ICES WGWIDE REPORT 2008

ICES ADVISORY COMMITTEE

ICES CM 2008/ACOM:13

Report of the Working Group on Widely Distributed Stocks (WGWIDE)

2–11 September 2008

ICES Headquarters Copenhagen

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

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

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1 Introduction

1.1 Terms of Reference

Generic ToRs for Review and Advice Drafting Groups in 2008

The review process will have a different role compared to previous years. The new review process will aim to provide a review of the scientific finding and the development of a final advice that can be submitted to the Advisory Committee for approval. This shall be done in two distinct processes.

a) The first part is done by review groups that are constituted of independent experts and are not involved with the expert group report to be reviewed:

   i) The review groups shall ensure the quality of the analyses that is produced by the Expert Group(s). The Group shall review the quality of the assessment work carried out by the Expert Group(s) and write technical minutes of the main findings in the review. These Technical Minutes are part of the Expert group report. The review shall consider whether the analysis integrates all relevant knowledge;

b) The second step is advice drafting. The first draft advice is developed by the senior advisors supported by chairs from the expert groups and the Secretariat.

This draft is considered by an advice drafting group that review the draft advice and ascertain that the advice is

- in accordance with the advisory principles established by ACOM and as
- laid down in the MoUs with Clients
- relevant and answering the request
- understandable
- credible
- according to the standard form and format of advice

   ii) for fisheries advice, produce consolidated eco-region advice that, together with single stock summaries can be submitted to the Advisory Committee for adoption.

Generic ToRs for Fish Stock Assessment Working Groups

For AFWG, HAWG, NWWG, NIPAG, WGWIDE, WGBFAS, WGNSSK, WGNSDS, WGSSDS, WGHMM and WGANC ToRs (1)-(4):

1) Assemble national data on relevant fisheries and environmental data

   a) Input and quality check all input data and where possible input into the INTERCATCH database;

   b) Produce an overview of the sampling activities on a national basis (if possible derived from the INTERCATCH database);

   c) Recommend specific actions to be taken to improve the basis for the advice in future

   (including improvements in data collection);

   d) When appropriate, conduct a Data Compilation Workshop as part of the expert group meeting where stakeholders are invited to contribute data including data from non-traditional sources. At these workshops stakeholders can also contribute to data preparation and evaluation of data quality. Data that are to be included in the analysis of the Expert Group shall satisfy quality criteria established by ACOM;

2) Update time-series of relevant fisheries and environmental data:

   a) catches (landings, discards, bycatch)(−by fisheries/fleets). Where misreporting is considered significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information.

   b) fishing effort (by fisheries/fleets)

   c) surveys

   d) environmental drivers

3) Update description of major regulatory changes (technical measures, TACs, effort control and management plans) and report on evaluations of their (potential) effects.

4) Produce a brief report of the work carried out by the Working Group. This report should summarise for the stocks and fisheries where the item is relevant:

   a) Stock status and catch options

   b) Mixed fisheries considerations

   c) Ecosystem effects of fisheries

   d) Regulatory changes in the fisheries which have consequences for the assessment or projections

   e) Agreed or proposed management plans

   f) Species interaction effects

For AFWG, HAWG, NWWG, NIPAG, WGWIDE in addition consider

5) Update the agreed analytical method for those stocks where a benchmark assessment is required to assess the state of the stocks and short term outlooks or update the agreed indicator(s) of stock trends

ToR for WGWIDE

2007/2/ACOM13 The **Working Group on Widely Distributed Stocks** [WGWIDE] (Chair: Beatriz Roel*, UK) will be established and will meet at ICES Headquarters, 2–11 September 2008 to:

a) compile, update, analyse and document time-series of relevant fisheries, environmental data and regulatory changes (see generic ToRs)

b) summarise the findings for the following stocks (see generic ToR 4):

   i) NEA Mackerel

   ii) Western and southern Horse mackerel

   iii) Norwegian Spring Spawning herring

   iv) Blue whiting

   v) Sardine in Divisions VIIIc and IXa

WGWIDE will report by 12 September 2008 for the attention of ACOM. This Group continues work previously undertaken by WGMHSA and WGNPBW. Anchovy assessments are moved to WGANC.

FishStock	Name	Stock Coordinator	Assessment Coordinator 1	Assessment Coordinator 2
her-noss	Norwegian spring-spawning herring	IS	NO	RUS
hom-nsea	Horse mackerel in the North Sea Area (Areas IIa, IV and IIIa)	NO	DK	NL
hom-soth	Southern horse mackerel (Divisions VIIIc and IXa)	SP	SP	POR
hom-west	Western horse mackerel (IIa,IVa,Vb,VIa,VIIa-c,e-k,VIIIabde)	NO	UK	NL
mac-nea	Mackerel (combined Southern, Western & N.Sea spawn.comp.)	IRL	UK(FRS)	NL
sar-soth	Sardine in Divisions VIIIc and IXa	POR	POR	SP
whb-comb	Blue whiting combined stock (Sub-areas I-IX, XII & XIV)	IS	DK	RUS

1.2 List of Participants

Beatriz Roel (Chair)	United Kingdom
Pablo Abaunza	Spain
Esther Abad	Spain
Paula Alvarez	Spain
Frans van Beek	Netherlands
Sergei Belikov	Russian Federation
Thomas Brunel	Netherlands
Andrew Campbell	Ireland
Høgni Debes	Faroes
Erwan Duhamel	France
Afra Egan	Ireland
Pavel Gasyukov	Russian Federation
Asta Gudmundsdóttir	Iceland
Jens Christian Holst	Norway
Detlev Ingendahl	Germany
Svein A. Iversen	Norway
Teunis Jansen	Denmark
Igor Karpusheveskiyi	Russia
Alexander Krysov	Russian Federation
Charlotte Main	United Kingdom
Jacques Massé	France
Manolo Meixide	Spain
Eugene Mullins	Ireland
Alberto Murta	Portugal
Jose de Oliveira	United Kingdom
Are Salthaug	Norway
Sonia Sanchez	Spain
Begoña Santos	Spain
John Simmonds	United Kingdom
Dankert Skagen	Norway

Alexandra Silva	Portugal
Jens Ulleweit	Germany
Nikolay Timoshenko	Russian Federation
Morten Vinther	Denmark
Sytse Ybema	Netherlands

1.3 Quality and Adequacy of Fishery and Sampling data

1.3.1 Sampling Data from Commercial Fishery

The working group again carried out a brief review of the sampling data and the level of sampling on the commercial fisheries. Sampling coverage for mackerel continued to increase and now stands at 87%, exceeding the long-term average (82%). The proportion of the horse mackerel catch sampled has considerably decreased from 72% in 2006 to 62% in 2007 with divisions where sampling is considered inadequate. Sardines continue to be well sampled with samples provided by Portugal, Spain and France.

Information on long term trends in sampling effort were not given in the previous WGNPBW reports. However, tables with the total figures since 2000 were added at the beginning of the Norwegian spring spawning herring and the blue whiting sections. Overall, Norwegian spring spawning herring and blue whiting sampling covers 94% and 87% of the total catch, respectively.

It should be noted that the information on the percentage of catch sampled depends entirely on the accuracy of the sampled catch figure provided by the relevant countries.

In general, to facilitate age-structured assessment, samples should be obtained from all countries with catches of the relevant species.

The sampling programmes on the various species are summarised as follows:

Mackerel

YEAR	TOTAL CATCH (WG CATCH)	% CATCH COVERED BY SAMPLING PROGRAMME*	NO. SAMPLES	NO. MEASURED	NO. AGED
1992	760,000	85	920	77,000	11,800
1993	825,000	83	890	80,411	12,922
1994	822,000	80	807	72,541	13,360
1995	755,000	85	1,008	102,383	14,481
1996	563,600	79	1,492	171,830	14,130
1997	569,600	83	1,067	138,845	16,355
1998	666,700	80	1,252	130,011	19,371
1999	608,928	86	1,109	116,978	17,432
2000	667,158	76	1,182	122,769	15,923
2001	677,708	83	1,419	142,517	19,824
2002	717,882	87	1,450	184,101	26,146
2003	617,330	80	1,212	148,501	19,779
2004	611,461	79	1,380	177,812	24,173
2005	543,486	83	1,229	164,593	20,217
2006	472,652	85	1,604	183,767	23,467
2007	579,379	87	1,267	139,789	21,791

***Percentage related to working group catch.**

In 2007, 87% of the total catch was covered by national sampling programmes, a small increase on the figure for the previous year (85%). This is despite a significant fall in the number of samples compared with recent years. Denmark, Germany, Iceland, Norway, Portugal, Russia, Scotland and Spain all sampled over 95% of their catch with Ireland and the Netherlands achieving rates over 85%. As in previous years, England & Wales sample a small fraction (6%), corresponding to the handline fishery in area VIIe and VIIf. The remaining countries (of which France, the Faroes, Northern Ireland, Sweden and Poland had significant catches) failed to sample any catches.

The sampling summary of the mackerel catching countries is shown in the following table:

COUNTRY	OFFICIAL CATCH	% CATCH COVERED BY SAMPLING PROGRAMME	NO. SAMPLES	NO. MEASURED	NO. AGED
Belgium	1	0	0	0	0
Denmark	25,223	99	34	2,875	2,875
Faroe Islands	13,430	0	0	0	0
France	20,038	0	0	0	0
Germany	18,221	97	54	15,090	1,765
Iceland	36,706	99	18	298	286
Ireland	49,259	94	40	7,436	2,443
Jersey	6	0	0	0	0
Lithuania	7	0	0	0	0
Netherlands	24,244	85	50	4,902	1,250
Norway	131,691	98	196	19,618	898
Poland	978	0	0	0	0
Portugal	2,605	100	273	21,732	1,497
Russia	35,408	100	87	23,105	1,288
Spain	62,946	100	379	26,162	4,888
Sweden	3,858	0	0	0	0
UK (England & Wales)	14,654	6	51	6,942	962
UK (Northern Ireland)	5,545	0	0	0	0
UK (Scotland)	113,490	97	85	11,629	3,639
Total	558,310	87	1,267	139,789	21,791

*** Percentage based on Working Group catch**

The following table describes the mackerel sampling levels by relating numbers measured and aged to the size of the catch in each ICES division. Areas where insufficient sampling was carried out include IIIa (1,485t), VIIc (1,260t), VIIk (495t), VIIIa (5,444t), VIIId (674t). This was also the case with VIIIa,d in previous years. No sampling was carried out in areas IIIb,c,d and VIIa,g,h although the corresponding catches were minor.

AREA	OFFICIAL CATCH	WG CATCH	NO SAMPLES	NO AGED	NO MEASURED	NO AGED/ 1000 TONNES*	NO MEASURED/ 1000 TONNES*
IIa	65,002	64,992	99	1,362	23,084	20	360
IIIa	1,485	1,485	0	0	0	0	0
IIIb	2	2	0	0	0	0	0
IIIc	3	3	0	0	0	0	0
IIId	2	2	0	0	0	0	0
IVa	247,958	256,152	271	4,617	28,502	18	115
IVb	908	1423	14	1,265	1,345	1,390	1,480
IVc	233	132	1	25	64	110	270
Va	7,802	7,802	4	112	119	10	20
Vb	97	97	2	100	200	1,030	2,050
VIa	111,996	111,193	90	3,161	14,875	28	133
VIIa	9	71	0	0	0	0	0
VIIb	20,220	23,801	29	1,971	6,139	97	304
VIIc	1,359	1,260	0	0	0	0	0
VIId	3,358	7,407	6	150	685	40	200
VIIe	541	2,535	31	215	4,849	397	8,963
VIIf	805	805	25	872	2,635	1,083	3,273
VIIg	27	27	0	0	0	0	0
VIIh	33	20	0	0	0	0	0
VIIj	22,871	26,894	42	1,531	9,333	70	410
VIIk	495	495	0	0	0	0	0
VIIIa	5,710	5,444	0	0	0	0	0
VIIIb	3,827	3,827	23	1,057	1,410	280	370
VIIIcE	46,557	46,557	224	2,446	15,429	50	330
VIIIcW	6,899	6,899	62	827	4,281	120	620
VIIId	730	674	0	0	0	0	0
IXaN	6,773	6,773	71	583	5,107	90	750
IXaCN	2,605	2,605	273	1,497	21,732	570	8,340
Total	558,307	579,377	1,267	21,791	139,789	39	250

*** Based on official catches**

Horse Mackerel

The following table shows a summary of the overall sampling intensity on horse mackerel catches in recent years:

YEAR	TOTAL CATCH (WG CATCH)	% CATCH COVERED BY SAMPLING PROGRAMME*	NO. SAMPLES	NO. MEASURED	NO. AGED
1992	436,500	45	1,803	158,447	5,797
1993	504,190	75	1,178	158,954	7,476
1994	447,153	61	1,453	134,269	6,571
1995	580,000	48	2,041	177,803	5,885
1996	460,200	63	2,498	208,416	4,719
1997	518,900	75	2,572	247,207	6,391
1998	399,700	62	2,539	245,220	6,416
1999	363,033	51	2,158	208,387	7,954
2000	272,496	56	1,610	186,825	5,874
2001	283,331	64	1,502	204,400	8,117
2002	241,336	72	1,768	235,697	8,561
2003	241,830	79	1,568	200,563	12,377
2004	216,361	68	1,672	213,066	16,218
2005	234,876	78	2,315	241,629	15,866
2006	215,277	72	1,623	231,344	12,009
2007	187,995	62	1,321	174,897	10,749

*** Percentage related to Working Group catch**

There was a considerable decrease in overall sampling for horse mackerel from 2006 to 2007. This is the lowest sampling level since 2000. As usual the large numbers of measured fish are due to intensive length measurement programs in the southern areas. In 2007, 76% of the horse mackerel measured were from Division IXa.

Countries that carried out sampling were Germany which covered 4% of the catches and Denmark, Ireland, the Netherlands, Norway, Portugal and Spain covered 501–00 of their catches. France, UK and Lithuania took considerable catches without providing any samples or data to the Working Group. The lack of sampling data for relatively large portions of the horse mackerel catches continues to have a serious effect on the accuracy and reliability of the assessment and the Working Group remain concerned about the low number of fish that are aged. Last year it was the first time Lithuania reported horse mackerel catches. Their main catches were taken in Division VIIb.

The following table shows the most important horse mackerel catching countries and the summarised details of their sampling programme in 2006:

COUNTRY	OFFICIAL CATCH	% CATCH SAMPLED*	NO. SAMPLES	NO. MEASURED	NO. AGED
Belgium	6	0			
Denmark	7,872	86	12	445	445
Faroe Islands	478	0			
France	18,097	0			
Germany	5,871	3	16	2,480	742
Ireland	30,092	91	43	8,117	2,980
Lithuania	5,763	0			
Netherlands	60,237	68	57	8,651	1,425
Norway	5,425	74	15	574	166
Portugal	10,380	100	750	120,730	1,681
Spain	27,319	98	428	33,900	3,342
Sweden	129	0			
UK (England & Wales)	12,403	0			
UK (Scotland)	1,403	0			
Sum (WG catch)	187,994	62	1,321	174,897	10,749

*** Percentage based on Working Group catch**

The following tables have information broken down by horse mackerel stock.

