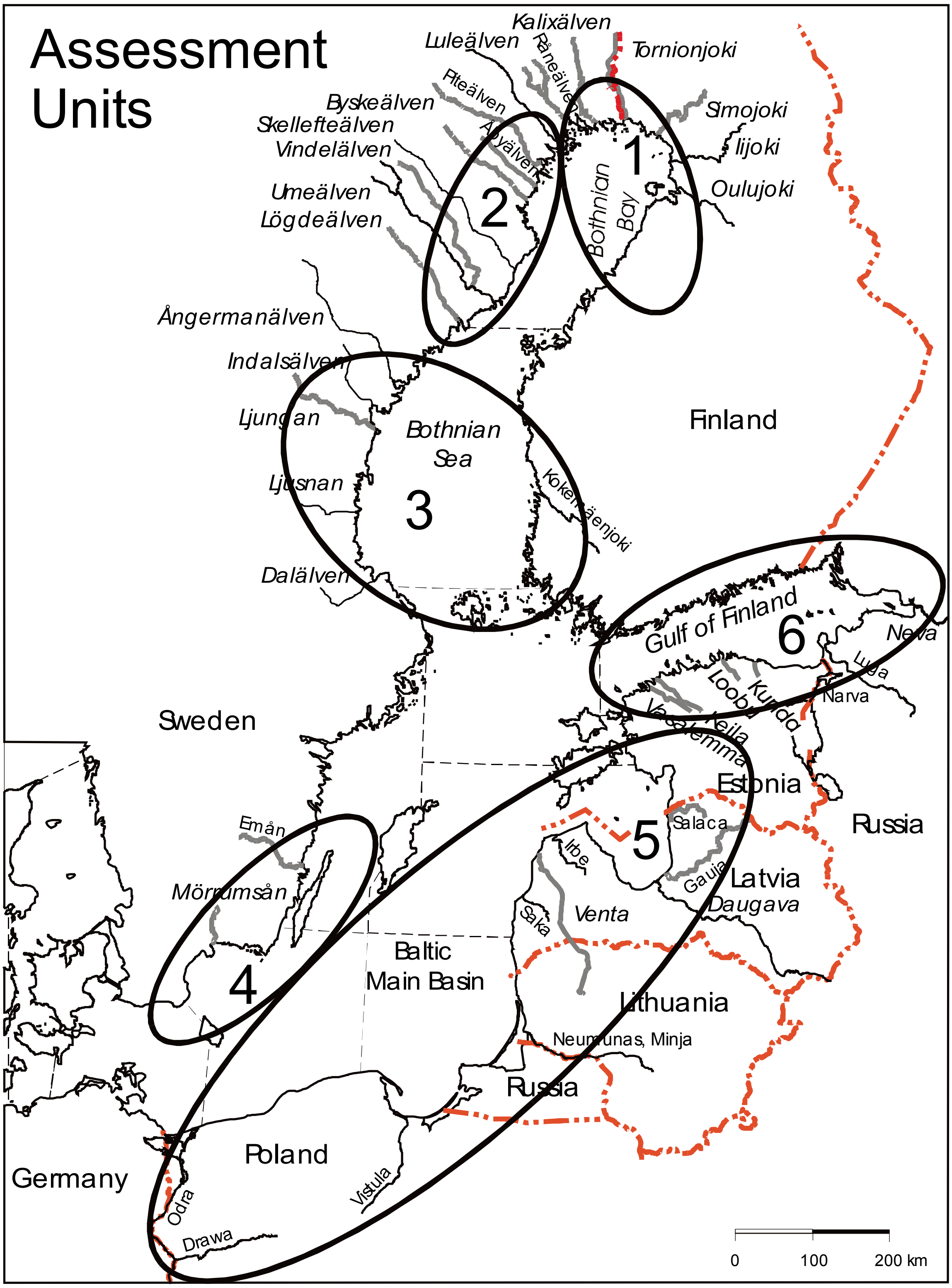

Figure 8.4.16.4 Grouping of salmon stocks in six assessment units in the Baltic Sea. Assessment unit 6 corresponds to Subdivision 32. The genetic variability between stocks of an assessment unit is smaller than the genetic variability between stocks of different units. In addition, the stocks of a particular unit exhibit similar migration patterns.

Table 8.4.16.1 Salmon in Subdivision 32 (Gulf of Finland). ICES advice, catch corresponding to advice, and agreed TAC for the Gulf of Finland (Subdivision 32).

Year	ICES Advice	Catch corresp. to advice '000 fish	Agreed TAC[3] tonnes	Agreed TAC[3] '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	-		15
2007	Retain sea fishery low. Special stock rebuilding measures for Estonian wild salmon rivers.	-		15
2008	No catch of wild salmon in the Gulf of Finland	-		15
2009	Same advice as last year	-		15
2010	Same advice as last year	-		15
2011	No catch of Estonian wild salmon in the Gulf of Finland. Any increase in total catches from present levels should be prevented.	13		15
2012	No catch of Estonian and Russian wild salmon in the Gulf of Finland. No increase in total catches from present levels (2006–2010 average).	12		15
2013	Catch of wild salmon should be kept to a minimum. Reduce effort.	-		

[1] Equivalent to 600 t.
[2] Equivalent to 400 t.
[3] No agreement between EU and Russia in the last years.

