6.4.15   Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to high long-term yield	Fishing mortality in relation to agreed target	Comment
Undefined	Undefined	Overfished	NA	

In the absence of agreed reference points, the state of the stock cannot be evaluated. SSB has been stable in recent years but is expected to decline rapidly due to poor recruitment. Fishing mortality has been stable and is estimated at 0.37, well above the candidate for F_{msy}. From 2004 onwards, recruitment has been declining and is now at a record-low.

Management objectives

There are no explicit management objectives for this stock.

Reference points

There are no precautionary approach reference points agreed for this stock.

Yield and spawning biomass per Recruit F-reference points (2009):

	Fish Mort Ages 3-6	Yield/R	SSB/R
Average last 3 years	0.37	0.03	0.06
Fmax*	-	-	-
F0.1	0.23	0.03	0.09
Fmed	0.39	0.03	0.05

*Fmax is not well defined.

Candidates for reference points consistent with high long-term yields and a low risk of depleting the productive potential of the stock are around $F_{0.1}$. Preliminary HCR evaluations are consistent with this view and have shown that candidates for F_{msy} can be found in the region of F = 0.25 (see section 8.3.3.1).

Single-stock exploitation boundaries

ICES advises on the basis of exploitation boundaries in relation to long-term yield that fishing at the candidate Fmsy fishing mortality (0.25) implies catches in 2010 not larger than 39 800 t in the entire distribution area.

Short-term implications

Outlook for 2010

Basis (for Western Baltic spring spawning herring WBSS): F(2009) = 0.29 [Catch constraint]; R_{09-11}=GM(2003-2007)=2225 million; SSB(2009) = 142; catch (2009) = 45[a]). Catches are for herring in Division IIIa and Sub-Divisions 22–24, see further in Section 6.4.16 on North Sea Autumn Spawning herring (NSAS).

Catch options and results for **WBSS** herring only: Division IIIa, Subdivisions 22-24 and Division IVaE [1)]

Rationale	Catch 2010	Basis	F 2010	22-24 Fleet F	IIIa Fleet C	IIIa Fleet D	IVaE Fleet A [2)]	SSB 2010 [3)]	SSB 2011 [3)]	% SSB change [4)]
Zero catch	0	F = 0.0	0	0	0	0	0	131	157	19%
High long-term yield	39.8	F_{sq}*0.9	0.25	18.8	18.7	2.2	0.1	128	122	-5%
Status quo	45.4	F_{sq}*1.0	0.29	21.5	21.3	2.5	0.1	128	117	-8%
	48.7	F_{sq}*1.1	0.31	23.1	22.9	2.7	0.1	127	114	-10%
	57.3	F_{sq}*1.3	0.38	27.2	26.9	3.1	0.1	127	107	-15%
	65.9	F_{sq}*1.5	0.45	31.3	31.0	3.6	0.1	126	100	-20%

Catch options for **WBSS and NSAS** herring: Division IIIa and Subdivisions 22-24 [1)]

Catch 2010	22-24 Fleet F	IIIa Fleet C	IIIa Fleet D	% TAC change [5)]
0	0	0	0	-100%
50.8	18.8	26.2	5.8	-31%
57.9	21.5	29.8	6.6	-21%
62.3	23.1	32.1	7.1	-15%
73.3	27.2	37.7	8.4	0%
84.3	31.3	43.4	9.6	15%

Weights in '000 t

[a)] assuming a utilisation of the TAC/bycatch ceiling of 97% (F-fleet), 52% (D-fleet) and 65% (C-fleet).
[1)] Ratio of herring catches between different fleets and areas in 2009 is based on the 2009 TACs (or bycatch ceiling in case of fleet D), ratio between the different herring stocks in IIIa is based on the 2008 catch ratios. The later ratio cannot be predicted and may therefore deviate significantly from the assumed ratio...
[2)] As in 2008 a catch of 0.1 t of WBSS herring taken in the Eastern North Sea is assumed.
[3)] For spring spawning stocks, the SSB is determined at spawning time and is influenced by fisheries between 1st January and spawning time.
[4)] SSB (2011) relative to SSB (2010).
[5)] Catches (2010) relative to TAC 2009 (SD 22-24 + IIIa + IIIa bycatch ceiling = 27.2+37.7+8.4 =73.3 kt).