The horse mackerel sampling intensity for the Western stock (areas) was as follows:

COUNTRY	OFFICIAL CATCH	% CATCH SAMPLED*	NO. SAMPLES	NO. MEASURED	NO. AGED
Denmark	7,617	86	6	399	399
Faroe Islands	478				
France	12,748				
Germany	5,784	4	16	2,480	743
Ireland	30,091	91	43	8,117	2,948
Lithuania	5,467				
Netherlands	29,083	50	32	4,649	800
Norway	4,182	97	15	574	166
Spain	14,257	100	254	20,811	2,367
Sweden	76				
UK (England & Wales)	5,482				
UK (Scotland)	778				
Sum (WG catch)	123,408	57	366	37,030	7,423

*** Percentage based on Working Group catch**

The horse mackerel sampling intensity for the North Sea stock (IVb,c, VIId and the eastern part of IIIa) was as follows:

COUNTRY	OFFICIAL CATCH	% CATCH SAMPLED*	NO. SAMPLES	NO. MEASURED	NO. AGED
Belgium	6				
Denmark	255	71	5	46	46
France	5,349				
Germany	87				
Ireland	1				
Lithuania	296				
Netherlands	31,154	92	25	4,002	625
Norway	1,243				
Sweden	53				
UK (Scotland)	625				
Sum (WG catch)	41,164	61	163	30	4,048

*** Percentage based on Working Group catch**

The horse mackerel sample intensity is higher than usual and is caused by the Netherlands which has an extensive sampling program takes 77% of the catches.

The horse mackerel sampling intensity for the Southern stock (areas) was as follows:

COUNTRY	OFFICIAL CATCH	% CATCH SAMPLED*	NO. SAMPLES	NO. MEASURED	NO. AGED
Portugal	13,043	95	174	13,089	975
Spain	103,380	100	750	120,730	1,681
Sum (WG catch)	23,323	97	924	133,819	2,656

*** Percentage based on Working Group catch**

The horse mackerel sampling intensity by division was as follows:

Area	Official catch	WG catch	No samples	No sampled	No measured	No aged/1000 tonnes	No measured/ 1000tonnes
IIa	0	0					
IIIa	148	148	0	0	0		
IIIb	4	4	0	0	0		
IIIc	22	22	0	0	0		
IVa	8198	6996	15	166	574	24	82
IVb	1126	1119	6	46	46	41	41
IVc	21333	8118	5	125	626	15	77
Va	0	0					
VB	366	366	0	0	0		
VIa	24474	25948	36	1954	5304	75	204
VIb	331	331	0	0	0		
VIIa	51	51	0	0	0		
VIIb	26608	29601	18	1120	3423	38	116
VIIc	1517	1159	0	0	0		
VIId	20529	29808	20	500	3376	17	113
VIIe	13248	18908	16	466	3138	25	166
VIIf	260	260	21	950	3381	3654	13004
VIIg	0.01	0.01	0	0	0		
VIIh	4295	4295	3	171	171	40	40
VIIj	10981	8866	0	0	0		
VIIk	185	185	0	0	0		
VIIIa	11251	11251	3	228	228	20	20
VIIIb	3174	3174	10	294	999	93	315
VIIIcE	4817	4817	148	1110	11660	230	2421
VIIIcW	9141	9141	96	963	8152	105	892
VIIId	3	3	0	0	0	0	0
IXaN	12046	12046	174	975	13089	81	1087
IXaCN	2700	2700	535	760	73701	281	27297
IXaCS	5580	5580	76	500	5716	90	1024
IXaS	2337	2337	139	421	41313	180	17678
SUM	184725	187995	1321	10749	174897	57	930

Sardine

The following table shows a summary of the overall sampling intensity over recent years on the catches of the sardine stock in VIIIc and IXa.

YEAR	TOTAL CATCH	% CATCH COVERED BY SAMPLING PROGRAMME*	NO. SAMPLES	NO. MEASURED	NO. AGED
1992	164,000	79	788	66,346	4,086
1993	149,600	96	813	68,225	4,821
1994	162,900	83	748	63,788	4,253
1995	138,200	88	716	59,444	4,991
1996	126,900	90	833	73,220	4,830
1997	134,800	97	796	79,969	5,133
1998	209,422	92	1,372	123,754	12,163
1999	101,302	93	849	91,060	8,399
2000	91,718	94	777	92,517	7,753
2001	110,276	92	874	115,738	8,058
2002	99,673	100	814	96,968	10,231
2003	97,831	100	756	93,102	10,629
2004	91,886	100	932	112,218	9,268
2005	97,345	100	925	116,400	9,753
2006	87,848	100	927	122,185	9,165
2007	94,648	100	797	97,187	8,607

- Percentage related to Working Group catch

The sampling intensity for all sardine catching countries was as follows:

COUNTRY	OFFICIAL CATCH	% CATCH COVERED BY SAMPLING PROGRAMME	NO. SAMPLES	NO. MEASURED	NO. AGED
Portugal	64,500	100	447	59,611	4,908
Spain	31,968	100	350	37,576	3,699
France	24,009	67	42	2,878	1,194
Ireland	82	0	0	0	0
UK (England & Wales)	2,576	0	0	0	0
Total	123,135	91,4	839	100,065	9,801

*** Percentage based on Working Group catch**

Norwegian Spring Spawning Herring (NSSH)

YEAR	TOTAL CATCH	% CATCH COVERED BY SAMPLING PROGRAMME	NO. SAMPLES	NO. MEASURED	NO. AGED
2000	1,207,201	86	389	55956	10901
2001	766,136	86	442	70005	11234
2002	807,795	88	184	39332	5405
2003	789,510	71	380	34711	11352
2004	794,066	79	503	48784	13169
2005	1,003,243	86	459	49273	14112
2006	968,958	93	631	94574	9862
2007	1,266,993	94	476	56383	14661

94% of the total catch was covered by national sampling programmes. The following table gives a summary of the sampling activities of the NSSH catching countries. The sampling coverage by country is between 74 to 100%. No sampling were carried by Greenland, Ireland and Poland but catches of these countries are representing together only 1.2% of the total catch.

:

COUNTRY	OFFICIAL CATCH	% CATCH COVERED BY SAMPLING PROGRAMME	NO. SAMPLES	NO. MEASURED	NO. AGED
Denmark	22,911	100	8	1038	1005
Faroe Islands	64,251	89	9	900	900
Germany	6,038	74	13	5271	895
Greenland	4,897	0	0	0	0
Iceland	173,621	80	66	2661	2493
Ireland	6,411	0	0	0	0
Norway	779,089	100	212	15897	7098
Poland	4,333	0	0	0	0
Russia	162,434	91	160	29600	2028
Scotland	13,244	100	1	143	67
The Netherlands	29,764	100	7	873	175
Total	1,266,993	94	476	56383	14661

*** Percentage based on Working Group catch**

Shown in the following table are the NSSH sampling levels by relating numbers measured and aged to the size of the catch in each ICES division.

AREA	OFFICIAL CATCH	WG CATCH	NO SAMPLES	NO AGED	NO MEASURED	NO AGED/ 1000 TONNES****	NO MEASURED/ 1000
IIa	1,205,106	1,205,106	417	12715	50454	11	42
IIb	8,291	8,291	23	313	4200	38	507
Va	46,743	46,743	29	933	1029	20	22
Vb	2,312	2,312	6	600	600	260	260
XIVa	4,541	4,541	1	100	100	22	22
Total	1,266,993	1,266,993	476	14661	56383	12	45

*** Based on official catches**

Blue Whiting

YEAR	TOTAL CATCH	% CATCH COVERED BY SAMPLING PROGRAMME	NO. SAMPLES	NO. MEASURED	NO. AGED
2000	1,412,928	*	1136	125162	13685
2001	1,780,170	*	985	173553	17995
2002	1,556,792	*	1037	116895	19202
2003	2,321,406	*	1596	188770	26207
2004	2,377,569	*	1774	181235	27835
2005	2,026,953	*	1833	217937	32184
2006	1,966,140	*	1715	190533	27014
2007	1,610,090	87	1399	167652	23495

*** no figures given**

87% of the total catch was covered by national sampling programmes. The sampling summary of the blue whiting catching countries is shown in the following table. No sampling were carried out by France, Lithuania and Sweden, representing together 1.7% of the total catch. All other countries are sampling for length and age with the exception of Germany which failed to provide age readings.

COUNTRY	OFFICIAL CATCH	% CATCH COVERED BY SAMPLING PROGRAMME	NO. SAMPLES	NO. MEASURED	NO. AGED
Denmark	48,659	99	28	1381	1381
Faroe	317,859	99	29	5337	2892
France	16,639	0	0	0	0
Germany	34,404	*	45	10669	0
Iceland	236,538	97	94	9833	4015
Ireland	31,132	99	19	3595	1704
Lithuania	9,812	0	0	0	0
Norway	539,587	100	353	30223	5915
Portugal	3,897	50	241	32358	1559
Russia	236,369	48	218	27553	2029
Scotland	43,540	77	7	1242	310
Spain	13,557	100	283	26914	2020
Sweden	464	0	0	0	0
The Netherlands	77,634	101	82	18547	1670
Total	1,610,090	87	1399	167652	23495

*** no figure given**

The following table describes the blue whiting sampling levels by relating numbers measured and aged to the size of the catch in each ICES division.

AREA	OFFICIAL CATCH	WG CATCH	NO SAMPLES	NO AGED	NO MEASURED	NO AGED/ 1000 TONNES*	NO MEASURED/ 1000 TONNES*
IIa	119,570	119,478	247	3467	28232	29	236
IIb	2,624	2,624	46	810	5366	309	2045
IIIa	334	334	9	142	684	425	2048
IVa	60,590	60,590	62	1678	5408	28	89
IVb	182	182	34	659	2418	3622	13291
Va	34,077	34,077	9	529	933	16	27
Vb	289,513	290,146	85	2939	8736	10	30
VIa	307,092	305,579	117	3248	22299	11	73
VIb	281,288	281,709	96	2164	12934	8	46
VIIb	821	821	0	0	0	0	0
VIIc	434,563	437,273	97	2989	13745	7	32
VIId	0	120	0	0	0	0	0
VIIIabd	3	3	0	0	0	0	0
VIIIc+IXa	17,453	17,453	524	3579	59272	205	3396
VIIj	96	58	0	0	0	0	0
XII	40,506	40,506	65	1291	5998	32	148
XIIb	4,848	4,848	0	0	0	0	0
XIVb	16,529	16,529	8	0	1627	0	98
Total	1,610,090	1,612,331	1399	23495	167652	15	104

*** Based on official catches**

1.3.2 Importance of métier identification.

A métier is defined as a fishing activity which is characterised by one catching gear and a group of target species operating in a given area during a given season, within which the catches taken by any unit of fishing effort account for the same pattern of exploitation by species and size group (Tétard *et al*., 1995). Later, the 'ICES Study group on the Development of Fishery-based forecast' (SGDFF, 2003) established 'métier' as:

- Fleet: a physical group of vessels sharing similar characteristics in terms of technical features.
- Fishery. Group of vessel voyages targeting the same (assemblage of) species using the same gear.
- Métier: homogeneous division of a fishery by vessel type.

The identification of métiers allows to have a more complete understanding (qualitatively and quantitatively) of the distribution of fishing effort between resources. The changes observed in effort may be due either to seasonal patterns of species distribution, fishing regulations and temporal restrictions, resource depletion, market forces or technical development. A case of resource depletion was described for purse seiners in the Galician area, when they were directed to horse mackerel during the scarcity of sardine (during 1996–1999); another example is the French purse seiners in the Bay of Biscay that due to the recent collapse of anchovy they are now incrementing the catches of sardine.

As it is has been presented in the WD-Abad *et al* (2008), focused on the purse seine Spanish fleet, the main objective of identifying métiers within a fleet, is to establish feasible fishing units to be used in effort-based management and to deepen the knowledge of the whole fishing system. Taking into account that the new European DCR (Data Collection Regulation) is based on métiers rather than stocks, defining métiers within a fleet is completely necessary.

In the working document, the methodology recommended is cluster multivariate analysis (CLARA and PAM methods). Six trips types with high consistency and a regular continuity along the time series were obtained for the Northern Coastal Spanish fleet operating in the ICES subdivision VIIIc and IXa North in the period analysed (20032–005). Also, the fleet analysis gave as results two homgeneous groups, one of big vessels and other of small ones. Before establishing métiers, it is necessary to follow the fishery behavior since the recent collapse of the anchovy stock. So, these six trips types have been defined instead of métiers for sampling and management purposes.

1) Purse seine trips targeting sardine.

2) Purse seine trips targeting anchovy.

3) Purse seine trips targeting mackerel.

4) Purse seine trips targeting horse-mackerel.

5) Purse seine trips targeting Sparidae.

6) Purse seine trips targeting mixed species (others)

All landings and onboard catches information from Purse seine fleet will be split in these 6 units for the Spanish Information and Sampling Programme but only units from 1 to 4 will be included in the length on market Sampling.

Although it is probable that no important changes will occur, some fleet adaptations could be adopted by the big vessels group. A new analysis including last years information is recommend to identify and define the métiers according with the fleet behavior since the anchovy depletion.

1.3.3 Catch Data

Recent working groups have on a number of occasions discussed the accuracy of the catch statistics and the possibility of large scale under reporting or species and area misreporting. These discussions applied particularly to mackerel and horse mackerel in the northern areas.

The working group considers that the best estimates of catch it can produce are likely to be underestimates.

For mackerel and horse mackerel it was previously concluded that in the southern areas the catch figures appear to be satisfactory.

For sardines and adult anchovy the WG assumption is that the landings figures are not significantly under reported.

1.3.4 Discards

In pelagic fisheries discarding occurs in a sporadic way compared to demersal fisheries. This is because the nature of pelagic fishing is to pursue schooling fish, creating hauls with low diversity of species and sizes and consequently often extreme fluctuation in discard rates (100% or null discards). Extreme discards occur especially during ´slippage´ events, when the entire catch is released. The main reasons for ´slipping´ are daily or total quota limitations, illegal size and mixture with unmarketable bycatch. Quantifying such discards at a population level is extremely difficult as they vary considerably between years, seasons, species targeted and geographical region.

Discard estimates of pelagic species from pelagic fisheries and demersal fisheries have been published by several authors. Discard percentages of pelagic species from demersal fisheries were estimated between 3% to 7% (Borges *et al*., 2005) of the total catch in weight, while from pelagic fisheries were estimated between 3% to 17% (Pierce *et al*. 2002; Hofstede and Dickey-Collas 2006, Dickey-Collas & van Helmond 2007, Ulleweit & Panten 2007, Borges *et al*. 2008). Slipping estimates have been published for the Portuguese purse seine fishery targeting sardine, with values at around 70% of the total catch (Stratoudakis *et al*., 2002) and recently for the Dutch freezer trawler fleet, with values at around 10% in numbers (Borges *et al*. 2008). Nevertheless, the majority of these estimates were associated with very large variances and composition estimates of ´slippages´ are liable to strong biases and are therefore open to criticism.

Borges *et al*. (2008) show that for the Dutch freezer trawler fleet between 2002 and 2005, the most important commercial species discarded is mackerel, accounting for 40% of total pelagic discards. Other important discarded species are herring (18%), horse mackerel (15%) and blue whiting (8%). These discards are also the consequence of fisheries targeted at other species (e.g. mackerel in the horse mackerel and herring targeted fisheries). The most important non-commercial species is boarfish accounting for 5% of the discards. Dutch-owned freezer-trawlers also operate in European waters under German, UK, and French flags.