Table 8.4.16.2 Salmon in Subdivision 32 (Gulf of Finland). Salmon catches (in numbers) by year, country (EE=Estonia, FI=Finland, RU=Russia), and fishery in the Gulf of Finland (Subdivision 32) in 2000–2011.

YEAR	COUNTRY	Commercial catch	Recreational catch	Discards, seal damages	Discards, other reasons	Grand Total
2000	EE	3166				3166
	FI	19844	11200	3631	66	34741
	RU	914				914
2000 Total		23924	11200	3631	66	38821
2001	EE	2344				2344
	FI	12082	11200	3394	15	26691
	RU	808				808
2001 Total		15234	11200	3394	15	29843
2002	EE	2076				2076
	FI	9371	5700	3127	30	18228
	RU	426				426
2002 Total		11873	5700	3127	30	20730
2003	EE	1358				1358
	FI	6865	4200	3454	2	14521
	RU	431				431
2003 Total		8654	4200	3454	2	16310
2004	EE	858				858
	FI	6892	4900	3682	14	15488
	RU	497				497
2004 Total		8247	4900	3682	14	16843
2005	EE	1126	206			1332
	FI	9462	6200	1711	2	17375
	RU	636				636
2005 Total		11224	6406	1711	2	19343
2006	EE	865	138			1003
	FI	10798	5100	2598	9	18505
	RU	450				450
2006 Total		12113	5238	2598	9	19958
2007	EE	1053				1053
	FI	10348	1577	1757	1	13683
	RU	520				520
2007 Total		11921	1577	1757	1	15256
2008	EE	820	295			1115
	FI	13827	182	2128		16137
	RU	220				220
2008 Total		14867	477	2128		17472
2009	EE	1112	436			1549
	FI	11780	2790	1860	2	16432
	RU	584				584
2009 Total		13476	3226	1860	2	18565
2010	EE	1360				1360
	FI	4873	764	883	2	6522
	RU	491				491
2010 Total		6724	764	883	2	8373
2011	EE	1091				1091
	FI	6858	960	873	33	8724
	RU	470				470
2011 Total		8419	960	873	33	10285

Table 8.4.16.3 Salmon in Subdivision 32 (Gulf of Finland). Nominal landings of Baltic salmon in round fresh weight, from sea, coast, and river in Subdivision 32.

Year	River	Coast	Offshore	Coastal and offshore[2]		Total[3]	
	tonnes	tonnes	tonnes	tonnes	'000 fish	tonnes	'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	74	14	90	18
2003	9	57	3	60	11	69	13
2004	11	62	3	64	11	75	13
2005	17	79	3	82	14	99	18
2006	13	70	3	73	12	86	14
2007	11	69	3	72	11	83	13
2008	10	100	2	102	16	112	18
2009	13	80	1	81	14	94	16
2010	4	39	0	40	7	44	7
2011[1]	5	47	0	48	8	52	9

[1]Preliminary.
[2] For comparison with TAC.
[3] Total catch includes catches from recreational fisheries.

8.4.17 Advice May 2012

ECOREGION Baltic Sea
STOCK Sea trout in Subdivisions 22–32 (Baltic Sea)

Advice for 2013

ICES advises on the basis of precautionary considerations that exploitation rates in the Gulf of Bothnia (ICES Subdivisions 30 and 31) and the Gulf of Finland (ICES Subdivision 32) should be reduced to safeguard the remaining wild sea trout populations in the region, both locally and on their migration routes. Additional management measures for Subdivisions 30–32 should be considered, in particular to address bycatch of sea trout. These could include minimum mesh size for gillnets, effort limitations, fishing bans at river mouths, minimum legal landing sizes, and closures in time and space.

Existing fishing restrictions in ICES Subdivisions 22–29 (for example closed season, fishing bans at river mouths, minimum landing size, and minimum mesh sizes) should be maintained. Habitat improvements by restoration are needed and accessibility to spawning and rearing areas should be improved in many rivers.