To derive the total herring catch for Division IIIa (right hand side of the table), predicted catches of NSAS (as advised in section 6.4.16) have to be added to the advised maximum catches of WBSS in the area. The total catch by fleet is only compatible with the advice for WBSS if the values given for NSAS are treated as maximum catches. Thus the resulting catch options were also used as constraints for catch options for the NSAS herring (Section 6.4.16). Note that the right hand side of the table is for illustrative purposes only and is not part of the ICES advice; the ratio of TACs between areas is not fixed and there are several options for TACs compatible with the removal of WBSS advised by ICES.
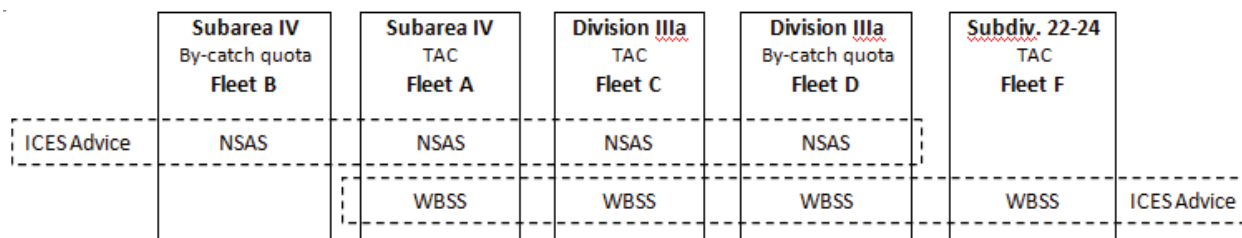
Explanation on fleet coding:

Area	Fleet	Description
North Sea	A	Directed herring fisheries with purse-seiners and trawlers. Bycatches in industrial fisheries by Norway are included.
	B	Bycatches of herring taken under EU regulations.
Division IIIa	C	Directed herring fisheries with purse-seiners and trawlers.
	D	Bycatches of herring caught in the small-mesh fisheries.
Sub-Divisions 22-24	F	All herring fisheries in Subdivisions 22–24.

Catch options for mixed stocks in Division IIIa based on short-term predictions for Western Baltic Spring-Spawning herring (WBSS)

Catch options for the whole stock of Western Baltic Spring-Spawning herring (WBSS) can be partitioned into catches by area. Catches of WBSS herring in Division IIIa also imply catches of North Sea Autumn-Spawning (NSAS) herring which constitute part of the total catch in that area.

ICES catch predictions versus management TAC

ICES advises on catch options by fleet for the entire distribution of the two herring stocks separately, whereas herring is managed by areas cross-sectioning the geographical distribution of the stocks (see the following text diagram).

	Subarea IV By-catch quota **Fleet B**	Subarea IV TAC **Fleet A**	Division IIIa TAC **Fleet C**	Division IIIa By-catch quota **Fleet D**	Subdiv. 22-24 TAC **Fleet F**	
ICES Advice	NSAS	NSAS	NSAS	NSAS		
		WBSS	WBSS	WBSS	WBSS	ICES Advice

The catch options for 2010 are based on the TAC proportions by fleet and area in 2009 and, for IIIa, on the observed stock composition (WBSS vs. NSAS) in catches taken in 2008. Short-term predictions are based on an expected catch in 2009 of 45 087 t of Western Baltic spring spawning stock taking into account the TACs by fleet for 2009, potential misreporting and the assumed proportion of Western Baltic spring spawning herring in the catches in Division IIIa.