In 2008, discard estimates from the Netherlands and UK (Scotland) for mackerel, horse mackerel and blue whiting for 2007 were provided to the working group. No discarding on freezer trawlers targeting the above species was observed during three German observer trips carried out in 2007. Some of the provided discard data included sampling levels and raised discard estimates, which can be raised by trips or total landings. The exact sampling and raising procedures used are unclear and differ between different datasets, which complicates comparison. In addition, the associated sampling levels are low, and therefore the data should be treated with caution. The necessary steps involved in providing discard data to stock assessments require further research.

Because of the potential importance of significant discarding levels on pelagic species assessments the **Working Group again recommends that observers should be placed on board vessels in those areas in which discarding occurs, and existing observer programmes should be continued. Furthermore agreement should be made on sampling methods and raising procedures to allow comparisons and merging of dataset for assessment purposes.**

Mackerel

The Netherlands and Scotland provided discard data on mackerel to the working group. Age and length disaggregated data were available from the Scottish fishery in the first quarter in area VIa and VIIb and for the first and fourth quarter in area IVa (more than 90% of total catches were from these areas. The estimated mackerel landings of Scotland and the Netherlands represent approximately 27% of the total landings. Mackerel catches of Germany, which observed zero discards, represent 3% of the total catch. For 2007 the total mackerel discards estimated for the Dutch and Scottish fishery were approximately 5,738 and 2,875t, respectively. Discard percentages of the total catch varied between 2.5 and 13.5%.

Horse Mackerel

In the past discards of juvenile horse mackerel have been thought to constitute a problem. However, in recent years a targeted fishery has developed on juveniles, including 1-year old fish and discarding of juveniles is now thought to be small. In 2007 the Netherlands estimated discards of 241t, accounting for less than 1% of the national landings. Horse mackerel catches of the Netherlands represent 38% of the total catch.

Sardine

A discard programme, sampling purse seine vessels, has started in Portugal. Nevertheless, discard estimates are still not available to the working group.

Norwegian Spring Spawning Herring

No data were provided to estimate possible discards in the herring fishery. Although discarding may occur on this stock, it is considered to be a minor problem to the assessment.

Blue Whiting

In general, discards are assumed to be minor in the blue whiting directed fishery. Discard data to the working group were provided by the Netherlands. Blue whiting is also by-catch in several Spanish bottom trawl fisheries directed to a mixture of species. However, the catch rates of blue whiting in these fisheries are low.

1.3.5 Age-reading

Reliable age data are an important pre-requisite in the stock assessment process. The accuracy and precision of these data, for the various species, is kept under constant review by the Working Group.

Mackerel

An otolith exchange exercise on mackerel is scheduled for spring 2009. FRS (Scotland) has agreed on organizing and coordinating the exchange. Countries providing mackerel age data have already been contacted.

Horse mackerel

An exchange and a workshop on age reading were carried out in the Netherlands in 2006. Experienced readers and trainees participated in the exchange and in the workshop. All countries providing age reading data to the WGWIDE were represented in both the exchange and the workshop by an experienced reader. Portugal, Germany and the Netherlands provided otolith sets for the exchange. The sets represented different otolith preparation methods and stocks. Two sets consisted of otoliths from the extremely strong 1982 year-class and hence the age is considered to be known (with a certainty of approximately 95%). One set focused on the younger fish which were expected to present problems based on the informal small-scale otolith exchange.

The experienced readers were accustomed to different otolith preparation methods and different growth patterns associated with the different stocks. Generally, the readers had more difficulty if they were reading material they were not accustomed to. Horse mackerel is regarded to be a difficult species to age and this was reflected by the results of the exchange. The agreement between the experienced readers was low, especially for otoliths from the Southern stock. For the sets including the 1982 year-class the agreement with the modal age was higher than with "true" age. Comparison with the "true" ages showed an overall tendency to underestimate the age.

Sardine

The last workshop on sardine age reading took place in June 2005 to discuss the results of an otolith exchange carried outin 2004. The report is available under http://www.ices.dk/reports/acfm/pgccdbs/pil.agewk2005.pdf. The otolith exchange and workshop aimed to evaluate readers' agreement and ageing precision, to assess the extent of ageing difficulties previously identified (identification of the first annual ring and ageing of older individuals) and to propose guidelines for their minimization. The consistency of age readings in time (comparison of the 1980s, 1990s and 2004) and in space (comparison with Mediterranean and northwest African areas) was also explored and the consequences of the assumed birth date for the estimation of growth were discussed. In addition, profiting from the experience of the workshop attendants, biological sampling methodologies (assignment of sexual maturity stages, visceral fat and stomach condition) were listed and discussed and standard protocols have been recommended.

Norwegian Spring Spawning Herring

A scale and otolith exchange of Norwegian spring spawning herring took place in 20072–008. Otolith and scale samples of Norwegian spring spawning herring (NSSH) from the ecosystem survey in the Nordic seas in May were provided by the Institute of Marine Research, Norway. Four countries were participating in the scale and otolith exchange; Norway, Faroe Islands, Iceland and Denmark. Norway and Iceland estimated the ages by reading scales, and Faroe Islands and Denmark estimated the ages by reading the otoliths.

Based on results from this scale and otolith exchange, the age estimate of NSSH between the four countries is very similar. High precision were obtained, and there were no relative bias between different countries. Precision of age estimates appears to be a little higher for the two countries reading scales compared to the two countries reading otoliths, but this is also influenced by technical aspect of the order the different readers are placed in the EFAN-spreadsheet. There is therefore no evidence for differences in the age estimates as a consequence of reading scales versus otoliths.

Another recent comparison (Couperus 2008) of age readings from scales and otoliths for Norwegian spring spawning herring from 2 samples taken at the ASH survey in 2008 demonstrates as well that there are no major differences between age readings from scales and otoliths. Scales were read by readers from Denmark, otoliths by readers from the Netherlands.

Blue Whiting

A workshop on blue whting age reading took place in June 2005. The objective of the workshop was to create the basis for a manual for age determination of blue whiting for future reference. The overall result of the workshop exercises was that there is a general high agreement between readers. An image analysis exercise clarified that lack of agreement can be referred to two reasons, the first being the position of the first ring where the Bower zone is clear. This is often seen in the younger individuals as the otolith is thinner and thus the structures more clear. The second reason to disagreement arose where some readers choose to leave out specific rings identified by other readers as true annual rings where the rings successive to the 2nd ring were split rings. The set of agreed age otoliths which is a product of the present report should be included in a future calibration.

1.3.6 Biological data

The main problems in relation to other biological data identified by the Working Group are listed by species.

Mackerel

There is inadequate sampling for stock weights during the spawning season. This applies particularly to the North Sea.

Horse Mackerel

No issues regarding biological data for horse mackerel were raised during the WG.

Sardine

There are no problems with regard to biological data for sardine.

Norwegian Spring Spawning Herring (NSSH)

The proportion mature at age used in assessment is based on various surveys and not always well documented. There is a potential problem of obtaining random samples of proportion mature at age from survey for NSSH due to the different catchability of mature and immature fish of the same age groups caused by spatial segregation. An alternative method for estimating proportion mature at age was presented to the Working Group (see 9.4.5). This method involves back-calculation of proportion mature at age from fully matured year classes. IMR (Norway) has agreed to put effort into updating estimates on proportion mature at age from recent years with this method and compare it with data on direct measurements on proportion mature at age from the Nordic ecosystem survey. Based on this, an evaluation will be done and the most reliable method will be adopted in future.

Blue Whiting

There are no critical issues with regard to biological data for blue whiting.

1.3.7 Quality Control and Data Archiving

Current methods of compiling fisheries assessment data

Information on official, area misreported, unallocated, discarded and sampled catches have again this year been recorded by the national laboratories on the WG-data exchange sheet (MS Excel; for definitions see text table below) and sent to the species co-ordinators. Co-ordinators collate data using the latest version of *sallocl* (Patterson, 1998) which produces a standard output file (*Sam.out*). However only sampled, official, WG catch and discards are available in this file. Efforts were made to use the Intercatch system this year in parallel to the existing system on a trial basis (see Sec.1.3.8 for details).

There are at present no defined criteria on how to allocate samples of catch numbers, mean length and mean weight at age to unsampled catches, but the following general process is implemented by the species co-ordinators. Searches are made for appropriate samples by gear (fleet), area, and quarter. If an exact match is not available the search will move to a neighbouring area, if the fishery extends to this area in the same quarter. More than one sample may be allocated to an unsampled catch, in this case a straight mean or weighted mean of the observations may be used. If there are no samples available the search will move to the closest non-adjacent area by gear (fleet) and quarter, but not in all cases. For example, in the case of NEA mackerel samples from the southern area are not allocated to unsampled catches in the western area. It would be very difficult to formulate an absolute definition of allocation of samples to unsampled catches which was generic to all stocks, however full documentation of any allocations made are stored each year in the data archives (see below). It was noted that when samples are allocated the quality of the samples may not be examined (i.e. numbers aged) and that allocations may be made notwithstanding this. The Working Group again encourages national data submitters to provide an indication of what data could be used as representative of their unsampled catches. Definitions of the different catch categories as used by the WGWIDE:

Official Catch	Catches as reported by the official statistics to ICES
Unallocated Catch	Adjustments to the official catches made for any special knowledge about the fishery, such as under- or over-reporting for which there is firm external evidence. (can be negative)
Area misreported Catch	To be used only to adjust official catches which have been reported from the wrong area. (can be negative). For any country the sum of all the area misreported catches should be zero.
Discarded Catch	Catch which is discarded
WG Catch	The sum of the 4 categories above
Sampled Catch	The catch corresponding to the age distribution

Quality of the Input data

Primary responsibility for the accuracy of national biological data lies with the national laboratories that submit such data. Each species co-ordinator is responsible for combining, collating, and interpolating the national data where necessary to produce the input data for the assessments. A number of validation checks are already incorporated in the data submission spreadsheet currently in use, and these are checked by the co-ordinators who in the first instance report anomalies to the laboratory which provided the data.

The working group acknowledges the effort some members have made to provide "corrected" data, which in some cases differ significantly from the officially reported catches. Most of this valuable information is gathered on the basis of personal knowledge of the fishery and good relations between the responsible scientist and the fishermen. The WG is aware of the problem that this knowledge might be lost if the scientist resigns, and asks the national laboratories to ensure continuity in data provision. In addition the working group recognises and would like to highlight the inherent conflict of interest in obtaining details of unallocated catches by country and increasing the transparency of data handling by the Working Group.

Overall, data quality has improved and sampling deficiencies have been reduced compared to earlier years, partly due to the implementation of the EU sampling regulation for commercial catch data. However, some nations have still not or inadequately aged samples. Others have not even submitted any data, so only catch data from Eurostat are available, which are not aggregated quarterly but are yearly catch data per area. Table 1.3.6.1 gives an overview on the availability and format of data provided to the species coordinators. Missing sampling data are regarded to be problematic for the Faroe Island, France, Northern Ireland, Poland and Sweden in the case of Mackerel; UK, France, Lithuania all with considerable catches in the case of Horse Mackerel; and England in the case of Sardine. Norwegian spring spawning herring and blue whiting are generally covered, countries not providing data constitute 1.2% and 1.7% of the total catch, respectively. However, under the EU directive for sampling of commercial catch the responsibility lies within the member state where the catch is landed. This would imply for instance that the Netherlands should be sampling French, UK and German mackerel and horse mackerel catches landed into the Netherlands. For sardine in the northern areas in VIIIa and VII some countries provided catch data but the sampling is still poor. This might become problematic if catches in this currently unregulated fishery continue to rise.

The Working Group documents sampling coverage of the catches in two ways. National sampling effort is tabulated against official catches of the corresponding country (section 1.3.1). Furthermore tables showing total catch in relation to numbers of aged and measured fish by area give a picture of the quality of the overall sampling programme in relation to where the fisheries are taking place. These tables are shown in section 1.3.1 as text tables under the species sections.

Transparency of data handling by the Working Group and archiving past data

The current practice of data handling by the working group has been the same for a number of years. Data received by the co-ordinators which is not reproduced in the report is available in a folder called "archives" under the working group and year directory structure. This archived data contains the disaggregated dataset, the allocations of samples to unsampled catches, the aggregated dataset and (in some cases) a document describing any problems with the data in that year.

Prior to 1997, most of the data was handled in multiple spreadsheet systems in varying formats. These are now stored in the original format, separately for each stock and catch year. It is the intention of the Working group that in the interim period until the proposed standard database is developed (see below) the previous years archived data will be copied over to the current year directory and updated at the working group. Thus the archive for each year will contain the complete dataset available. Further, it should be backed up on Compact Disk/DVD. **The WG recommends that archives folder should be given access only to designated members of the WGWIDE**, as it contains sensitive data.

The WG continues to ask members to provide any kind of national data reported to previous working groups (official catches, working group catches, catch-at-age and biological sampling data), to fill in missing historical disaggregated data. However, there was little response from the national institutes. **The WG recommends that national institutes increase national efforts to gain historical data, aiming to provide an overview which data are stored where, in which format and for what time frame.** The Working Group still sees a need to raise funds (possibly in the framework of a EU-study) for completing the collection of historic data, for verification and transfer into digital format. This is particularly relevant given that for the 2005 mackerel assessment the time series had to be truncated due to poor data in the earliest years.

Table 1.3.7.1. Overview of the availability and format of data provided to the species coordinators Catch year 2007.