Stock status

The Baltic Sea contains approximately 1000 sea trout stocks and about half of them are wild. There are no estimates of the historical numbers of sea trout populations or quantitative estimates of the total natural smolt production in past years. The status of wild sea trout in the Baltic Sea is quite variable between areas. Densities of juveniles (parr) observed in electrofishing surveys in rivers indicate a highly varying recruitment between areas. When grouping populations into large assessment units – southern Baltic Sea (ICES Subdivisions 21–25), eastern Baltic Sea (Subdivisions 26 and 28), western Baltic Sea (Subdivisions 27 and 29), Gulf of Bothnia (Subdivisions 30 and 31), and Gulf of Finland (Subdivision 32) – only the Gulf of Finland shows strong indications of having densities of parr that are below reference densities adjusted for river width and temperature (Figure 8.4.17.1). When looking at a less aggregated level (ICES subdivisions), the Bothnian Bay (ICES Subdivision 31) and northern Main Basin (Subdivision 29) also show some indications of parr densities being below the reference (Figure 8.4.17.2). For the Bothnian Bay area, a sharp decline in river catches since the 1960s (Figure 8.4.17.3) in combination with a continued decline in the age of sea trout caught in this area (Figure 8.4.17.4) also indicate that populations are well below historic levels. Parr densities in the Bothnian Sea (Subdivision 30) are close to being significantly above the reference level, indicating a better status of sea trout stocks in this area.

Trend analyses indicate a positive development in parr abundance during the last decade for Subdivisions 30 and 32 (Figure 8.4.17.5). A statistically significant negative trend in parr abundance was only observed for Subdivision 25. More detailed analysis in the Gulf of Bothnia shows indications of an increasing trend in parr abundance in Swedish populations, as opposed to Finnish populations (Figure 8.4.17.6). In the Gulf of Finland, Estonian sea trout populations show an increasing trend in abundance, as opposed to Finnish and Russian populations (Figure 8.4.17.7). It is possible that these differences reflect management changes in Sweden and Estonia.

Despite some positive signals for Subdivision 30, the additional management measures listed in the advice section above include this subdivision because the fishery in this area also catches sea trout from Subdivision 31 on their feeding migration.

Biology

Sea trout is an anadromous form of brown trout (*Salmo trutta* L.). Sea trout usually live in the same water system as resident brown trout, and they can be genetically isolated from each other or breed together and genetically belong to the same population. The species is naturally distributed in northern and western Europe from the White Sea to northern Spain, including the entire Baltic Sea area. Populations are often partially migratory, i.e. one part of the population leaves the river for feeding in the sea (predominantly females migrate), while the other part stays in the river as residents. Sea trout spawn in rivers and smaller streams, often in the upper reaches or in smaller tributaries, where the nursery areas of trout are also found. They live their first (1–5) years as parr in the stream, leaving the stream as smolts for a feeding migration at sea that lasts for ½ up to 5 years, after which they return to their natal stream for spawning. Spawning may be repeated several times.

Environmental influence on the stock

There is a large variability in the habitat quality of sea trout rivers. Although the habitat in many rivers is suitable for sea trout, many populations are reported to be limited from both poor habitat conditions and migration obstacles. Habitat improvements by restoration should be promoted where needed and accessibility to spawning and rearing areas should be secured.

The fisheries

The nominal sea trout catch from the Baltic Sea was 479 tonnes in 2011, which is 199 tonnes (30%) less than in 2010 (Table 8.4.17.1). Most of the stocks in the Baltic Sea migrate in the coastal area within about 150 km of the home river and are therefore exploited locally, but longer migrations also occur in all areas, particularly in Poland, southern Sweden, and Denmark. The fish that migrate only short distances are mainly exploited in coastal and river fisheries, but long-migrants are also taken in offshore fisheries. The majority of sea trout catch is from mixed-stock fisheries.

The Main Basin is the most important area for professional sea trout catches, with the catch in this area constituting more than 60% of the total catch in 2011. Catches in the Main Basin have decreased from 1023 tonnes in 2002 to a minimum of 262 tonnes in 2008. After two years of catches around 500 tonnes, the catch fell again in 2011 to 293 tonnes. The catch of sea trout by Poland may be heavily overestimated due to possible misreporting of salmon as trout.

Around half of the total Baltic catch was taken by the coastal fishery, mainly in the Gulf of Bothnia and slightly less in the Main Basin. About one third was caught by the offshore fishery, almost exclusively by Polish vessels. River catch was 92 t in 2011. The largest part of this (41 t) was reported from Swedish rivers flowing to the Gulf of Bothnia, mainly as anglers' catch, and from Polish rivers (39 t) as commercial catch and brood-stock fishery.

Catch in the recreational fishery is known with little accuracy and only part of it is included in the nominal catch presented above. Information has been gathered in Sweden, Finland, and Denmark in recent years, and the annual estimated catch for the Gulf of Bothnia could be as high as 400 to 500 tonnes. In Denmark, the total recreational catch in Subdivisions 22–25 in 2010 was estimated to be 346 tonnes. In spite of figures being incomplete, the share caught in the recreational fishery constitutes a significant part of the total catch, in some areas by far the largest share.

In the Gulf of Bothnia and Gulf of Finland, the fishery targeting sea trout is very limited. Instead, sea trout are caught as bycatch in fisheries targeting whitefish, pikeperch, and perch. This fishery has had a high effort level in the past ten years in Finland. A significant part of this fishery is recreational.

Catch distribution Total catch (2011) is 0.479 kt, where 100% are landings.