To make fleet wise catch options for the prediction year it is assumed that the TAC distribution by fleet in 2010 will be equal to 2009. It is also assumed that there will be allowed a subtraction of 20% of the Norwegian quota that is transferred to the A-fleet (as NSAS). Further it is assumed that each fleet catches its total TAC. Finally it is assumed that the 2008 proportions of WBSS by fleet hold for 2010. The proportions of WBSS in catches were 0.71 in the C-fleet, 0.37 in the D-fleet and 1.00 in the F-fleet and further a constant catch of 120 t of WBSS caught in the A-fleet in Division IVa East.

Management considerations

North Sea Autumn-Spawning and the Western Baltic Spring-Spawning herring stocks are exploited and managed simultaneously in Division IIIa. Hence, the management of the herring fisheries in Division IIIa influences both stocks.

Recruitment of Western Baltic herring has been reduced by 15-35% annually from 2004 onwards. The estimated strength of the 2008 year class is the lowest of the whole times series, and amounts to only a quarter of the average. There is no indication that recruitment would return to the previous level in the near future. The poor year classes have not yet fully contributed to the SSB but will increasingly do so in the near future. In this situation, there is no alternative to reduce F significantly to avoid a drastic decline of the SSB.

ICES has used the mean recruitment from 2003–2007 (year-classes) for the short-term prediction which might be overly optimistic in the present situation.

Factors affecting the fisheries and the stock

Regulations and their effects

Corrections for misreporting by area have been incorporated in the assessment. In recent years, ICES has calculated that a substantial part of the catch reported as taken in Division IIIa by fleet C was actually taken in Subarea IV. These catches have been allocated to the North Sea stock and accounted for under the A fleet. Regulations allowing quota transfers from Division IIIa to the North Sea were introduced as an incentive to decrease misreporting for the Norwegian part of the fishery. Recent Working Group estimates of 30% misreporting in Division IIIa may be underestimating the problem because not all countries supply this information to ICES.

The quota for the C fleet and the bycatch quota for the D fleet (see above) are set for the NSAS and the WBSS stocks together. The implication for the catch of NSAS must also be taken into account when setting quotas for the fleets that exploit these stocks.

Changes in fishing technology and fishing patterns

There have been only minor changes in the fishery technology in recent years.

Impact of the environment on the fish stock

Herring in Division IIIa and Subdivisions 22–24 are migratory. There are feeding migrations from the Western Baltic into more saline waters of Division IIIa and the eastern parts of Division IVa. There are indications from parasite infections that yet unknown proportions of sub-stocks spawning at the southern coast in the Baltic proper may perform similar migrations.

Western Baltic herring recruitment has been reduced by 15-35% annually from 2004 onwards and is now at a record low. North Sea herring, with which Western Baltic herring shares the same environment at least for part of the year, has also produced only very small year classes since 2002. In a recent recruitment analysis for different Baltic herring stocks, the Baltic Sea Index (BSI) reflecting Sea Surface Temperature (SST) was the main predictor for Western Baltic herring (Cardinale et al., *in press*). There are no indications of systematic changes in growth or age at maturity, and candidate key stages for reduced recruitment are probably the egg or the larval stage. The specific reasons for reduced egg or larval survival are not known. Further investigation of the causes of the poor recruitment will require targeted research projects.

Scientific basis

Data and methods

The otolith microstructure method has been used to calculate the proportion of spring and autumn spawners caught in these areas for all catch and survey data in the period 1991–2008. An analytical FLICA assessment is based on catch data and the results of two acoustic and one larval survey.

Information from the fishing industry

VMS data confirm that area misreporting from the North Sea to the Skagerrak has declined in proportion with the reduction in reported landings. Identified misreported catch has been moved to the appropriate areas and are thus taken into account in the assessment.

Uncertainties in assessment and forecast

There is no firm basis to predict the fraction of NSAS in the catches by the C- and D-fleets. The proportions of the two stocks as well as the distribution pattern of the fishery in the Eastern North Sea and in Division IIIa changes dynamically year by year. This is probably influenced by the year class strength of the two stocks and their relative geographical distributions, as well as by fleet behavior reacting to herring availability and management decisions.