A. Mackerel
Stock Coordinator: Andrew Campbell

Country*	Data supplied	Data exchange sheet	Aged Samples
Denmark	YES	YES	YES
England&Wales	YES	YES	YES
Faroes	YES	YES	NO
France	YES	YES	NO
Germany	YES	YES	YES
Iceland	YES	YES	YES
Ireland	YES	YES	YES
Netherlands	YES	YES	YES
Northern Ireland	YES	YES	NO
Norway	YES	YES	YES
Poland	NO	-	-
Portugal	YES	YES	YES
Russia	YES	YES	YES
Scotland	YES	YES	YES
Spain	YES	YES	YES
Sweden	YES	NO	NO

* Belgium, Jersey and Lithuania not listed (Offical catches below 100t)

B. Horse Mackerel
Stock Coordinators: Svein Iversen (Western & North Sea), Pablo Abaunza (Southern

Country*	Data supplied	Data exchange sheet	Aged Samples
Denmark	YES	YES	YES
England&Wales	YES	YES	NO
Faroes	YES	YES	NO
France	YES	YES	NO
Germany	YES	YES	YES
Ireland	YES	YES	YES
Lithuania	NO	-	-
Netherlands	YES	YES	YES
Norway	YES	YES	YES
Portugal	YES	YES	YES
Scotland	YES	YES	NO
Spain	YES	YES	YES
Sweden	NO	-	-

* Belgium not listed (Offical catches below 100t)

C. Sardine
Stock Coordinator: Alexandra Silva

Country	Data supplied	Data exchange sheet	Aged Samples
France	YES	YES	YES
England&Wales	YES	YES	NO
Ireland	YES	YES	NO
Portugal	YES	YES	YES
Spain	YES	YES	YES

D. Norwegian Spring Spawning Herring
Stock Coordinators: Asta Gudmundsdottir, Alexander Krysov

Country	Data supplied	Data exchange sheet	Aged Samples
Denmark	YES	YES	YES
Faroe Islands	YES	YES	YES
Germany	YES	YES	YES
Greenland	NO	-	-
Iceland	YES	YES	YES
Ireland	YES	NO	NO
Norway	YES	YES	YES
Poland	YES	YES	NO
Russia	YES	YES	YES
Scotland	YES	YES	YES
The Netherlands	YES	YES	YES

E. Blue Whiting
Stock Coordinator: Manolo Meixide

Country	Data supplied	Data exchange sheet	Aged Samples
Denmark	YES	YES	YES
Faroe	YES	YES	YES
France	NO	-	-
Germany	YES	YES	NO
Iceland	YES	YES	YES
Ireland	YES	YES	YES
Lithuania	NO	-	-
Norway	YES	YES	YES
Portugal	YES	YES	YES
Russia	YES	YES	YES
Scotland	YES	YES	YES
Spain	YES	YES	YES
Sweden	NO	-	-
The Netherlands	YES	YES	YES

1.3.8 InterCatch

Prior to the working group, 5 WGWIDE stocks were targeted for entry to InterCatch and comparison with the output from the traditional software tool, sallocl. The average and maximum discrepancy for the catch in tonnes and catch and weight at age between InterCatch and sallocl for the North East Atlantic Mackerel, North Sea Horse Mackerel, Sardine, Southern Horse Mackerel and Norwegian Spring Spawning Herring stocks are given in the text table below:

	NEA-MAC		HOM-NSEA		SAR-SOTH		HOM-SOTH		HER-NOSS	
Parameter	Avg Disc.	Max Disc.	Avg Disc.	Max Disc.	Avg Disc.	Max Disc.	Avg Disc.	Max Disc.	Avg Disc.	Max Disc.
Caton	0.00%	N/A	0.00%	N/A	0.04%	N/A	0.00%	N/A	0.01%	N/A
Canum	0.09%	0.57%	0.02%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
Weca	0.03%	0.08%	0.01%	0.04%	0.02%	0.06%	0.02%	0.09%	0.09%	0.84%

Good agreement was obtained for the stocks examined and discrepancies are of the order reported last year. A proportion of the observed discrepancy can be attributed to the varying accuracy to which the different applications report the results. For stocks were no allocation in required (e.g. Sardine), the sallocl application requires a 'dummy' allocation to be made in order for the program to run successfully. While a very small value is used for the allocation, it is likely to have some impact on the results and so will contribute to the discrepancy when compared with the InterCatch results.

A number of issues with the InterCatch application were identified by the working group last year (ICES 2007c). In response to this, additional reporting has been implemented in InterCatch, as part of the data export functionality. Additional output files have been included to enable users to readily produce the data tables that are routinely included in working group reports. The following new outputs have been added:

- A description of the allocations and associated weight schemes and values
- Catch and sampling meta-data per country for each area/division
- Catch and sampling meta-data per country for each season (quarter)
- Catch numbers, mean weights and mean lengths at age for each seaon (quarter)
- All catch and sample data (including values derived from allocations) by country, area and age.

The new outputs are welcomed by the working group. Upon examination, the following issues have been identified

- InterCatch is rounding official catch values.
- In the report of catch number, weight and length at age the some information is missing e.g. for North East Atlantic Mackerel catches were input for area VIIj in all quarters yet the report only contains data for quarters 2 and 3. Other problematic areas are VIIId and VIIIcW.

The following general points were raised during the meeting (the first two are considered to be of a high priority and would be at the top of any 'wish-list' for the future development of the application)

- InterCatch identifies a stock as a collection of species-area combinations and selects the appropriate data from that uploaded when the stock coordinator requests the information for a particular stock in any year. There is, at present, no way to distinguish between stocks of the same species that may originate from the same area. This causes problems for stocks such as Western Horse Mackerel and North Sea Horse Mackerel where catches in quarters 1 and 2 in area IVa are considered part of the North Sea Horse Mackerel stock and catches in quarters 3 and 4 are assigned to the Western Horse Mackerel stock. This issue could be resolved by the introduction of a temporal element to the InterCatch stock definition. However, this does not solve the problem where stocks of the same species are reported from the same area at the same time of the year. While there is a workaround available (which involves transforming (mapping) data to alternative area and country codes), the method is not readily understandable and would benefit from detailed attention in the user manual and ultimately, improved functionality in InterCatch.
- The development of tools to aid formulation of the input files is a prority. This task would have to be undertaken at a national level since different nations maintain their catch and sampling data in different formats. It is a requirement that individual institute directors are made aware of this and that they assign appropriate resource to carry this out.
- It would be useful if the system could issue a warning to inputters if they attempt to upload data with a species/area combination for which there is no associated InterCatch stock.
- Performance of the InterCatch application can be poor when carrying out stock coordination tasks for larger stocks.
- Internet Explorer is not an appropriate browser for the larger stocks, due to a software bug. Mozilla Firefox is a suitable alternative.
- The current exchange format provides for catches to be reported by statistical rectangle (separately to the catches by area). This additional data provides a valuable source of information which can also be used for quality control.

1.4 Checklists for quality of assessments

To further continue the systematic documentation of assessment procedures and quality, checklists as suggested by the HAWG (ICES 2000) were updated for mackerel and added for horse mackerel and Sardine (Tables 1.4.11−.4.4)

1.5 Comment on update and benchmark assessments

For this year, ICES had scheduled a benchmark assessment for Norwegian Spring Spawning Herring, an update assessment for Sardine and Blue Whiting, and all other assessments as experimental. It should be noted that the Update assessment for Sardine refers only to VIIIc and IXa. This is for a number of reasons but primarily as this is the only area where sufficient data exist. A brief overview is given below; details are given in the respective sections.

NEA mackerel: Update: Catch and survey data were fit using FLICA which corresponds to ICA run with FLR. Further exploration of the effect of under reported catches is provided in the report.

North Sea horse mackerel: As the advice for this stock is the same as last year's no data exploration was conducted.

Western horse mackerel: Exploratory. The historic catch data are dominated by the very strong 1982 year class going through the fishery. Catch data was explored by means of a modified SAD assessment which accounts for the age structure in population in the relationship between the egg abundance and the SSB. This has helped to scale the assessment. An assessment is proposed by the WG.

Southern horse mackerel*:* Exploratory: The AMCI approach required strong conditioning and gave unrealistic results. XSA was used in 2006 and did not converge. With the surveys combined a clear cohort signal was evident. This was explored along with the catch at age data in an ASAP model (Legault and Restrepo, 1998).

Sardine: Update assessment: Performed with the AMCI model. The assumptions on selectivity in the plus group were explored. Although much progress has been made with various technical aspects, some remain outstanding with the final assessment and will require further exploration.

Norwegian Spring Spawning herring: Benchmark assessment: Most data exploration, as well as the final assessment was done with the recently developed toolbox TASACS. TASACS has multiple options for assessment, including 4 age structured assessment models, and also diagnostics that were used to analyse the role of individual data in the assessment. A detailed description is given in Annex 2. The WG agreed on a final assessment using a VPA. The assessment with most other models, as well as those resulting from applying the same procedure as last year, with SeaStar, appeared consistent with the VPA results.

Blue Whiting: Update. Data exploration conducted using FLICA, TSVPA and SMS. Final assessment presented using SMS.

Table 1.4.1. Checklist for North-East Atlantic Mackerel assessments

1. General

step	Item	Considerations
1.1	Stock definition	Assessments are performed for mackerel (Scomber scombrus) over the whole distribution area. Stock components are separated on the basis of catch distribution, which reflects management considerations and different historical information for the components rather than biological evidence: Western component: spawning in Sub-areas and Div. VI, VII, VIIIabde, distributed also in IIa, Vb, XII, XIV; North Sea component: spawning in IV and IIIa (but as the North Sea component is relatively small, most of the catches in IVa and IIIa are considered as belonging to the Western component); Southern component: spawning in VIIIc and IXa. Possible problems with species mixing (S. japonicus) in the Southern part of the area.
1.2	Stock structure	
1.3	Single/multi-species	Single species assessments

2. Data

step	Item	Considerations
2.1	Removals: catch, discarding, misreporting	Catch estimates are based on official landings statistics and are augmented by national information on misreporting and discarding. In the 2006 data the age structure of the discards from one fleet (Scotland) was available. This age structure was not applied to other discarded catches. Discarding is considered a problem in the fishery. Separation of the different mackerel stock components is on the basis of the spatial and temporal distribution of catches (see above). The ICA assessment in 2004 accepted by ACFM shows that the Egg Survey is estimated with a Q of 1.3, suggesting that bias in the catches or at least unaccounted mortality from all sources exceeds bias in the Egg Survey which is itself believed to be an underestimate (of very approximately 40% see Egg Survey below), leading to uncertain estimates of unaccounted mortality which is of the order of an amount equal of the reported catch. This discussed in section 2.2.1 and section 2.8.2.6 of this report.
2.2	Indices of abundance	
	Catch per unit effort	CPUE (at age) information for the Southern area only
	Gear surveys (trawl, longline)	Trawl surveys for juvenile mackerel, which give indications of recruit abundance and distribution. These are currently not used for the assessment, but did accurately predict the weak 2000 year class, and also the strong 2002 year class. The surveys have estimated the 2003 year class as mid range with the 2004 estimate higher than average. The use of these surveys needs further investigation.
	Acoustic surveys	Experimental surveys in 1999 to 2004 by Norway, Scotland, Spain, Portugal and France. Results from the North Sea have been tested in an assessment but not fully evaluated. These are not currently used in the assessment.

Table 1.4.1 (Cont'd)

	Egg surveys	The triennial egg survey for mackerel and horse mackerel currently provides the only fishery independent SSB estimate used in the assessment. The survey has been conducted in the western area since 1977, and in the southern area since 1992. In its present form the survey aims at covering the whole spawning time (January–July) and area (South of Portugal to West of Scotland) for both components since 1995. The most recent survey was carried out in 2007, and used in the assessment in this year. Applied method: Annual Egg Production Method. Similar egg surveys are also carried out on a roughly triennial basis in the North Sea, but these have only a partial spatio-temporal coverage and are not currently used in the assessment An analysis carried out by Portilla for WGMEGS (ICES 2005) indicates that egg mortality which is not currently included in the survey estimates is of the order of 30%, and would lead to a corresponding underestimate of the biomass. Furthermore, an additional study by Mendiola and Alvarez (WD 2005), carried out on mackerel from the southern spawning component, indicated a faster egg development time than that used in the calculation of egg production by the WGMEGS. This was calculated to lead to an underestimate of the egg production by between 7 and 12%. These two studies indicate that the egg production might be underestimated by 40% but these estimates are very uncertain.
	Larvae surveys	None
	Other surveys	Russian aerial surveys have been conducted annually in July since 1997 in international waters in the Norwegian Sea and in part of the Norwegian and Faroese waters (Div. IIa). This gives distribution and biomass estimates, not currently used in the assessment. The aerial surveys now include Norwegian & Faroese participation.

Table 1.4.1 (Cont'd)

2.3	Age, size and sex-structure: catch-at-age, weight-at-age, Maturity-at-age, Size-at-age, age-specific reproductive information	Catch at age: derived from national sampling programmes. Sampling programmes differ largely by country and sometimes by fishery. Sampling procedures applied are either separate length and age sampling or representative age sampling. 85% of the catch was sampled for length and age in 2006 (was 83% for 2005). Total number of samples taken (2006): 1,604; total number of fish aged:23,467; total number of fish measured: 183,767. Weight at age in the stock: Stock weights were available from national sampling programmes in 2006. Western component: based on Dutch and Spanish commercial catch data collected in Divisions VIIh, VIIIa and VIIIb from March to May, and supplemented by samples from the egg survey. Southern component: based on samples taken in VIIIc and IXa in the second quarter. North Sea components: based on the sample catches collected by the Norwegians and Dutch from areas IVa and IVb during 2006. The separate component stock weights were then weighted by the relative proportion of the SSB estimates (from egg surveys) for the respective components (Western / Southern / North Sea from egg surveys in 2005 and 2007 respectively: 81.4% / 8.6% / 10.0%). Weight at age in the catch: derived from the total international catch at age data weighted by catch in numbers. In some countries, weight at age is derived from general length-weight relationships, others use direct measurements. Maturity at age: based on biological samples from commercial and research vessels; weighted maturity ogive according to the SSB biomass in the three components. As there was no new data there was no change in the estimated maturity ogive in 2006 even though the weighting changed between the Western / Southern / North Sea component as described above.
2.4	Tagging information	Used as indicator for the mixing of the Southern and Western components; used to estimate total mortality; for exploratory assessment runs (WINBUGS ICA).
2.5	Environmental data	Not currently used but under investigation
2.6	Fishery information	Several scientists involved in the assessment of this stock are familiar with the fishery. Most major mackerel fishing nations have placed observers aboard the fishing vessels. Anecdotal information on the fishery may be used in the judgement of the assessment.

3. Assessment model

step	Item	*Considerations*
3.1	Age, size, length or sex-structured model	Current assessment model: FLICA
3.2	Spatially explicit or not	No
3.3	Key model parameters: natural mortality, vulnerability, fishing mortality, catchability	Natural mortality: fixed parameter over years and ages (M=0.15) based on tagging data. Selection at age: Reference age 5 for which selection is set at 1. Selection at final age set to 1.5. One period of 12 years of separable constraint (including the egg survey biomass estimates from 1992 onwards). Population in final year: 13 parameters. Population at final age for separable years: 11 parameters. Recruitment for survivors year: Total number of parameters: 46 Total number of observations: 150 Number of observations per parameter: 3.3
	Recruitment	No recruitment relationship fitted.
3.4	Statistical formulation: - what process errors - what observation errors - what likelihood distr.	Model is in the form of maximum log likelihood. Terms are weighted by manually set weights. Index for biomass from egg surveys is given a weight of 30 and each catch at age observation in the separable period is given a weight of 1 except 0-group, which is down-weighted to 0.01 and the 1-group which is down-weighted to 0.1. The survey biomass estimate was treated as relative from 1999 to 2007
3.5	Evaluation of uncertainty: - asymptotic estimates of variance, - likelihood profile - bootstrapping - bayes posteriors	Maximum likelihood estimates of parameters and 95% confidence limits are given. Total variance for the model and model components given, both weighted and unweighted. (weighted is currently incorrectly calculated in the model) Several test statistics given (skewness, kurtosis, partial chi-square). Historic uncertainty analysis based on Monte-Carlo evaluation of the parameter distributions. (this failed this year and was replaced by WINBUGS ICA)
3.6	Retrospective evaluation	Currently retrospective analysis is carried out (in FLICA) because the assumptions concerning the separable period have been very variable over recent years. Historic realisations of assessments are routinely presented and form a direct overview on the changes in the perception of the state of the stock. These are presented for SSB, fishing mortality and recruitment. The quality of the assessment was evaluated by comparing the first estimates of recruitment in a certain year with the second , the third, etc. estimates for that same year from following WG meetings. These figures indicate the precision and bias in successive estimates of recruitment.
3.7	Major deficiencies	selection at final age not well determined, evaluated as 1.5. weighting for catch and survey data set approximately equivalent but not well related to variability in the data area misreporting of catch is a minor problem In the past catches at age have been treated as being not biased, but information from many sources now indicates substantial unaccounted mortality of which an important part may be because catches could be seriously underestimated simpler assessment models currently not evaluated Assessment is over sensitive to recent survey SSBs

4. Prediction model(s) – SHORT TERM

step	Item	Considerations
4.1	Age, size, sex or fleet-structured prediction model	Age-structured model, by fleet and area fished. Because of the uncertainty in levels of catch these should be used only in a relative sense to indicate the direction and relative magnitude of exploitation options.
4.2	Spatially explicit or not	Not
4.3	Key model (input) parameters	Stock weights at age: average from last 3 years Natural mortality at age: average from last 3 years (fixed) Maturity at age: average from last 3 years Catch weights at age: average from last 3 years Proportion of M before spawning: 0.35 Proportion of F before spawning: 0.42 Fishing mortalities by age: From ICA (from 12 year separable model) Numbers at age: from ICA, final year in assessment; ages 2 to 12+ 0-group is GM recruitment whole period except last 3 years 1-group is GM recruitment applying mortality at age 0
4.4	Recruitment	Geometric mean over whole period except last 3 years.
4.5	Evaluation of uncertainty	Uncertainty in model parameters is NOT incorporated, though sometimes a limited number of sensitivity analyses may be performed, usually with regard to recruitment level.
4.6	Evaluation of predictions	Predictions are not evaluated retrospectively (this is tricky to do in terms of catches, but some evaluation in terms of population numbers at age should be done).
4.7	Major Deficiencies	Catches are likely to be underestimated (see above) this leads to a perception that the current assessment gives biased estimates of SSB but provided the bias is sufficiently constant F maybe unbiased and trend in SSB and F will be unbiased SSB estimates from egg surveys are only available every 3 years. Assessment/Prediction mismatch: In particular, stock estimates are based on a separable model, which is then treated in a non-separable way in the short term predictions. Catch options: no unique solution for catches by fleet when management objectives are stated in terms of Fadult and Fjuvenile. No stochasticity/uncertainty reflected in short term predictions. Intermediate year: general problem- whether to use status quo F or a TAC constraint for intermediate year Software: MFDP /FLSTF

5. Prediction model(s) – MEDIUM TERM

No medium term projections were carried out this year.