Effects of the fisheries on the ecosystem

The effects of sea trout fisheries probably have a minor influence on the marine ecosystem function, but as some trout populations are at low levels fisheries in these cases have affected the biodiversity of the ecosystems, particularly in rivers. There is limited knowledge on the magnitude of these effects.

Quality considerations

Electrofishing survey data were not available from all countries, and there is a general need for more electrofishing data to increase precision in the analyses.

The catch estimates for recreational fishing are incomplete or totally missing for several countries. The unknown share of the recreational catch can be considerable. Sea trout that migrate offshore are to a large extent taken as bycatch in the offshore salmon fishery. Salmon catches are to some extent misreported as trout in this fishery and improvement of control measures is therefore desirable to prevent misreporting. According to an estimate in the Baltic salmon assessment model, the misreporting of salmon as sea trout in the Polish offshore fishery in 2011 could have been around 43 000 individuals. Assuming an average weight of salmon of 4.57 kg, this means that the Polish sea trout catch could be overestimated by around 197 tonnes, which constitutes up to about 40% of the total sea trout catch.

Inclusion of trout in the EU Data Collection Framework should be considered. Collection of sea trout data from rivers is important, similarly to the salmon situation.

Scientific basis

The assessment of sea trout stocks is based on densities of parr in rivers, estimated from electrofishing survey data. The observed densities have been compared to reference densities derived from good habitats, adjusted for climate and river width. In addition, data on numbers of ascending spawners, recapture rates of tagged sea trout, smolt counting in rivers, and catches in rivers are used in the monitoring of sea trout stocks, when such information is available.

Working group report: WGBAST

ECOREGION Baltic Sea
STOCK Sea trout in Subdivisions 22–32 (Baltic Sea)

Reference points

There are no MSY-based reference points for sea trout. The status of sea trout stock complexes in different areas is evaluated using parr densities relative to references derived from good habitats, adjusted for climate and river width.

Outlook for 2013

No quantitative forecast could be provided.

MSY approach

No stock–recruit data exist at the moment, precluding estimation of potential parr densities, as well as parr densities, smolt production, and number of spawners at MSY.

PA considerations

In some areas parr densities are below and exploitation is considered to be above possible targets. Therefore, exploitation should be reduced in those areas. Because of the migratory behaviour of sea trout, the same advice applies to nearby areas. In addition, habitat improvements in the freshwater environment are recommended.

Additional considerations

In the Gulf of Bothnia and Gulf of Finland, the majority of the sea trout are caught during their first two years in the sea and before reaching sexual maturity. In the Bothnian Bay, sea trout become mature mainly after spending 3 winters at sea (3SW). The current minimum landing size is 50 cm in the area, but this will not provide full protection for first-time spawners to reach maturity (lengths above 55 cm). According to tagging data, less than 5% of the catch has consisted of 3SW or older fish in the last 15 years (Figure 8.4.17.4). Minimum landing size as a measure to reduce exploitation of immature trout will not protect smaller sea trout from being caught as bycatch in fisheries targeting other species. However, it could be an effective measure for fisheries targeting sea trout.

Many sea trout stocks are widely migratory in the Main Basin. This requires international cooperation when managing fisheries on these stocks. There is no TAC set for sea trout, but national regulations include *inter alia* minimum landing size, local and seasonal closures, and minimum mesh sizes for the gillnet fishery. On the Swedish side of the Bothnian Bay, for example, gillnet fishing is banned during spring and fall in waters of less than three meters of depth, in order to decrease the bycatch of sea trout. It is possible that the positive trend in parr abundances observed in Swedish rivers in the Gulf of Bothnia (Figure 8.4.17.6) could at least partly reflect management changes in Sweden. The application of such measures in other areas would likely benefit sea trout stocks also in those areas.

Improvement in water quality and habitats, as well as better accessibility to spawning and nursery areas, are needed in many rivers.

Management plans

The HELCOM Ministerial Meeting, Krakow, Poland, 15 November 2007, agreed on a Baltic Sea Action Plan (BSAP), which proposes the development of management plans for sea trout.

Data and methods

Information is available from scientific electrofishing, smolt trapping, fish ladder counts, tag returns, and catch data from the fisheries. The assessment of sea trout populations is based on abundance of juveniles (parr) in streams, studied using electrofishing. A reference abundance was calculated for each site in the dataset, based on sites with good habitat and good water chemistry, and adjusted for climate and stream width. In each site, observed abundance was compared to the reference abundance to derive an estimate of relative recruitment status, which was expressed on a subdivision/assessment unit level by calculating the average value over electrofishing sites with a 95% confidence interval. The reference abundance was derived based on abundances observed at selected sites. Therefore, it should not be interpreted as what the population might be able to produce at carrying capacity (i.e. “potential” production). High observed parr abundance compared to reference abundance might still reflect recruitment far below potential recruitment.

Trends in parr abundance over time were calculated based on the correlation between parr abundances and year (2000–2011). For each subdivision/assessment unit, trends at individual sites were combined to estimate an average trend with a 95% confidence interval.