The strength of a year class is not firmly estimated before the year class has been followed for 2–3 years. However, the introduction of a larval 0-group recruitment index (N20) in 2008 appears to contribute valuable and consistent information to the estimate of the 1-winter ringers in the assessment.

Comparison with previous assessment and advice

A benchmark assessment was carried out in 2008. The update assessment this year shows a reduction of 23% of the estimated fishing mortality in 2007 and a 21% increase for the SSB in 2007. However trends in recruitment and SSB are similar.

In 2008 ICES advised an immediate reduction in F to candidate for Fmsy = 0.25. In the light of the continuing reduction of recruitment, the basis for the advice did not change.

Source of information

Report of the Herring Assessment Working Group for the Area South of 62°N, 17-25 March 2009 (ICES CM 2009/ACFM:03).

Cardinale, M., Mölmann, C., Bartolino, V., Casini, M., Kornilovs, G., Raid, T., Margonski, P.,Raitaniemi, L., and Gröhsler, T. (*in press*). Climate and parental effects on the recruitment of Baltic herring (*Clupea harengus membras*) populations. Conditionally accepted by MEPS.

Table 6.4.15.1   Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners). Single stock exploitation boundaries (advice), management and catches.

Year	ICES Advice	Pred. catch corresp. to advice	Agreed TAC IIIa[2]	ICES catch of Stock			
				22–24	IIIa	IV	Total
1987	Reduction in F	224	218	102	59	14	175
1988	No increase in F	196	218	99	129	23	251
1989	TAC	174	218	95	71	20	186
1990	TAC	131	185	78	118	8	204
1991	TAC	180	155	70	112	10	192
1992	TAC	180	174	85	101	9	195
1993	Increased yield from reduction in F; reduction in juvenile catches	188	210	81	95	10	186
1994	TAC	130–180	191	66	92	14	172
1995	If required, TAC not exceeding recent catches	168–192	183	74	80	10	164
1996	If required, TAC not exceeding recent catches	164–171	163	58	71	1	130
1997	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	66–85[1]	100	68	55	1	124
1998	Should be managed in accordance with North Sea autumn spawners	-	97	51	53	8	112
1999	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-	99	50	43	5	98
2000	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~60 for Subdivs. 22–24	101	54	57	7	118
2001	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Subdivs. 22–24	101	64	42	6	112
2002	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Subdivs. 22–24	101	53	47	7	107
2003	Reduce F	<80	101	40	36	2	78
2004	Separate management regime for this stock Reduce F	<92	91	42	24	7	77
2005	Separate management regime for this stock *Status quo* F	95	120	44	38	7	89
2006	Separate management regime for this stock *Status quo* F	95	102[3]/47.5*	42	36	11	89
2007	Separate management regime for this stock *Status quo* F	99	69[3]/49.5*	40	28	1	68
2008	Separate management regime for this stock Reduce F by 20% towards $F_{0.1}$	71	51.7[3]/45*	43	25	0	68
2009	Separate management regime for this stock Reduce F to F = 0.25	< 32.8	37.7[3]/27.2*				
2010	Separate management regime for this stock Reduce F to F = 0.25	<39.8					

Weights in '000 t.

[1]Catch in Subdivisions 22–24.

[2]Including mixed clupeoid TAC and bycatch ceiling in small-mesh fishery.

[3] Human consumption in Division IIIa, not incuding industrial bycatch or mixed clupeoids, but including North Sea Autumn Spawner catch in fleet C.