Table 1.4.2. Checklist for assessments of Western Horse Mackerel

1. General

step	Item	Considerations
1.1	Stock definition	Stock caught in divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa–c, e–k and VIIIa-e
1.2	Stock structure	No sub-populations have been defined.
1.3	Single/multi-species	Single species assessment

2. Data

step	Item	Considerations
2.1	Removals: catch, discarding, fishery induced mortality	Discards are not included but are considered not relevant. Misreporting of juvenile catch taken in VIIe,h and VIId (mostly North Sea stock). Catches outside the area covered by the TAC.
2.2	Indices of abundance	Series of tri-ennial AEPM surveys since 1983 (with a gap in 1986). Acoustic and bottom trawl surveys do not cover the entire distribution of the stock. Not used in the assessment.
	Catch per unit effort	Series of catch per unit effort fromVIIIc. Not used in assessment.
	Gear surveys (trawl, longline)	
	Acoustic surveys	French acoustic spring survey indices available (PELGAS) only covering VIIIa & b.
	Egg surveys	Total egg production estimate used in the assessment as a relative index of SSB.
	Larvae surveys	None.
2.3	Age, size and sex-structure: catch-at-age, weight-at-age, Maturity-at-age, Size-at-age, age-specific reproductive information	A large portion of the catch remains un-sampled. Catch-at-age data has improved in recent years. However, the number of age readings for some of fishing areas is not satisfactory. Proportion mature at-age data have not been provided since 1993. Weight-at-age in the stock data are based on a small sample.
2.4	Tagging information	None.
2.5	Environmental data	The availability of western horse mackerel in the Norwegian NEZ in the third/fourth quarter seems to be linked with the modelled influx of Atlantic water to the North Sea the first quarter (Iversen et.al. 2002).
2.6	Fishery information	Directed trawl fishery operated by Ireland, Denmark, Scotland, England & Wales, The Netherlands, France and Germany. Norway operates a directed purse-seine fishery. Spain operates both purse-seines and trawlers. A varying proportion of the total catch is caught in the area where juveniles are distributed (Divisions VIIa,e,f,g,h and VIIIa,b,d).

3. Assessment model

step	Item	Considerations
3.1	Age, size, length or sex-structured model	Age-structured. A linked separable VPA and ADAPT VPA model (SAD), so that different structural models are applied to the recent and historic periods. The separable component is short (currently 4 years) and applies to the most recent period, while the ADAPT VPA component applies to the historic period. Model estimates from the separable period initiate a historic VPA for the cohorts in the first year of the separable period.
3.2	Spatially explicit or not	No
3.3	Key model parameters: natural mortality, vulnerability, fishing mortality, catchability	The parameters treated as "free" in the model (i.e. those estimated directly) are: (1) Fishing mortality year effects for the final four years for which catch data are available; (2) Fishing mortality age effects (selectivities) for ages 11−0 (except for selectivity at age 8 which is set to 1); (3) scaling parameter for fishing mortality at age 10 relative to the average for ages 79− (ignoring the 1982 year-class where applicable); (4) fishing mortality on the 1982 year-class at age 10 in 1992; (5) realised fecundity parameter, relating realised fecundity to potential fecundity, and therefore also relating estimated SSB to the egg production estimates; (6) potential fecundity parameters (intercept and slope), relating potential fecundity to fish weight.
	Recruitment	No stock recruitment relationship is assumed.
3.4	Statistical formulation: - what process errors - what observation errors - what likelihood distr.	The estimation is based on maximum likelihood. There are three components to the likelihood that correspond to the egg estimates, catches for the separable period, and catches for the plus-group. The variance of each component is estimated.
3.5	Evaluation of uncertainty: - asymptotic estimates of variance, - likelihood profile – bootstrapping - bayes posteriors	Asymptotic estimates of variances by the inverse of the Hessian matrix.
3.6	Retrospective evaluation	Historic retrospective last performed in 2008 showed retrospective pattern.

4. Prediction model(s) – SHORT TERM

Step	Item	Considerations
4.1	Age, size, sex or fleet-structured prediction model	Catch advice based on agreed Management Plan.
4.2	Spatially explicit or not	N/a
4.3	Key model (input) parameters	N/a.
4.4	Recruitment	N/a
4.5	Evaluation of uncertainty	N/a
4.6	Evaluation of predictions	N/a
4.7	Major deficiencies	N/a

5. Prediction model(s) – MEDIUM TERM

No medium term predictions are conducted.

Table 1.4.3 Checklist for assessments of Southern Horse Mackerel

1. General

step	Item	Considerations
1.1	Stock definition	Stock caught in division IXa.
1.2	Stock structure	This has been defined as a single stock unit in a multidisciplinary stock-identification project.
1.3	Single/multi-species	Single species assessment

2. Data

step	Item	Considerations
2.1	Removals: catch, discarding, fishery induced mortality	Discards are not included but are considered not relevant.
2.2	Indices of abundance	Age-structured abundance indices from a series of bottom-trawl surveys covering the Portuguese and Spanish areas of the stock. Series of SSB estimates from triennial DEPM surveys (2002, 2005 and 2007).
	Catch per unit effort	Series of catch per unit effort from the Marin bottom-trawl fleet. Not used in assessment.
	Gear surveys (trawl, longline)	Annual bottom-trawl surveys covering the whole stock area.
	Acoustic surveys	Portuguese and Spanish acoustic survey indices are not available for this species.
	Egg surveys	SSB estimates available from DEPM egg surveys.
	Larvae surveys	None.
2.3	Age, size and sex-structure: catch-at-age, weight-at-age, Maturity-at-age, Size-at-age, age-specific reproductive information	Most of the catch is covered in the sampling program. Catch-at-age data is based on quarterly age-length keys made for the Portuguese and Spanish areas. Each key is made with around 400 otoliths. Catch at age is also privided by fishing fleet (available series: 19922−007) . Maturity ogive for the period 19922−006 is fixed. It was made in 2003 using data obtained with histological slides. New stimates for 2007. Weight-at-age in the stock is assumed the same as in the catch.
2.4	Tagging information	None.
2.5	Environmental data	The recruitment strength of southern horse mackerel seems to be well correlated with upwelling indices.
2.6	Fishery information	Directed trawl fishery operated Portuguese and Spanish vessels, and also caught as bycatch in the purse-seine and polyvalent fisheries in the waters of both countries. Catches are taken along the whole coastal area, to a depth of 400m . Juveniles are closer to the shore and caught mainly by purse-seiners. Fishing fleets differ in their exploitation pattern. Spanish bottom trawl fleet is mainly directed to adult fish as is the case of Portuguese and Spanish artisanal fishing fleets, whreas catches of purse seiners and Portuguese bottom trawl fleet are mainly dominated by juveniles.

Table 1.4.3 (Cont'd)

3. Assessment model

step	Item	Considerations
3.1	Age, size, length or sex-structured model	Age-structured. A statistical catch-at-age assessment model (ASAP). The optimisation of a complex objective function, based on likelihoods with different sources of information, is made by automatic differentiation.
3.2	Spatially explicit or not	No.
3.3	Key model parameters: natural mortality, vulnerability, fishing mortality, catchability	Natural mortality fixed at 0.15/year. The estimated parameters are: vectors of selectivities-at-age for 1992 for the three blocks in which the selectivity patterns are classified from the different fleets, kept fixed during the whole assessment period , F multiplier for the first year, deviations to the F multiplier for each year except the 1st one , a vector of catchabilities-at-age, kept fixed during the whole assessment period , a vector of the recruitment deviations from the mean for each year , a vector of deviations, for each age, from the number at age 0 in the 1st year , the virgin biomass for the stock-recruitment relationship
	Recruitment	A Beverton-Holt stock recruitment relationship is assumed, but recruitment estimates are allowed to deviate from that relationship.
3.4	Statistical formulation: - what process errors - what observation errors - what likelihood distr.	The estimation is based on maximum likelihood. There are eleven components to the likelihood that correspond to the total catch, catch proportions at age, abundance indices,
3.5	Evaluation of uncertainty: - asymptotic estimates of variance, - likelihood profile – bootstrapping - bayes posteriors	Asymptotic estimates of variances by the inverse of the Hessian matrix.
3.6	Retrospective evaluation	Historic retrospective was performed

4. Prediction model(s) – SHORT TERM

Step	Item	Considerations
4.1	Age, size, sex or fleet-structured prediction model	Age structured model.
4.2	Spatially explicit or not	No
4.3	Key model (input) parameters	Weight-at-age, proportion mature at age, estimates of numbers-at-age, selectivity-at-age, target catch, geometric mean recruitment from 1992 to 2006.
4.4	Recruitment	Was fixed as the geometric mean of the period 19922−006.
4.5	Evaluation of uncertainty	N/a
4.6	Evaluation of predictions	N/a
4.7	Major deficiencies	N/a

Table 1.4.4 Check List for the assessment of sardine in Area VIIIc and IXa

1. General

step	*Item*	*Considerations*
1.1	Stock definition	The stock is distributed in the Iberian Peninsula. Some mixing with adjacent populatons from French waters (Division VIIIb) and northern Morrocco is aknowledged, but it considered not to affect the assessment. The assessment is believed to reflect the dynamics of sardine in Iberian waters.
1.2	Stock structure	No subpopulations have been defined, although life-history properties indicate some heterogeneity across the stock area.
1.3	Single/multi-species	Single species assessment

2. Data

step	*Item*	*Considerations*
2.1	Removals: catch, discarding, fishery induced mortality	Discards are considered not relevant. The fishing statistics are considered accurate and landings are representative of catches. 99% of the landings are from purse-seiners.
2.2	Indices of abundance	Acooustic and DEPM (Daily Egg Production Method) surveys.
	Catch per unit effort	None.
	Gear surveys (trawl, longline, etc.)	Pelagic and bottom trawls. In some cases (opportunistically) purse seining.
	Acoustic surveys	Series of spring acoustic surveys covering the whole stock area since 1996 (gap in 2004). Two surveys, one covering the northern Spanish waters (Division VIIIc and IXaN) and another covering the Portuguese waers and Gulf of Cadiz (the remaining area of Division IXa) are carried out each year. Data (numbers-at-age) from the two surveys are combined (summed) in a single index of stock abundance.
	Egg surveys	SSB estimated from triennial DEPM surveys since 1997 covering the whole stock area.
	Larvae surveys	None.
2.3	Age, size and sex-structure: catch-at-age, weight-at-age, Maturity-at-age, Size-at-age, age-specific reproductive information	Biological sampling of the catches is generally good. Sampling levels improved across the time series. Calibration of age readings and maturity criteria between Portuguese and Spanish laboratories rsponsible for sampling. A revision of maturity and stock weights-at-age for 1996 – 2005 was presented in 2006.
2.4	Tagging information	None.
2.5	Environmental data	No environmental data is currently used in the assessment.
2.6	Fishery information	Sardine is mainly exploited by purse-seine fisheries in both Spanish and Portuguese waters. The fishery operates across the whole area and all year round but 60% of the landings occur in the second semester. Seasonal closures of 12−- months during winter are observed in some areas. A total of 531 vessels with lengths in the range of 83−8 m and 241−100 HP contributed to landings in 2007.

3. Assessment model

step	Item	Considerations
3.1	Age, size, length or sex-structured model	The stock is assessed using an age structured model (ACMI-Assessment Model Combining Information from various sources).
3.2	Spatially explicit or not	No
3.3	Key model parameters: natural mortality, vulnerability, fishing mortality, catchability	Natural mortality is 0.33 for all ages and years. Both the fishery selection and survey catchability are assumed equal for ages 4 and 5. Selection-at-age is allowed to change gradually across the period using the recursive updating algorithm in ACMI, with a gain factor of 0.2 for all ages and years, providing a fishery mortality model close to separable. Survey catchability-at-age assumed constant over time. Catchability of the DEPM survey assumed constant over time. 0-group catches downweighted (0.1). Equal weights for surveys and equivalent to catch data.
	Recruitment	No stock recruitment relationship is assumed.
3.4	Statistical formulation: - what process errors - what observation errors - what likelihood distr.	No process errors are assumed. Observation errors are not assumed to follow specific distributions. The objective function is a sum of squared log residuals for catch numbers-at-age, survey indices-at-age and DEPM indices of SSB (not likehood function).
3.5	Evaluation of uncertainty: - asymptotic estimates of variance, - likelihood profile – bootstrapping - bayes posteriors	Asymptotic estimates of variance and correlatons by the inverse of the Hessian matrix. Median and 90% limits of SSB, R and F trajectories estimated by non-parametric bootstrap of catch and survey residuals.
3.6	Retrospective evaluation	One year retrospective analysis.

4. Prediction model(s) – SHORT TERM

Step	Item	Considerations
4.1	Age, size, sex or fleet-structured prediction model	Age-structures deterministic short term prediction.
4.2	Spatially explicit or not	No
4.3	Key model (input) parameters	Weight-at-age in the stock and in the catches and selection-at-age were calculated as the arithmetic mean value of the last three years (20052−007). The maturity ogive corresponds to the 2007 values. Natural mortality was 0.33 and the proportion of F and M before spawning was 0.25. F_{sq} was the average F 20052−007, unscaled.
4.4	Recruitment	Recruitments for 2008 and 2009 were calculated as the geometric mean recruiment for 19982−007. This procedure is identical to previous years. Recruitment for 2007 was that estimated by the assessment model.
4.5	Evaluation of uncertainty	No.
4.6	Evaluation of predictions	No.
4.7	Major deficiencies	The outcome of deterministic predictions has a high uncertainty due to the use of assumed vlues of recruitment, the projection of current levels of fishing mortality and possible bias in the assessment.