Uncertainties in assessment and forecast

The quality and quantity of data on trout populations needs to be improved if the quality of the advice is to be enhanced. The need for monitoring is not recognised in all countries and, consequently, some countries do not have a regular monitoring programme. In some cases, monitoring of sea trout occurs in conjunction with the monitoring of salmon populations, and because these monitoring sites have been established specifically for salmon, estimates of sea trout recruitment will be less precise due to the different habitat requirements of the species.

Comparison with previous assessment and catch options

The new data available for sea trout stocks and the new model used for assessment do not change the perception of the stock status. The fisheries catching sea trout have not changed markedly from previous years and management considerations and recommendations are similar to last year's advice.

Assessment and management area

The assessment of stock status has been carried out on assessment units and also on less aggregated levels (ICES subdivisions and individual countries). Five assessment units have been established: southern Baltic Sea (ICES Subdivisions 21–25), eastern Baltic Sea (Subdivisions 26 and 28), western Baltic Sea (Subdivisions 27 and 29), Gulf of Bothnia (Subdivisions 30 and 31), and Gulf of Finland (Subdivision 32).

Sources

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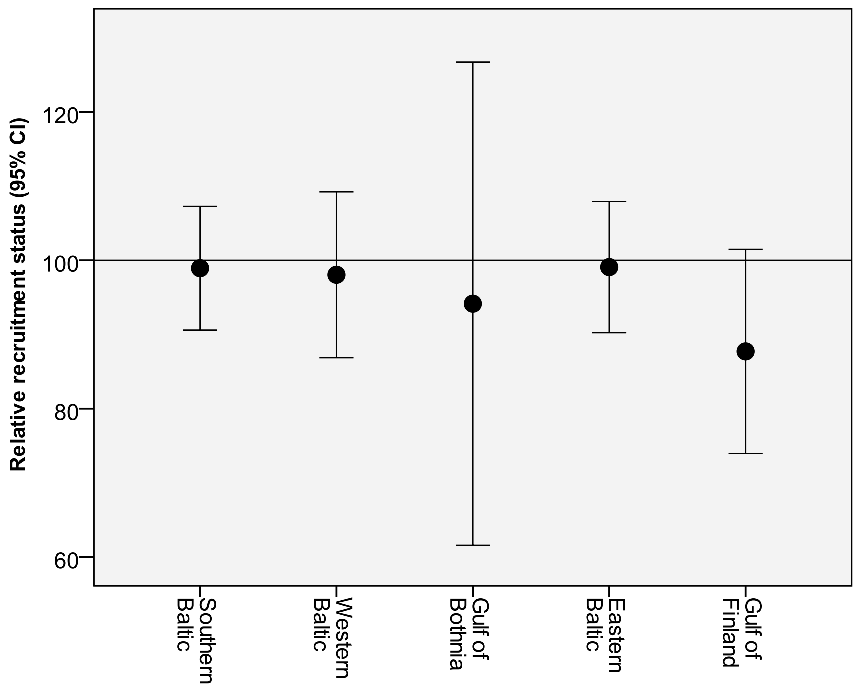

Figure 8.4.17.1 Average relative recruitment status ((observed parr abundance/reference abundance)*100) for different parts (assessment units) of the Baltic Sea.

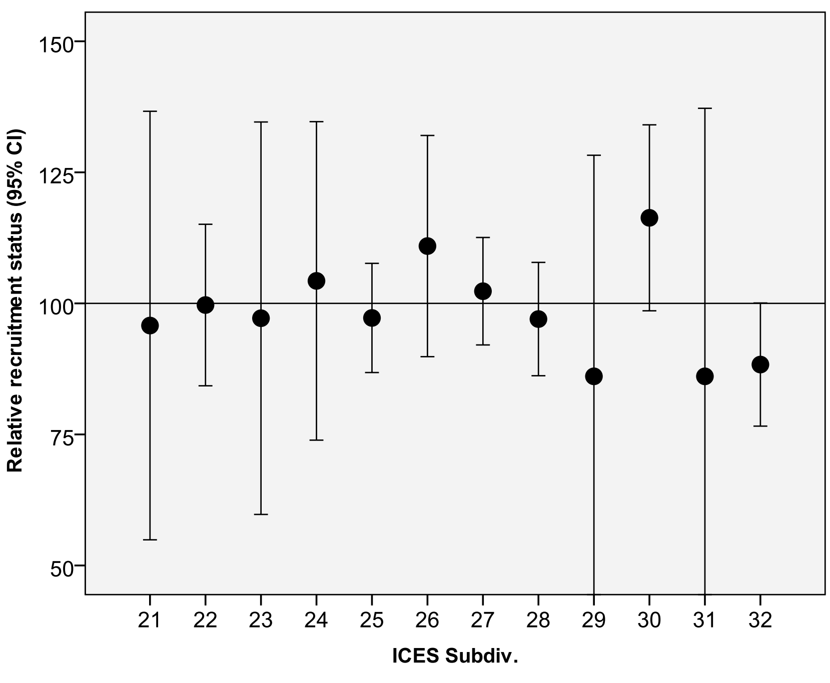

Figure 8.4.17.2 Average relative recruitment status ((observed parr abundance/reference abundance)*100) for each ICES subdivision.