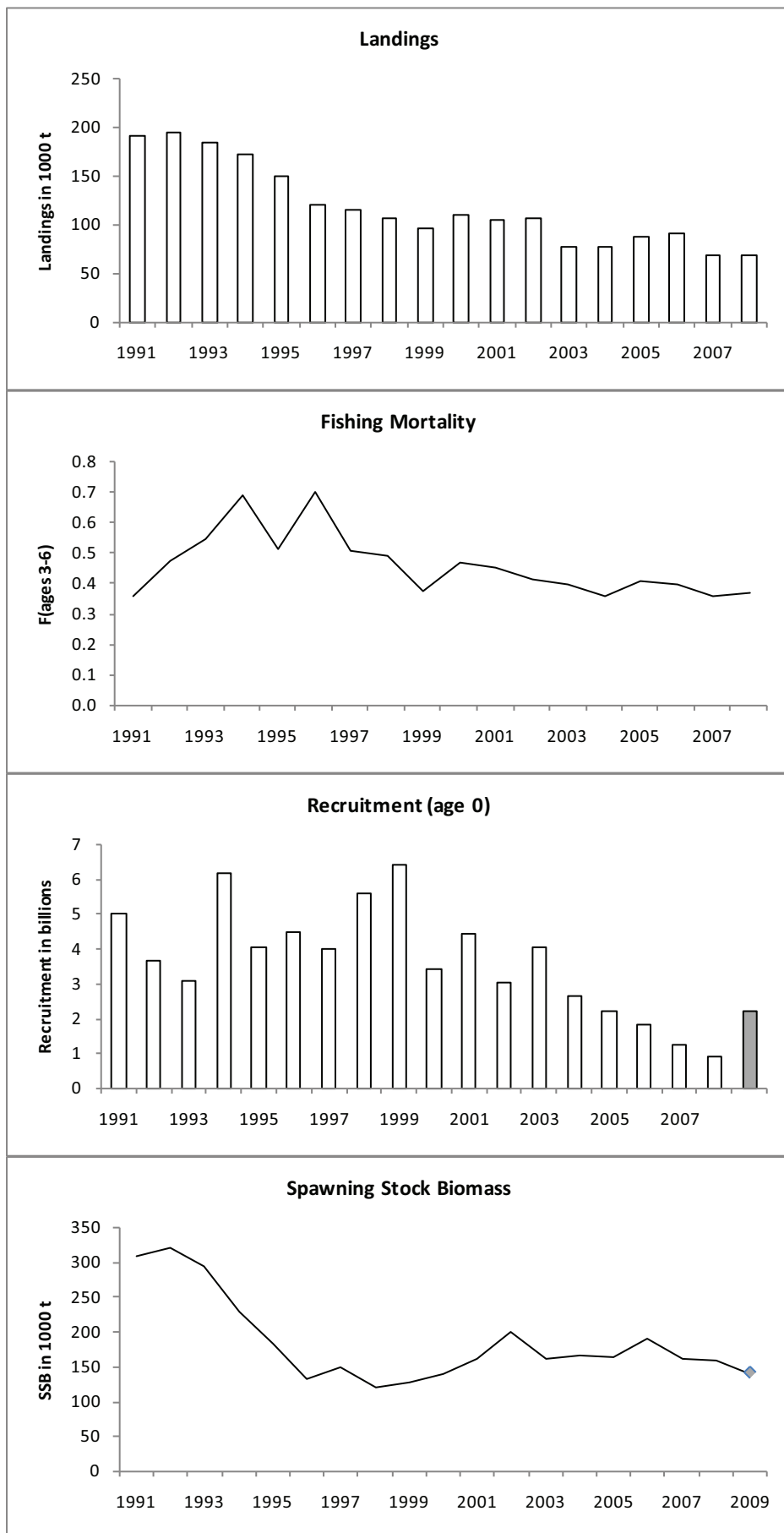* separate TAC for SD 22–24.