5. Prediction model(s) – MEDIUM TERM

No medium term predictions are conducted.

1.6 The ICES stock handbook

As in previous years and due to time constraints, the working group could not begin to create the stock handbook for WGMHSA. Therefore the "static" parts of the report have remained in the body of the report. With the current workload, it is unlikely that the stock handbook can be created during the working group session and thus intersessional work is required to create the handbook.

1.7 Reference points relevant for WGWIDE

No revisions of the reference points have been considered at this meeting for blue whiting, Norwegian spring spawning herring, horse mackerel and sardine stocks. In the case of Northeast Atlantic mackerel there are indications from the management simulations that F values around 0.23 provide maximum sustainable yields that are compatible with precautionary biomass limits. This would mean an increment in the defined Fpa, and a revision of mackerel reference points are considered (see section 2.6).

1.8 Blue Whiting

1.8.1 Blue Whiting Management Plan Evaluation

1.8.1.1 EC/Faroe Islands/Iceland/Norway request on long-term management of blue whiting

Request

ARRANGEMENT FOR THE LONG-TERM MANAGEMENT OF THE BLUE WHITING STOCK

1) *The Parties agree to implement a long-telll1 management plan for the fisheries on the Blue Whiting stock, which is consistent with the precautionary approach, aiming at ensuring harvest within safe biological limits and designed to provide for fisheries consistent with maximum sustainable yield, in accordance with advice from ICES.*

2) *For the purpose of this long-term m anagement plan, in the following text, "TAC" means the sum of the coastal State TAC and the NEAFC allowable catches.*

3) *As a priority, the long-telll1plan shall ensure with high probability that the size of the stock is maintained above 1.5 million tonnes (Blim).*

4) *The Parties shall aim to exploit the stock with a fishing mortality of 0.18 on relevant age groups as defined by ICES.*

5) *While fishing mortality exceeds that specified in paragraph 4, the Parties agree to establish the TAC consistent with annual [x%] reductions in fishing mortality until the fishing mortality established in paragraph 4 has been reached.*

For the purposes of this calculation, the fishing percentage mortality reduction should be calculated with respect to the year before the year in which the TAC is to be established. For this year, it shall be assumed that the relevant TAC constrains catches.

6) *When the fishing mortality in paragraph 4 has been reached, the Parties agree to establish the TAC in each year in accordance with the following rules:*

- *In the case that the spawning biomass is forecast to reach or exceed 2.5 million tonnes (SSB trigger level) on 1 January of the year for which the TAC is to be set, the TAC shall be fixed at the level consistent with the specified fishing mortality.*
- *In the case that the spawning biomass is forecast to be less than 2.5 million tonnes on 1 January of the year for which the TAC is to be set (B), the TAC shall be fixed that is consistent with a fishing mortality given by:*
  - *F = 0.05 + [(B1−.5)(0.180−.05) / (2.51−.5)]*
- *In the case that spawning biomass is forecast to be less than 1.5 million tonnes on 1 January of the year for which the TAC is to be set, the TAC will be fixed that is consistent with a fishing mortality given by F = 0.05.*

7) When the fishing mortality rate on the stock is consistent with that established in paragraph 4 and the spawning stock size on 1 January of the year for which the TAC is to be set is forecast to exceed 2.5 million tonnes, the Parties agree to discuss the appropriateness of adopting constraints on TAC changes within the plan.

8) The Parties, on the basis of ICES advice, shall review this long-telll1 management plan at intervals not exceeding five years and when the condition specified in paragraph 4 is reached.

1) ICES are requested to assess whether the draft 1ong-term management plan is in accordance with the Precautionary Approach.

2) ICES are requested to assess the medium-term consequences of the application of this plan.

3) ICES are invited to suggest and to evaluate alternative values for the "trigger biomass" value of 2.5 million tonnes and the target fishing mortality rate.

4) ICES are requested to provide a range of options in accordance with paragraph 5 of Annex I for the reduction of fishing mortality to the target level identified in paragraph 4 of Annex I with a clear indication of the associated levels of risk and uncertainty.

ICES response

The plan includes two phases. First, the plan has a rule for a gradual reduction of the fishing mortality from the present high level down to a future lower target fishing mortality. Secondly, when that fishing mortality has been reached, the plan has rules for setting the TAC according to the level of SSB.

Simulations were done with 2008 as the starting year. The simulations account for uncertainty in the present and future assessments and in the future recruitments, assuming recruitments at the level experienced in the year classes 1981−1995. It was assumed that the TAC derived from the rule would be taken precisely in all years

A range of reduction rates for F ,trigger biomasses and target Fs was explored. In all these simulations, a high risk for SSB to fall below Blim was found from 2010 and some years onwards. In the longer term, this risk was reduced to well below 5% after 2020. Figure 1 shows as an example the risk year by year with a trigger biomass of 2.5 million tonnes and a reduction rate of 30% per year. The risk that SSB falls below Blim at least once in the first 7 years is around 23% in this example. The risk in the early period was reduced by a stronger reduction of the F-value, but even with a 50% annual reduction it was well over 10%. The choice of trigger biomass has little influence on these results. The long term yield with the assumed recruitment regime is between 300 and 470 thousand tonnes, with a mean at about 390 000 thousand tonnes. The log term yield is independent on both F reduction rate (unless the rate is very low) and trigger biomass.

Although the rule appears to ensure recovery when the SSB falls below Blim, the high risk in the early years implies that the proposed plan is not in accordance with the precautionary approach, unless the reduction is sufficiently fast to ensure full reduction in one year..

A more robust alternative would be to apply the long term harvest rule (Paragraph 6) immediately, with a target F of 0.18. That leads to a risk of falling below Blim at least once in the years 17– between 5 and 9%. The risk is lower with a higher trigger biomass. The time course of Risk and Yield for this option is shown in Figure 2.

Hence, ICES recommends to implement Paragraph 6 immediately, with a trigger biomass of at least 2.5 million tonnes, which is considered precautionary since the rule should ensure rapid recovery in that case. The long term catches with this alternative would be similar to those resulting from the proposed rule, but the early reduction in catches would be faster.

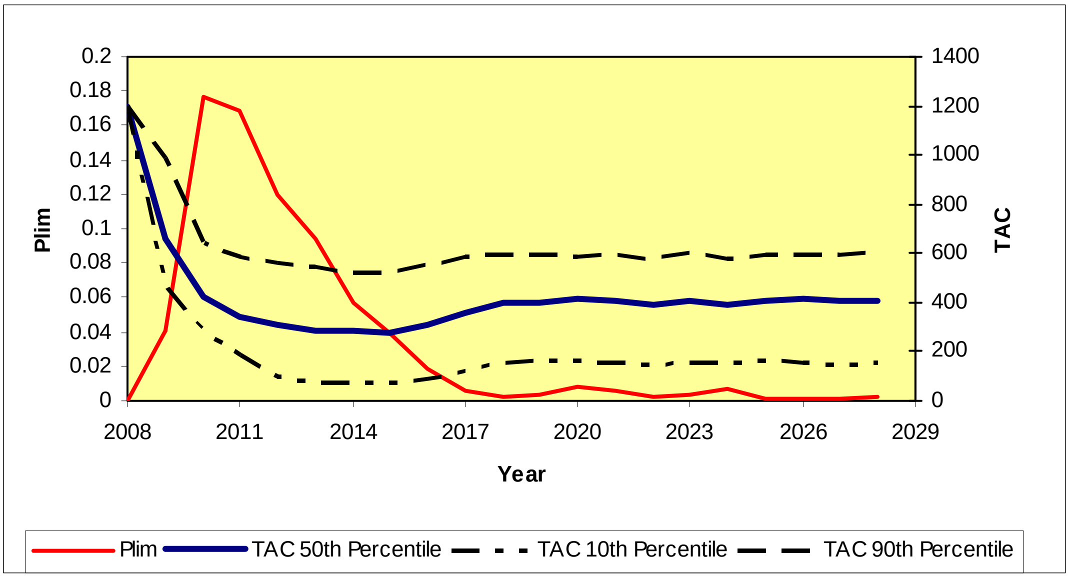

Figure 1.

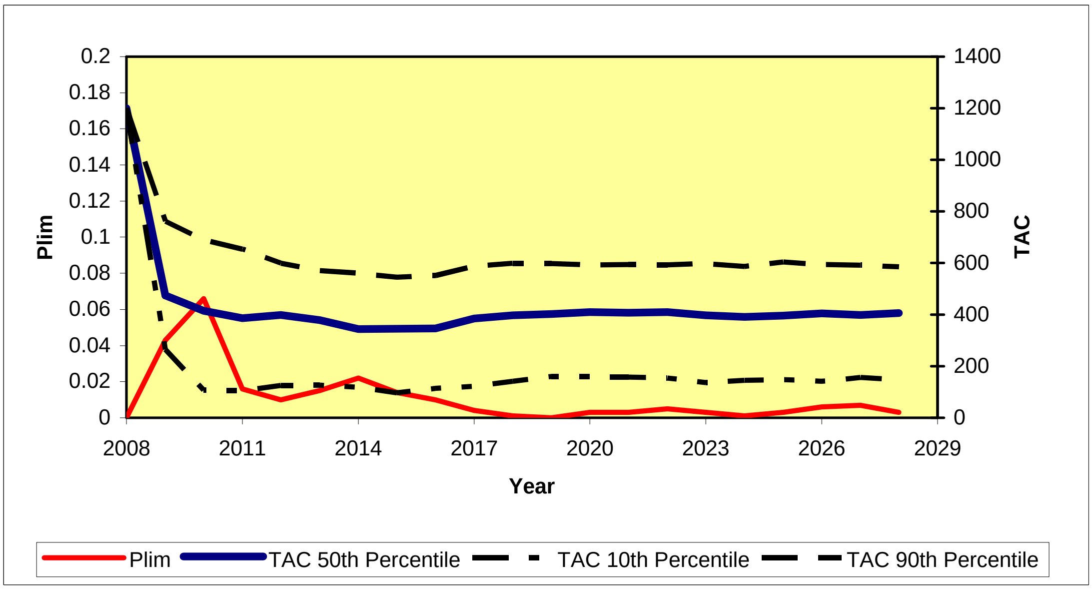

Figure 2

1.8.1.2 Irish request on management plan for blue whiting and stock structure

Request

Ireland requests ICES to consider the following two questions as part of its evaluation process Ireland takes the view that these questions are important considerations in the development of a blue whiting management plan.

> *1. Should such a management plan include provision for the separate management of juveniles, as is the case for North Sea herring?*
>
> *2. What is the latest scientific information on the stock structure of blue whiting? Any plan that is developed would have to be robust to possible changes to the assessment and management units.*

Question 1: In order to examine the impact of the juvenile fishery, the effects of applying three different exploitation patterns on ages 12− were explored. Three options for exploitation pattern were as follows (1) zero exploitation, (2) "high" exploitation and (3) the constant F selection pattern used in the assessment from 1999 onwards. The "high" exploitation pattern which gave the highest relative fishing mortality on ages 12− during the last 15 years was derived from the XSA assessment. The assessment exploitation pattern was used on ages older than 2 years. The results show that the difference between exploitation rates is marginal. The conclusion is that the effect on yield of protecting juveniles is likely to be very small. A separate clause for the protection of juveniles in the management plan is therefore not needed.

Question 2: There is growing evidence from the studies conducted that there may be several components in the North East Atlantic blue whiting stock. It is difficult to determine how many possible sub-populations may exist. In many of the studies carried out to date samples have not been sufficiently large to identify separate components. A more extended coordinated sampling programme across the stock area is required. Further investigation would then be needed if any changes were required regarding existing management units. In the event that there are several components management would need to be more precautionary, spreading exploitation evenly among units to avoid local depletion. Until further information becomes available ICES recommends that management of blue whiting follow the single stock unit advice.

1.8.2 Answer to special request on NEA mackerel

1.8.2.1 Request from EU, Norway and Faeroes coastal states.

1. In its 2007 advice, ICES presented analyses indicating that unreported catches are still a major uncertainty affecting the reliability of the assessment. The coastal States request ICES to:

> *i. Provide estimates of the magnitude in tonnes and precision of the unaccounted mortality in the fisheries on North-East Atlantic mackerel;*
>
> *ii. Indicate where possible the sources of this mortality;*
>
> *iii. Evaluate where possible any historical changes in this unaccounted mortality;*
>
> *iv. Provide estimates of historic Spawning Stock Biomass and Fishing Mortality thatwould be compatible with these estimates of unaccounted mortality.*

2. The coastal States request ICES to include the North-East Atlantic mackerel stock in their routine reviews of reference points.

The response to the individual questions is provided below. A brief description of the analyses carried out are included in section 2.5.2 and 2.7.2 for questions 1 and section 2.6 for question 2.

Question 1

i) Estimates of the magnitude (in tonnes) and precision of the unaccounted mortality in the NEA mackerel fisheries suggest that, on average (19752–007), total catch related removals are equivalent to between 1.6 and 3.4 times the catch, or an average removals (19752–007) of between 0.91 and 2.96 Mt per year with a long term mean of 1.92 Mt

ii) The additional sources of this mortality include:
- escapees from fishing that die, such as those that pass through the meshes and die
- discards, slippage and high-grading not included in the ICA assessment
- unreported catch throughout the timeseries

There is no basis for allocating the total quantities among these different sources. Because the additional catch cannot be partitioned amongst the various sources, the availability of this biomass to any fishery cannot be estimated. Currently the best estimates of availability of mackerel are given by the virtual population analysis provided by the ICA assessment.

iii) It has not been possible to evaluate where any significant historical changes in this unaccounted mortality. This is primarily because the only data source that can provide this information is the tag mortality data. These data show a great deal of variability and fit only weakly to the population, providing a good estimate of long term mean mortality but no evidence of changes with time. In particular, the absence of tag data after 2003 means that the four most recent years have no mortality data. In the absence of tag mortality estimates after 2003, mortality estimates are therefore based on the mean. The only signs of recent changes in unaccounted mortality, is a decline in the estimated factor for 2003.

iv) The spawning stock biomass may on average be between 1.7 and 2.7 times the ICA virtual population estimate, giving a long term mean SSB 1975 to 2007 of between 4.3 and 6.9Mt with a mean of 5.5Mt. Estimates of historic SSB and F are given in Figures 9.3.2.12.13–. The ICA assessment estimates long term mean F 48– as 0.25, this compares with the Bayesian estimate of 0.27 within an 95% interval of 0.19 to 0.35. Generally this good correspondence between methods supports the view that managing through the use of fishing mortalities or catch/biomass ratios is robust to uncertainties in unaccounted mortality.

Question 2

The WG has examined the reference points for NEA mackerel (See section 2.6) which were previously unchanged since 1998. A brief description of the analyses carried out is included as Annex II ICES has revised values for F_{lim}, B_{lim} and F_{pa} but B_{pa} remains unchanged because it has not been possible to select a value fully compatible with the precision of the assessment and the stock dynamics. Under these circumstances it is recommended to manage using criteria in the management plan rather than B_{pa}. The short term forecasts options (section 2.8) are provided for the current management plan, exploitation at revised F_{pa} and for a range of options under a revised management plan.