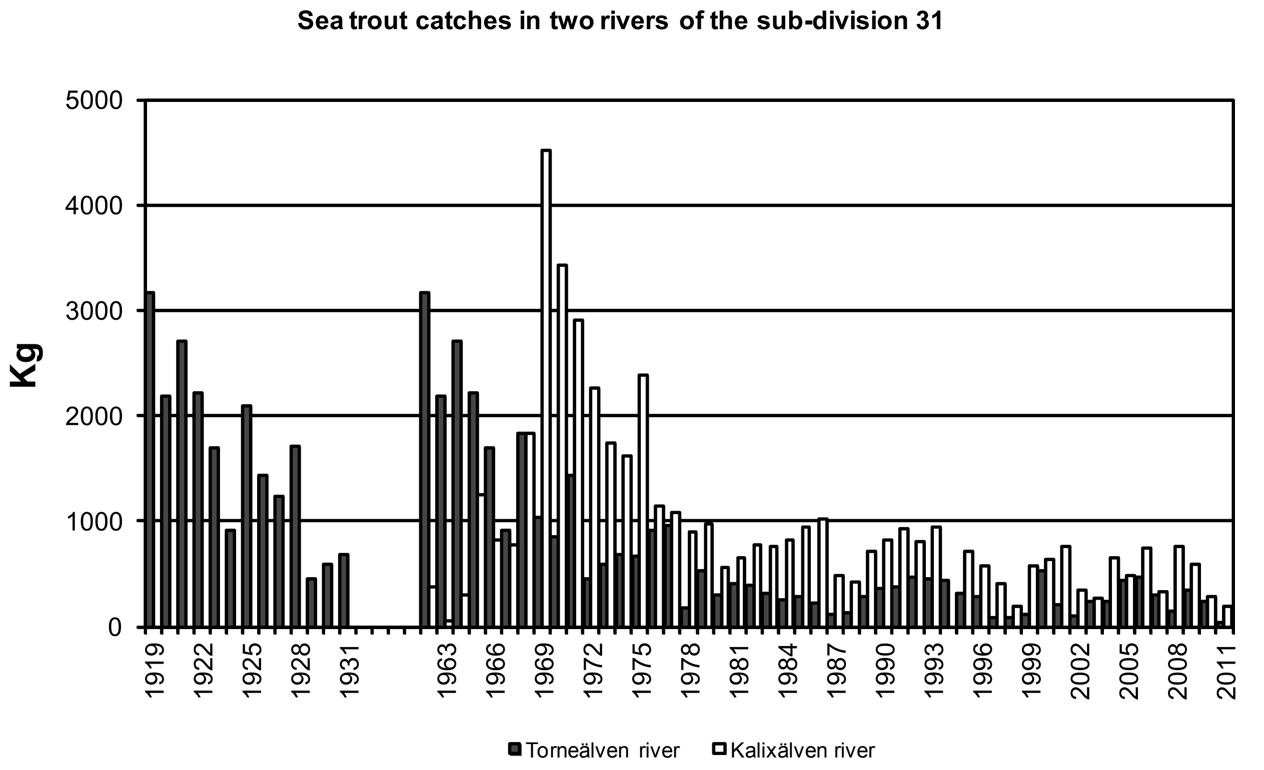

Figure 8.4.17.3 Sea trout catches in two rivers in Subdivision 31 between 1919 and 2011 (The Swedish Board of Fisheries, Fisheries Research Office in Luleå, unpublished data).