Figure 6.4.15.1 Herring in Subdivisions 22–24 and Division IIIa (spring spawners). Landings, fishing mortality, recruitment, and SSB. Estimates are shown in grey. 2009 recruitment taken as GM 2003–2007.
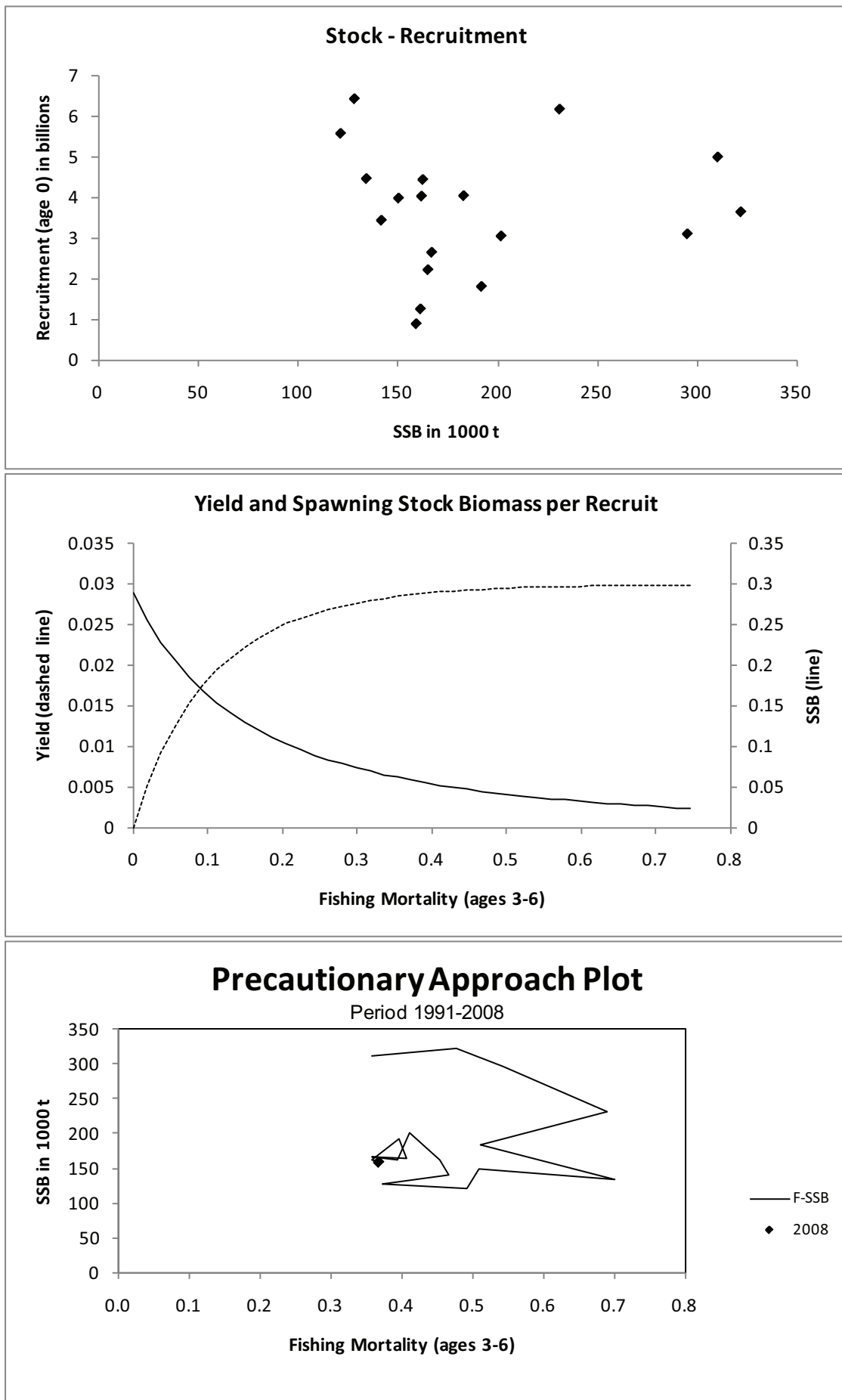
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Figure 6.4.15.2   Herring in Subdivisions 22–24 and Division IIIa (spring spawners). Stock recruitment, yield and SSB per recruit, precautionary approach.
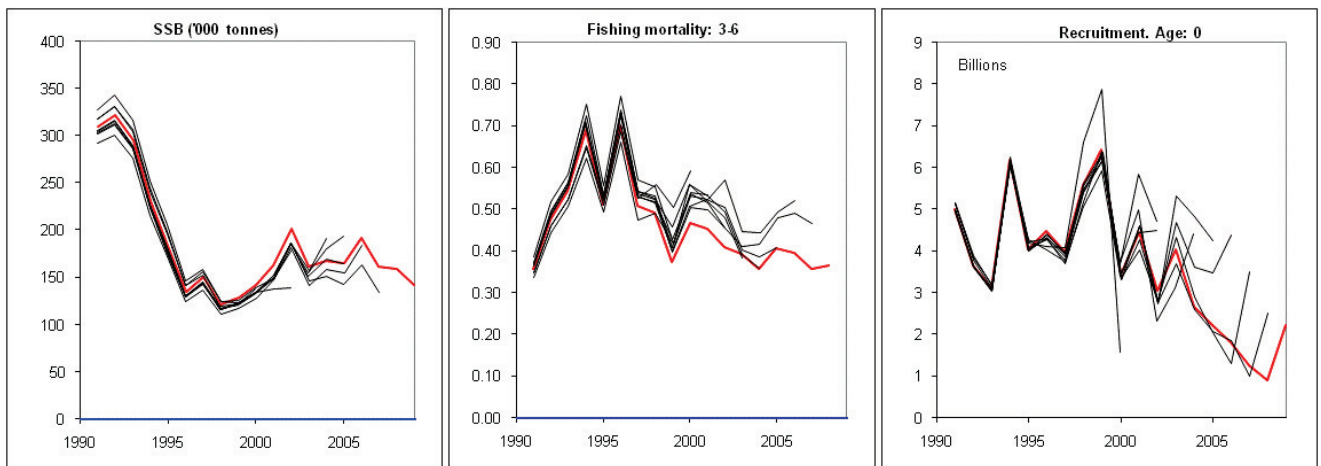
Figure 6.4.15.3 Herring in Subdivisions 22–24 and Division IIIa (spring spawners). Historical performance of the assessment. The last data point for SSB is a prediction, for Recruitment the last data points is GM 03-07.