1.8.2.2 Irish request on long-term management for North East Atlantic mackerel

Request

In light of the scientific report on long term management for mackerel, Ireland requests ICES:

(1) to identify the appropriate Fpa for NEA mackerel;

(2) to comment on the appropriateness of the range of fishing mortalities specified in the existing TAC setting arrangement of the Coastal States, should any change in Fpa be identified.

ICES response

Question 1

ICES has examined the reference points for NEA mackerel which were previously unchanged since 1998. A brief description of the analyses carried out is included as Annex II to Coastal states request 9.3.2.12. ICES has concluded that revisions F_{lim}, B_{lim} and F_{pa} are required but B_{pa} remains unchanged, because it has not been possible to select a value fully compatible with the precision of the assessment and the stock dynamics. Under these circumstances it is recommended to manage using criteria in the proposed management plan rather than B_{pa}.

Revised Reference points

	Type	Value	Technical basis
Precautionary approach	Blim	1.67 Mt	Blim=Bloss, Biomass above which reduced recruitment has not been observed
	Bpa	2.3 million t.	Bloss in Western stock raised by 15%: = 2.3 million t.
	Flim	0.42 the fishing mortality estimated to lead to potential stock collapse	Flim =Floss
	Fpa	0.23	Flim * 0.55

Revised in 2008.(Bpa unchanged since 1998)

Question 2

Following the review of reference points for NEA mackerel and the revision of F_{pa} ICES considers that the existing range of mortalities specified in the existing TAC setting arrangement of the Coastal States for NEA mackerel (0.15 to 0.2) are precautionary and consistent with sustainable long term yield. ICES has provided advice (section 9.3.2.1 European Commission (EC) request on evaluation of management plan for NEA mackerel) in June 2008 regarding a range of appropriate management targets for this stock.

1.8.3 Irish request on long-term management for North East Atlantic mackerel

Request

In light of the scientific report on long term management for mackerel, Ireland requests ICES:

(1) to identify the appropriate Fpa for NEA mackerel;

(2) to comment on the appropriateness of the range of fishing mortalities specified in the existing TAC setting arrangement of the Coastal States, should any change in Fpa be identified.

ICES response

Question 1

ICES has examined the reference points for NEA mackerel which were previously unchanged since 1998. A brief description of the analyses carried out is included as Annex II to Coastal states request 9.3.2.12. ICES has concluded that revisions F_{lim}, B_{lim} and F_{pa} are required but B_{pa} remains unchanged, because it has not been possible to select a value fully compatible with the precision of the assessment and the stock dynamics. Under these circumstances it is recommended to manage using criteria in the proposed management plan rather than B_{pa}. The short term forecasts options (Section 2.8) are provided for the current management plan, exploitation at revised F_{pa} and for a range of options under a revised management plan.

Question 2

Following the review of reference points for NEA mackerel and the revision of F_{pa} ICES considers that the existing range of mortalities specified in the existing TAC setting arrangement of the Coastal States for NEA mackerel (0.15 to 0.2) are precautionary and consistent with sustainable long term yield. ICES has provided advice (section 9.3.2.1 European Commission (EC) request on evaluation of management plan for NEA mackerel) in June 2008 regarding a range of appropriate management targets for this stock.

1.9 Ecosystem considerations for widely distributed and migratory pelagic fish species

It has been known for more than a century that ecosystem factors have a determinant effect on the productivity of fish stocks, and may therefore be a source of variation as important as exploitation by fisheries (Hjort, 1914). Various biological aspects of fish stocks such as recruitment, growth or natural mortality, are influenced by ecosystem factors (Skjoldal *et al*. 2004). Geographical distribution of stocks and species migration patterns may also vary according to environmental conditions (Sherman and Skjoldal 2002). Ecosystem factors influencing fish stocks include:

- Physical (temperature, salinity) conditions
- Hydrographical (turbulence, stratification) conditions
- Large scale circulation patterns
- Inter-species and intra-species relationships
- Bottom-up effect of zooplankton on pelagic fishes
- Competition for food or space between pelagic species
- Top-down control of pelagic species by predator abundance

In a first attempt to integrate ecosystem considerations with fish stock assessment in WG WIDE, this section presents a short review of some recent changes which have taken place from the Bay of Biscay to the Barents Sea. Some of the possible implications of these changes are briefly reported in this section and then detailed in the sections specific to each stock.

An important challenge for the future meeting of this working group will be to take ecosystem considerations into account in stock assessment methods in order to reduce levels of uncertainty regarding the status and prediction of stocks. WGWIDE encourages further work to be carried out on ecosystem considerations linked to widely distributed fish stocks including NEA mackerel, Norwegian spring-spawning herring, blue whiting, horse mackerel and sardine. Emphasis should be on how ecosystem considerations from scientific studies and knowledge may be implemented and applied for management considerations. WGWIDE invite scientists working on ecosystem considerations to collaborate and present relevant working documents and publications for the next meeting in 2009.

Ecosystem Factors Affecting the Stocks Included in WGWIDE

Climate variability and climate change

Climate, in its wider sense, refers to the state of the atmosphere, for instance in terms of partitioned air masses (IPCC 2001). Climate variability, caused by the variations of atmospheric characteristics around the average climatic state, occurs via recurrent and persistent large-scale patterns of pressure and circulation anomalies. The North Atlantic Oscillation (NAO) is the recurrent pattern of variability in circulation of air masses over the North Atlantic region, corresponding to the alternation of periods of strong and weak differences between Azores high and Icelandic low pressure centers. Variations in the NAO influence winter weather over the North Atlantic (storm track, precipitations, strength of westerly winds) and hence have a strong impact on oceanic conditions (sea temperature and salinity, Gulf Stream intensity, wave height). Since 1996 the Hurrell winter NAO index has been fairly weak but mainly positive, except for during 2001, 2004 and 2006 (ICES, 2007). The Iceland Low and the Azores High were both weaker than normal in 2007 and 2008, and the centre of the Iceland Low was displaced towards the southwest to the entrances to the Labrador Sea (ICES 2007, 2008).

Accumulation of anthropogenic greenhouse gases in the atmosphere is currently effecting climate change (IPCC 2001). The classical measure of global warming is the Northern Hemisphere Temperature anomaly (NHT) (Jones and Moberg, 2003) which is computed as the anomaly in the annual mean of sea water and land air surface temperature over the northern hemisphere. Since the early 1900s, a warming of the northern hemisphere is evident. A first period of increasing temperature occurred from the early 1920s to about 1945. The period from the 1950s to the middle of the 1970s, corresponded to a light decrease of the NHT. During the last three decades, NHT anomalies have exhibited a strong warming trend.

Circulation pattern

Large-scale circulation patterns set the stage for important processes influencing fish species and ecosystems covered by WG WIDE. The circulation of the North Atlantic Ocean is characterized by two large gyres: the *subpolar* (SPG) and *subtropical* gyres (Rossby, 1999). When the SPG is strong it extends far eastwards bringing cold and fresh subarctic water masses to the NE Atlantic, while a weaker SPG allows warmer and more saline subtropical water to penetrate further northwards and westwards over the Rockall plateau area. Changes in the oceanic environment in the Porcupine/Rockall/Hatton areas have been shown to be linked to the strength of the subpolar gyre (Hátún *et al.*, 2005). In recent years the area has been dominated by the warmer and saline Eastern North Atlantic Water (Hátún *et al.*, 2007). The large oceanographic anomalies in the Rockall region spread directly into the Nordic Seas, regulating the living conditions there as well as further south. Such changes are likely to have an impact on the spatial distribution of spawning and feeding grounds and on migration patterns of certain pelagic species.

Temperature

Temperature is well known to affect many aspects of fish biology, such as recruitment, growth, or mortality rates.. Temperature affects fish both directly – through its effect on metabolic rates affecting growth and energy requirements and indirectly – through its effect on the production of prey items and production and distribution of predators.

Feeding and spawning distributions and migration patterns of widely distributed species are also closely related to temperature: the timing of migration is triggered by temperature and migration routes are related to temperature gradients. A better understanding of these effects could provide valuable information for both assessment and management of widely distributed stocks.

Time-series of sea surface temperature (SST) and salinity for the North Atlantic show recent generally rising trends. The trend from 19962–008 has been warming and increasing salinity in the upper ocean (ICES 2008). In 2008 Atlantic Water surface temperatures were above the long term mean. The increase in SST at several of the stations in the NE Atlantic is up to 3°C since the early 1980s. This rate of warming is very high relative to the rate of global warming (ICES 2007, 2008). The upper layers of the North Atlantic and Nordic Seas remained exceptionally warm and saline in 2006 and 2007 compared with the long-term average (ICES WGOH 2007, 2008). The largest anomalies were observed at high latitudes. The North Sea, Baltic Sea and Bay of Biscay had an unusually warm winter and spring. This was due to a combination of stored heat from the warm autumn in 2006, and high solar radiation in 2007 (ICES WGOH 2008).

Phytoplankton

Phytoplankton abundance in the NE Atlantic has increased in cooler regions (north of 55°N) and decreased in warmer regions (south of 50°N). These changes in the primary production are likely to have impacts on zooplankton because of tight trophic coupling. Similar effects may be expected for other mid-latitude pelagic ecosystems, because the proposed mechanisms are general and the results for the NE Atlantic are consistent and based on very large scale, long-term sampling (Richardson and Schoeman, 2004).

Zooplankton

Indicators of zooplankton communities which have been developed over recent years reveal important changes in the pelagic ecosystems of the North East Atlantic (Beaugrand, 2005). A northwards shift of 10° of latitude of the biogeographical boundaries of copepod

species has, for instance, occurred during the past four decades (Beaugrand *et al*. 2002). One well-known example of these changes is the decline in the North Sea of the sub-arctic copepod *Calanus finmarchicus*, an important food item for a number of fish species, and its replacement by *Calanus helgolandicus*, a temperate water species. Progressive increases in aboundance of warm water/sub-tropical phytoplankton species into more temperate areas of the northeast Atlantic (Beaugrand *et al*. 2005) have in turn influenced zooplankton communities.

The average biomass of zooplankton in the Norwegian Sea has followed a decreasing trend since 2002, but increased in 2008 compared to 2007. Average biomass of zooplankton in May 2008 was lower than in 2006 and 2007, and was the lowest measured since 1997 (ICES 2008). Increased biomass was observed in the eastern region, while biomass in the western region decreased abruptly from 2007 to 2008. The overall distribution pattern of zooplankton biomass in 2008 resembles largely the distribution during previous years with the highest biomass in the cold water of the East Icelandic Current, where high aggregations of adult herring and mackerel were also observed.. The biomass in the western region was much lower than any previous recordings Higher concentrations along the Arctic front further north were not obvious as opposed to in previous years.

Species interactions

A central element in ecosystem considerations is how different species interact with each other (Rothschild 1986, Skjoldal *et al*. 2004). The distribution of species considered by WG WIDE can overlap to a large extend during some part of the year and according to life history stages Since these species are mainly planktivorous, concurence for food is likely to hapend. The larger species (mackerel and horse mackerel) are also potential predator of the juveniles of the other pelagic species. Canibalism of adults on the eggs, larvea and juvenils is also likely to happend. Consequently, interspecific interaction between pelagic species could play an important role in the dynamics of these stocks. .

Various pelagic species (e.g. mackerel, horse mackerel, sardine, blue whiting) also represent an important food source for many top predators such as marine mammals, seabirds and other species of pelagic fish. Many pelagic ecosystems (particularly those in upwelling areas) are characterised by a wasp-waist control, where a few, but highly abundant fish species effectively regulate the populations of their prey (top down control) but also of their predators (bottom up control). This type of regulatory mechanism makes pelagic fish have a key role in ecosystem functioning.

There is a large body of literature on the diet of predator species feeding on pelagic fish in the Northeast Atlantic: sardine, mackerel, horse mackerel, blue whiting and herring have all been found in the diet of several cetacean and seabirds species and are also part of the diet of other fish species (e.g. hake, tuna found with sardine and anchovy).

Because of the numbers involved, if we compare population estimates of pelagic fish and those of top predators, it would appear than predation on pelagic fish by other pelagic fish could have a much bigger impact in regulating populations than that of predation by marine mammals and seabirds (as already suggested by Furness (2002) in the context of the North Sea). Nevertheless, top predators could play a bigger role in pelagic fish dynamics at regional or local scales particularly when fish biomass is low.

Overview of the environmental conditions during the recent years in the North East Atlantic ecosystems

Bay of Biscay to west of the British Isles

Hydrological and oceanographical data from the ICES Ocean Climate Report 2007 showed a cold winter and low sea surface temperatures, followed by an unusually warm summer and autumn, and correspondingly high SST (ICES 2007). This situation has recently influenced migration patterns and distribution of juvenile and adult NEA mackerel. Possible mechanisms involved are: earlier onset of spawning and migration to higher latitudes due to generally higher temperatures triggering spawning, and earlier spring blooms in the region important for some species such as mackerel and horse mackerel.

North Sea

The warm conditions from 2006 remained high until autumn 2007. Model simulations combined with survey data show that inflow of Atlantic water into the North Sea was the lowest ever recorded and cooling in winter has been far weaker than usual. The spring bloom started approximately one month earlier than normal. Increased temperatures have influenced biomass, species composition, distribution area and seasonal cycles of several zooplankton species. The cold water copepod *Calanus finmarchicus* has been considerably reduced in biomass in the North Sea during the last decade and has also moved northwards. This species has been only partly replaced by the smaller, warmer water species *C. Helgolandicus*. This may provide less favourable feeding conditions and less biomass of preferred prey in this area, especially for NEA mackerel and horse mackerel at different life stages.

Norwegian Sea

During winter 2008 strong westerlies (high NAO index) resulted in an increased influence of Arctic water in the southern Norwegian Sea for 2008 compared to 2007. Also compared to the average 19952–006 an increased Arctic influence was observed, especially in the western and southwestern part. This situation has strongly influenced the migration pattern and distribution in spring and summer of both NSS herring and NEA mackerel. The volume of transport of Atlantic water into the Norwegian Sea increased considerably during 2005 and record-high transport values were observed during winter 2006 (ICES Advice 2008). At the surface, the temperature in 2008 was warmer than the average for most of the Norwegian Sea. Nevertheless, after some years with large westerly extension of Atlantic water and additional warm Atlantic water in the Norwegian Sea, especially in 2003 and 2004, a temperature reduction in the western Norwegian Sea is observed in the last years. This is due to a decreased extension in the Atlantic water and the occurrence of an increased transport of Arctic water to the area. Thus, the temperature in the western Norwegian Sea in 2008 is close to and in some areas less than the 19952−006 average. However, in the eastern part, near the Norwegian coast, the water is still warmer than the average because the inflow of Atlantic water through the Faroe-Shetland Channel is warmer than normal. At the surface, the air-sea heat flux during April-June 2008 was higher than normal causing the relatively warm surface water.

The Atlantic water in the Norwegian Sea has been anomalously warm and salty since 2002. In 2007, the Atlantic water in the southeastern Norwegian Sea was 0.8C° warmer than normal. After the record-high volume transport of Atlantic water into the Norwegian Sea during winter 2006 it fell to a record-low during summer 2007.

Barents Sea

The general circulation pattern in the Barents Sea is strongly influenced by topography. The coastal water is fresher than the Atlantic water, and has a stronger seasonal temperature signal. The inflow of Atlantic Water to the Barents Sea was higher and warmer than ever recorded and the ice cover was the lowest on record for the winter of 2006. This expanded the possible distribution area for widely distributed stocks. In 2007, the temperature in the inflowing water was colder and less saline than in the previous year and at about the same level as 2005, but still above the long-term average (ICES Advice 2008). Compared with the two previous years, less zooplankton was observed in the Barents Sea in 2007, probably related to a lower amount of Atlantic water being transported into the area, and grazing by pelagic planktivorous species.