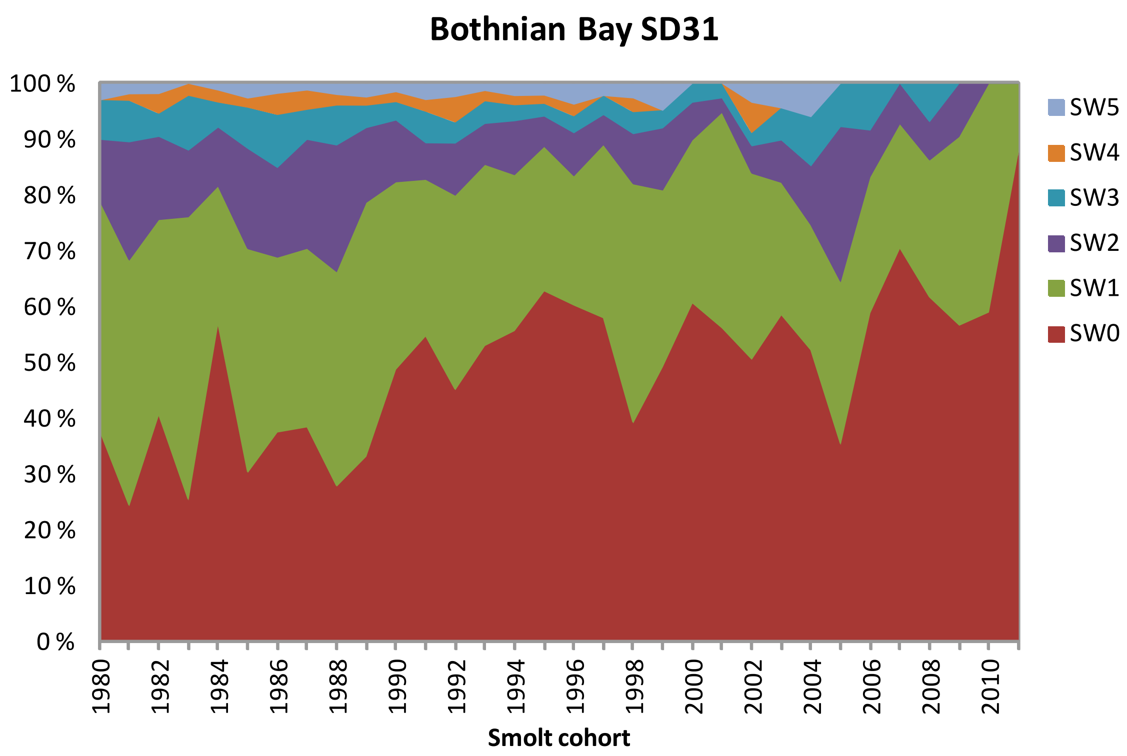

Figure 8.4.17.4 Age distribution of recaptured Carlin-tagged sea trout released in the Bothnian Bay (Subdivision 31) area in Finland in 1980–2010, plotted versus smolt cohort years.

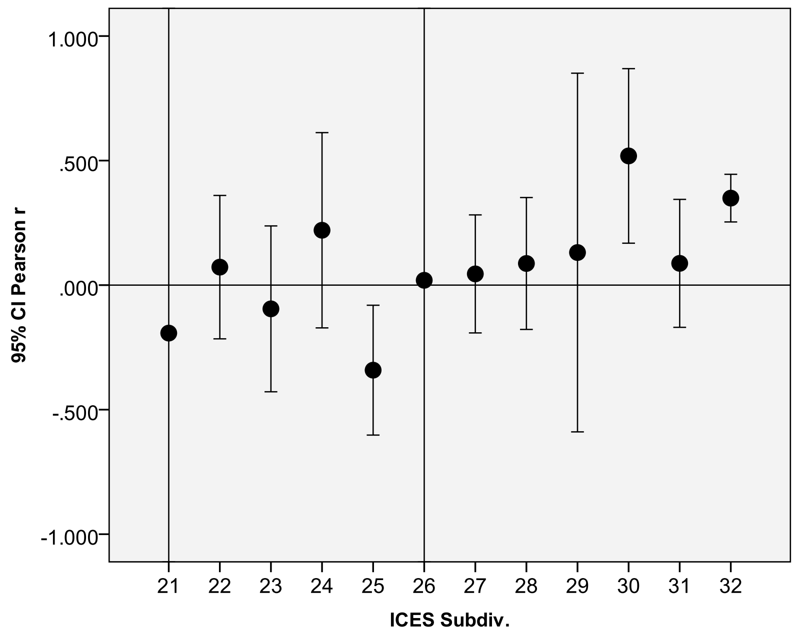

Figure 8.4.17.5 Average Pearson r (trend in parr abundance during 2000–2011) for each ICES subdivision.

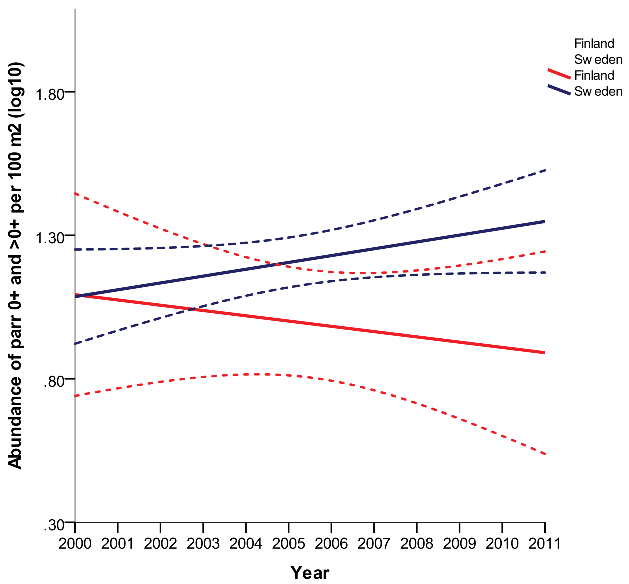

Figure 8.4.17.6 Trend in abundance (log_{10} per 100 m^2) of 0+ and >0+ parr in the Gulf of Bothnia (Subdivisions 30–31), separately for Swedish and Finnish sites (95% confidence interval of the mean). The figure only represents streams and sites included in the assessment (2000–2011). Regression: Finland R^2 = 0.473, F = 0.473, p = 0.496; Sweden R^2 = 0.017, F = 3.073, p = 0.081.