Table 6.4.15.2   Herring in Subdivisions 22–24 and Division IIIa (spring and autumn spawners). Landings ('000 t).

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Skagerrak											
Denmark	105.0	144.4	47.4	62.3	58.7	64.7	87.8	44.9	43.7	28.7	14.3
Faroe Islands											
Germany											
Norway	1.2	5.7	1.6	5.6	8.1	13.9	24.2	17.7	16.7	9.4	8.8
Sweden	51.2	57.2	47.9	56.5	54.7	88.0	56.4	66.4	48.5	32.7	32.9
Total	157.4	207.3	96.9	124.4	121.5	166.6	168.4	129.0	108.9	70.8	56.0
Kattegat											
Denmark	46.6	76.2	57.1	32.2	29.7	33.5	28.7	23.6	16.9	17.2	8.8
Sweden	29.8	49.7	37.9	45.2	36.7	26.4	16.7	15.4	30.8	27.0	18.0
Total	76.4	125.9	95.0	77.4	66.4	59.9	45.4	39.0	47.7	44.2	26.8
Sub. Div. 22+24											
Denmark	32.5	33.1	21.7	13.6	25.2	26.9	38.0	39.5	36.8	34.4	30.5
Germany	53.1	54.7	56.4	45.5	15.8	15.6	11.1	11.4	13.4	7.3	12.8
Poland	8.0	6.6	8.5	9.7	5.6	15.5	11.8	6.3	7.3	6.0	6.9
Sweden	7.8	4.6	6.3	8.1	19.3	22.3	16.2	7.4	15.8	9.0	14.5
Total	101.4	99.0	92.9	76.9	65.9	80.3	77.1	64.6	73.3	56.7	64.7
Sub. Div. 23											
Denmark	0.8	0.1	1.5	1.1	1.7	2.9	3.3	1.5	0.9	0.7	2.2
Sweden	0.2	0.1	0.1	0.1	2.3	1.7	0.7	0.3	0.2	0.3	0.1
Total	1.0	0.2	1.6	1.2	4.0	4.6	4.0	1.8	1.1	1.0	2.3
Grand Total	336.2	432.4	286.4	279.9	257.8	311.4	294.9	234.4	231.0	172.7	149.8