Subsurface temperature and salinity were lower in 2008 than normal in the west indicating a stronger influence of Arctic water. The midwater section was warmer and saltier than average, partly due to a deeper Atlantic layer there compared to the long-term-mean. A body of relatively cold and fresh water extends eastward from the Iceland Sea. Arctic waters are separated from the Atlantic by the Arctic Front, which is indicated by closely spaced isotherms. The temperature distribution in 2008 resembles in general that of 2007. Below the upper layer (>1 00 m) the water in the southern part is colder in 2008 than 2007. At some location the differences can be up to 1°C. This difference can be explained by increased intrusion of Arctic water there. In the Barents Sea highest zooplankton biomass was observed in the eastern part of the survey area. Average biomass was higher than 2007 but lower than in 2005. The Barents Sea component now consists of an abundant 2004 year class and weak 2005 and 2006 year classes of Norwegian spring spawning herring. Results from the Barents Sea bottom trawl survey in January-March also indicate that the 20052−007 year classes of blue whiting are poor, which is in line with the observations from the International Ecosystem Survey in the Nordic Seas.

Stock specific ecosystem considerations

North East Atlantic Mackerel

The NEA mackerel stock is distributed in the whole ICES area and currently supports one of the most valuable European fisheries. The distribution of the NEA mackerel stock in 2008 was between the Iberian Peninsula and the northernmost part of the Norwegian Sea (75°N). Distribution changes with life history stage and migration patterns. Geographical changes in the centre of spawning areas along the western shelf have been observed recently with peak spawning shifting west and northwards (Reid, 2001, Beare and Reid, 2002). This trend has continued and the northernmost observed spawning of mackerel was documented in the international egg survey in 2007 (ICES WGMHSA 2007). Mackerel has now the largest spatial expansion and distribution pattern in summer recorded in the Northeast Atlantic (see section 2.13).

NEA mackerel is dependent on zooplankton for growth and survival (Prokopchuk and Sentyabov 2006). The zooplankton *C. finmarchicus* is a key prey species for mackerel and most pelagic stocks in the North East Atlantic (Melle *et al*. 2004). Locally higher biomass was observed in the waters dominated by the East Icelandic current of the western Norwegian Sea. The distribution and biomass of *C. finmarchicus* likely influenced the feeding migration and distribution of adult mackerel from spring to autumn. Increased biomass of zooplankton was observed in the northeastern Norwegian Sea in 2008 compared to earlier periods, and coincided with increased presence of mackerel in these areas, including in coastal waters where mackerel was caught for the first time in decades.

Mackerel migrations in the southern and western part of the distribution area are closely associated with the slope current, and mackerel migration is modulated by temperature (Reid *et al*., 2001). The continued rapid warming of the slope current strongly suggests effects on both the timing and the spatial extent of this migration. The southward migration of mackerel from the wintering and pre-spawning areas in the Norwegian Sea and North Sea to the spawning grounds west of Ireland generally commences when the temperature falls below about a threshold of 9C°. During warmer oceanographic conditions, migration is only initiated once the threshold is reached and southwards movements may likely be delayed (Reid *et al*. 2001). In 2006 and 2007 we observed a later southward movement, and this influenced the timing of the fishery, where large proportions of mackerel in recent years in the North Sea have been caught later in the season compared to previous periods (ICES 2007). Furthermore, the post-spawning migration northwards to the Norwegian Sea has undergone considerable changes in the last few decades with an earlier migration occurring in recent years (Reid *et al* 2006). A pronounced length and age dependent migration pattern with the largest individuals moving to the northernmost areas has been found for mackerel (Nøttestad *et al*. 1999). This size selective migration pattern has remained strong the last decade, but also with a more pronounced western distribution of large mackerel in summer (Nøttestad *et al*. 2007). Catch data on mackerel also show the same pattern (ICES 2007, 2008). Furthermore, juvenile mackerel from the 2006 year class where present for the first time in relatively large quantities up to 66ºN and constituted about 10% of the sampled specimen (ICES, 2007c). They were also mostly feeding on *C. finmarchicus*, further showing the importance of this prey in the ecosystem. The 2006 year class was also sampled in similar areas in 2008 based on national surveys, suggesting that immature mackerel are distributed over considerable areas, although we do not know yet how strong this year class is within the stock.

Norwegian spring spawning herring

Norwegian spring spawning herring are a highly migratory and straddling stock carrying out extensive migrations in the NE Atlantic. This applies to the wintering, spawning and feeding area. Juveniles and adults of this stock form an important part of the ecosystems in the Barents Sea, the Norwegian Sea, and the Norwegian coast. Herring has an important role as food resource to higher trophic levels (e.g. cod, seabirds, and marine mammals). Recent changes in the herring migration have led to an increased proportion of the population feeding in Faroese and Icelandic waters. The growth of these herring is faster than those feeding further east and north. The size of the feeding area is influenced by the stock size. Additionally, ocean climate and current systems are obvious candidates affecting the feeding area with more northerly migrations in warming periods. Other factors could be the entrance of large year classes of young herring from the Barents Sea into the Norwegian Sea and asymmetrical plankton concentrations throughout the potential feeding area. Herring (as with previous years) had a somewhat more southerly distribution in 2008 than in 2007. This south-westward shift in feeding migration and distribution continued in 2004 through 2006, and especially in 2007 the fishery continued in the south-western areas throughout the summer, leading to some speculations of a change in their late autumn migrations of parts of the adult stock (see Fernö *et al*. 1998; Nøttestad *et al*. 2004).

The inflow of Atlantic water into the Norwegian Sea and Barents Sea seems to influence the condition and hence fecundity of adult fish as well as the survival of larvae (Toresen and Østvedt , 2000, Fiksen and Slotte, 2002, Sætre *et al*., 2002). Environmental conditions may also affect fish, which may result in reduced fecundity (Oskarson *et al*., 2002). The strong year classes have occurred in periods of good condition and high temperatures.

Two main features of the circulation in the Norwegian Sea, where the herring stock is grazing, are the Norwegian Atlantic Current (NWAC) and the East Icelandic Current (EIC). The highest concentrations of herring in 2007 recorded at the eastern edge of the cold waters of the East Icelandic Current but slightly farther to the northeast compared to 2006 and 2007. The increased concentrations are reflected both in the surveys and through a significant fishery in the southwestern area during 2007. Most of the oldest herring fed in the southwestern area during 2008. About 40% of the abundant 2002 year class was found in this area. The plankton concentration during the May survey in the southwestern part of the ocean was consistently higher than further north and east. The herring feeding in this region have previously been shown to have a higher condition factor than the rest of the stock. It was mainly older herring that appeared in the southwestern areas (1998, 1999 and 2002 year classes now at ages 10, 9 and 6). As in previous years the smallest fish are found in the northeastern area. Size and age were found to increase to the west and south.

Herring overlapped spatially in distribution with mackerel in several parts of its distribution area in 2008, including the south-western and northern part of the distribution area, but was not present in the warmer southern part of the Atlantic water masses. This could have considerable consequences for fishing because of considerable spatiotemporal overlap and bycatch issues involved when fishing for herring as well as mackerel.

Blue whiting

Blue whiting has an important role in the pelagic ecosystems of the NE Atlantic, both by consuming zooplankton and small fish, and by providing a food resource for larger fish and marine mammals.

In the last 15 years large changes have occurred in stock size, and during the last few years the stock has decreased rapidly; not only in terms of spawning stock biomass: recruitment has also been weak and lower than expected. This signal is reflected in changes in large-scale hydrographic systems in the north Atlantic (the subpolar gyre, SPG). Changes in the strength of the SPG have been shown to coincide with the recent large changes observed in the blue whiting recruitment (Hátún *et al*., 2005). The strength of the SPG might affect the spawning distribution of the blue whiting as well as the main migration pattern into feeding areas in the north (see section 10.15.1 for a detailed discussion). In addition it might also influence the relative amounts of eggs and larvae drifting to northern and southern nursery areas; a certain spawning area may seed northern areas in one year and southern areas in another (Skogen *et al*., 1999).

The recent large inflow of warm Atlantic water to the Barents Sea had a positive effect on abundance of blue whiting in the Barents Sea one year later (Heino *et al*., 2003). The strength of year classes as 0-group in the North Sea is only weakly coupled to the strength of year classes in the main Atlantic stock. This suggests either local recruitment or variation in transportation of larvae into the North Sea.

Blue whiting condition has decreased quite substantially the last 15 years. There are several possible explanations for this overall negative trend.

- Lower plankton concentrations in general.
- Lower plankton concentrations in particular areas and times occupied by blue whiting – an unfortunate match in time and space.
- Intra- or interspecific competition – too many fish competing for the same food resource.

For a detailed discussion on these different hypotheses see section 10.15.2.

Horse Mackerel.

Horse mackerel is widely distributed on the continental shelf in the Northeast Atlantic and Mediterranean Sea. Horse mackerel is a schooling and migratory species that are adapted to swimming at a low but a very constant speed (Enders, 1998). Migration (spawning, feeding, over-wintering) is probably driven by water temperature and availability of prey. Their prey are mainly the different components of the zooplankton. Horse mackerel is a serial spawner probably with indeterminate fecundity. Apparently, the water temperature of 8º C is the lower limit for horse mackerel, which they avoid during over-wintering, and they stop feeding at water temperatures below 9ºC. Migrations are closely associated with the slope current, and horse mackerel migration is known to be modulated by temperature (Reid *et al*., 2001). Continued warming of the slope current is likely to affect the timing and the spatial extent of this migration. For North Sea horse mackerel data exploration again showed inconsistent signals in the catch at age data and a survey index, which may be missing an important component of the stock due to seasonal migration. The WG concluded that more intensive age sampling and a directed survey will need to be available before an analytical assessment can be attempted for this stock.

Horse mackerel are a fairly long-lived species, reaching a maximum age of well over 30 years. Therefore, an occasional strong year class can lead to high abundance of horse mackerel (Abaunza *et al*., 2003). Since the strong 1982 year class of the western stock started to appear in the North Sea in 1987 there has (except for 2000) been good correlation between the modeled influx of Atlantic water to the North Sea in the first quarter and the horse mackerel catches taken in the Norwegian EEZ (NEZ) later the same year (Iversen *et al.* 2002). The correlation has been used locally to predict the catch level in NEZ since 1997. The predicted and actual catch matched very well in 2006. The influx in 2007 indicates an increase in the catch rate from 27,000 tons in 2006 to more than 60,000 tons in 2007 (Iversen *et. al* WD 2007). A very deep distribution of horse mackerel from hydro-acoustic recordings and trawl data in the northern North Sea in October-December, partly resulted in reduced availability of horse mackerel to the fishing fleet, and catches within NEZ remained low in 2007.

The recruitment seems to be more dependant on environmental factors than on the size of the parental stock (at least when it is not depleted). The recruitment of horse mackerel in the southern areas (Iberian coasts) seems to be related to temperature variables and/or upwelling phenomena (Santos *et al*., 2001; Lavin *et al*., 2007). In this sense cooler waters seems to favour horse mackerel recruitment in southern areas (Lavin *et al*., 2007). More research is needed on how horse mackerel respond to environmental and ecosystem changes and variation within its distributional area.

Sardine

European sardine (*Sardina pilchardus*) is found from Mauritania and Senegal to the North Sea, being also present in the Black Sea. This wide geographical range implies that the species is able to sustain wide ranges of both temperature and salinity. Recent studies by Bernal (1998) have also shown a wide temperature tolerance (121–7C°) for sardine spawning habitat and distribution.

Sardine in the western Iberia area seem to have a more coastal distribution than sardine in the Bay of Biscay probably due to the narrower shelf found in the area. In the Bay of Biscay juveniles are found mainly concentrated all along the French coast mixed with anchovy and sprat in areas influenced by river plumes while adult sardine tend to be seen offshore in big schools at the surface.

Several studies have tried to find a relationship between selected environmental variables and sardine dynamics and in particular to try to explain its high recruitment variability (see section 8.6). As with any other pelagic species, recruitment is highly dependent on favourable environmental conditions (concentrations of egg/larvae in suitable areas) and several local and large scale variables that could be affecting this process have been explored (i.e. upwelling index and NAO). In general, environmental effects on the models tend to be weak and sometimes give contradictory results.

Sardine is a passive filter-feeder that is able to feed on a wide variety of prey (both by particle-feeding and filter-feeding) (e,g, Bode *et al*., 2004) which could buffer it against changes in prey supply.

In waters off the Iberian Peninsula and the Bay of Biscay, sardine has been found in the diet of several cetacean species, as well as in other fish species. Sardine is one of the main prey species in the diet of common dolphins (*Delphinus delphis*) in Galician (NW Spain) (Santos *et al*., 2004) and Portuguese waters (Silva, 2001). Anchovy and sardine were found to be the numerically most important prey taken by common dolphins stranded on the Atlantic French coast (Meynier, 2004). Common dolphins are the most abundant cetacean species in the area, with numbers estimated to reach several thousands (López *et al*., 2004).

French and UK fleets fishing for sardine operate mainly in the Channel during winter. Data from the position of the fishing vessels indicate a progressive movement of the fleet southwards from the Channel at the beginning of the year towards southern Brittany and SW Cornwall. This movement could be related to sardine movement but more data are needed to confirm this pattern.

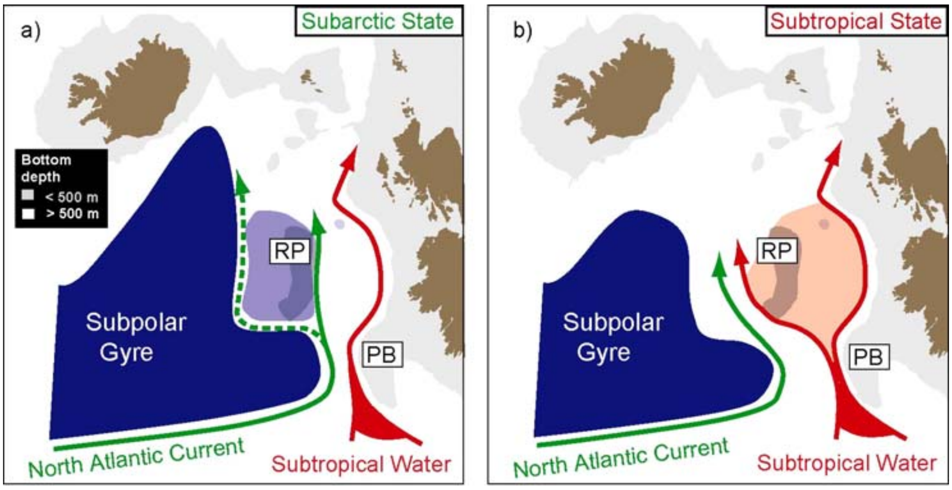

Figure 3 Outline of the source flows to the blue whiting spawning grounds in the Rockall Region. (a) A strong subpolar gyre (SPG) results in strong influence of cold subarctic water near the Rockall Plateau. (b) A weak gyre results in warm subtropical dominance near the plateau (based on Hátún et al., 2005). AbbreviationsR–P: Rockall Plateau and PB: Porcupine Bank.