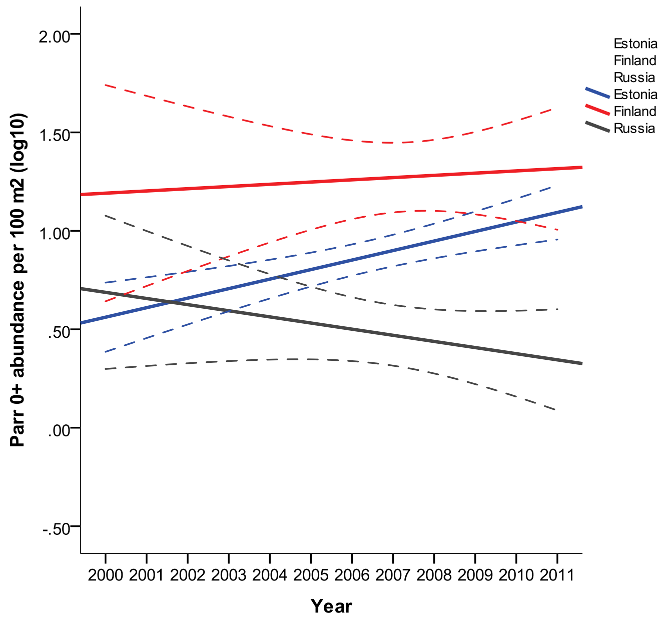

Figure 8.4.17.7 Trend in abundance ($\log_{10}$ per 100 m^2) of 0+ parr in the Gulf of Finland (Subdivision 32), separately for Finnish, Estonian, and Russian sites (95% confidence interval of the mean). The figure only represents streams and sites included in the assessment (2000–2011). Regression: Estonia $R^2 = 0.011$, $F = 3.861$, $p = 0.05$; Finland $R^2 = 0.002$, $F = 0.104$, $p = 0.748$; Russia $R^2 = 0.027$, $F = 1.491$, $p = 0.224$.

Table 8.4.17.1 Nominal sea trout landings (tonnes) by country.

Year				Country					
	Denmark[1,4]	Estonia	Finland[2]	Germany[4]	Latvia	Lithuania	Poland[7]	Sweden	Total
1979	3	na	89	na	na	na	105[3]	3	200
1980	3	na	173	na	na	na	74[3]	3	253
1981	6	2	310	na	5	na	66[3]	3	392
1982	17	4	326	1	13	na	111	3	475
1983	19	3	332	na	14	na	133	3	504
1984	29	2	387	na	9	na	185	3	617
1985	40	3	368	na	9	na	166	13	599
1986	18	2	349	na	8	na	140	49	566
1987	31	na	373	na	2	na	200	47	653
1988	28	3	582	na	8	na	170	112	903
1989	39	3	666	18	10	na	184	169	1 089
1990	48[3]	4	841	21	7	na	488	154	1 563
1991	48[3]	3	829	7	6	na	309	171	1 373
1992	27[3]	9	837	na	6	na	281	249	1 409
1993	59[3]	15	1 250[5]	14	17	na	272	138	1 865
1994	33[6,3]	8	1 150	15[7]	18	na	222	161	1 607
1995	69[6,3]	6	502	13	13	3	262	125	993
1996	71[6,3]	16	333	6	10	2	240	166	844
1997	53[6,3]	10	297	+	7	2	280	156	805
1998	60[6,3]	8	460	4	7	na	468	145	1 158
1999	110	10	440	9	10	1	626	115	1 321
2000	58	14	445	9	14	1	812	99	1 452
2001	54	10	367	10	12	1	716	85	1 257
2002	35	16	201	12	13	2	863	76	1 219
2003	40	9	189	9	6	+	823	65	1 141
2004	46	10	150	12	7	1	764	61	1 050
2005	14	11	164	14	9	2	586	61	859
2006	44	20	265	12	7	1	530	60	940
2007	26	17	278	9	8	1	525	55	918
2008	18	14	262	13	8	2	172	65	555
2009	12	18	260	4	11	2	389	70	765
2010	8	16	124	3	6	2	454	65	678
2011[8]	6	22	134	3	6	3	244	61	479

[1]Additional sea trout catches are included in the salmon statistics for Denmark until 1982.

[2]Finnish catches include about 70% non-commercial catches in 1979–1995, 50% in 1996–1997, and 75% in 2000–2001.

[3]Rainbow trout included.

[4]Sea trout are also caught in the western Baltic in Subdivisions 22 and 23 by Denmark, Germany, and Sweden.

[5]Finnish catches include about 85% non-commercial catches in 1993.

[6]ICES Subdivisions 22 and 24.

[7]Catches in 1979–1997 included sea and coastal catches.

[8]Preliminary data.

+ Catch less than 1 tonne.