Year	1998[2]	1999[2]	2000	2001[5]	2002[4]	2003	2004	2005	2006[1,3]	2007	2008[1]
Skagerrak											
Denmark	10.3	10.1	16.0	16.2	26.0	15.5	11.8	14.8	5.2	3.6	3.9
Faroe Islands									0.4		0.0
Germany						0.7	0.5	0.8	0.6	0.5	1.6
Norway	8.0	7.4	9.7							3.5	4.0
Sweden	46.9	36.4	45.8	30.8	26.4	25.8	21.8	32.5	26.0	19.4	16.5
Total	65.2	53.9	71.5	47.0	52.3	42.0	34.1	48.5	31.8	26.9	26.0
Kattegat											
Denmark	23.7	17.9	18.9	18.8	18.6	16.0	7.6	11.1	8.6	9.2	7.0
Sweden	29.9	14.6	17.3	16.2	7.2	10.2	9.6	10.0	10.8	11.2	5.2
Total	53.6	32.5	36.2	35.0	25.9	26.2	17.2	21.1	19.4	20.3	12.2
Sub. Div. 22+24											
Denmark	30.1	32.5	32.6	28.3	13.1	6.1	7.3	5.3	1.4	2.8	3.1
Germany	9.0	9.8	9.3	11.4	**22.4**	18.8	18.5	21.0	22.9	24.6	21.8 [6]
Poland	6.5	5.3	6.6	9.3	-	4.4	5.5	6.3	5.5	2.9	5.5
Sweden	4.3	2.6	4.8	13.9	10.7	9.4	9.9	9.2	9.6	7.2	7.0
Total	49.9	50.2	53.3	62.9	46.2	38.7	41.2	41.8	39.4	37.6	37.5
Sub. Div. 23											
Denmark	0.4	0.5	0.9	0.6	4.6	2.3	0.1	1.8	1.8	2.9	5.3
Sweden	0.3	0.1	0.1	0.2	-	0.2	0.3	0.4	0.7		0.3
Total	0.7	0.6	1.0	0.8	4.6	2.6	0.4	2.2	2.5	2.9	5.7
Grand Total	169.4	137.2	162.0	145.7	128.9	109.5	92.8	113.6	93.0	87.7	81.3

[1] Preliminary data.

[2] Revised data for 1998 and 1999
   Bold = German revised data for 2001

[3] 2000 tonnes of Danish landings are missing, see text section 3.1.2

[4] The Danish national management regime for herring and sprat fishery in Subdivision 22 was changed in 2002

[5] The total landings in Skagerrak have been updated for 1995-2001 due to Norwegian misreportings into Skagerrak.

[6] This value is incorrect but could not be corrected in subsequent calculations before the completion of the meeting. The correct value is 22.8

Table 6.4.15.3   Herring in Subdivisions 22–24 and Division IIIa (spring spawners). Summary of the assessment.

Year	Recruitment Age 0 thousands	SSB at spawning time tonnes	Landings tonnes	Mean F Ages 3-6
1991	5003979	310543	191573	0.3576
1992	3652584	322123	194411	0.4762
1993	3109372	295303	185010	0.5439
1994	6182874	231273	172438	0.6894
1995	4050991	183178	150831	0.5121
1996	4472243	134412	121266	0.7007
1997	3991042	150554	115588	0.5097
1998	5585578	121510	107032	0.4919
1999	6439794	128418	97240	0.3730
2000	3444329	141946	109914	0.4661
2001	4448602	162715	105803	0.4537
2002	3057143	201961	106191	0.4102
2003	4039490	162065	78309	0.3944
2004	2655128	167171	76815	0.3577
2005	2226088	165281	88406	0.4073
2006	1813432	192109	90549	0.3959
2007	1259682	161537	68997	0.3576
2008	894443	159406	68484	0.3670
2009*	2225068	141824		
Average	3607756	185965	118270	0.4591

* Recruitment is GM (2003–2007). SSB is predicted.