ICES WGNPBW Report 2007

ICES Advisory Committee on Fishery Management

ICES CM 2007/ACFM:29

Report of the Working Group on Northern Pelagic and Blue Whiting Fisheries (WGNPBW)

27 August–1 September 2007

Vigo, Spain

ICES
International Council for the Exploration of the Sea
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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

Recommended format for purposes of citation:

ICES. 2007. ICES WGNPBW Report 2007. 229 pp.

ISBN 87-7482-058-3

ISSN 1017-6195

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Executive Summary

The ICES Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW) met for 6 days in August 2007 to assess the state of the stocks of blue whiting and Norwegian spring spawning herring. Age-based assessments were carried out for both stocks.

For various reasons, a few members cancelled participation to the meeting at the last moment. This affected the expertise present and amount of work which could be carried out by the Working Group. For instance, the ecosystem chapter has not been updated.
Two models were used to explore the data of Norwegian spring spawning herring. Both models gave a similar perception of the development of the stock. Like last year, tagging information is not included in the final assessment. The results of the assessment were very sensitive to the tagging data. Because of change in wintering areas of the stock, the surveys on the wintering stock had not covered the entire stock and have underestimated the stock in recent years. Like previous years, the information in these surveys had been excluded from the assessment for years where this seems to be the case. Fishing mortality on the herring stock is estimated to be low and the stock has been increasing due to a number of good year classes. The 2002 year class is estimated to be strong and is now considered fully mature. The spawning stock biomass is estimated around 12 million tons and has not been larger since the early fifties. Several age groups contribute to the spawning stock. The year class 2004 is also considered to be strong and is expected to recruit in the spawning stock in the coming years.

The evaluation of the maturity at age information of Norwegian spring spawning herring has been postponed to next years meeting. The data were not made available to the Working Group.

Five different assessment models were used to explore the data for blue whiting. The results of these assessments can be split in two groups. One group indicates that the fishing mortality has increased sharply in recent years. The other group indicates a more stable fishing mortality. All models show the decline in spawning stock biomass but to differing extents. The assessment traditionally relied on external information from the Norwegian acoustic survey on the spanning grounds. However, this survey was discontinued in 2007. The only updated fishery-independent external information available on blue whiting came from the International Blue Whiting Spawning Stock Survey. This survey has a better coverage of the blue whiting stock. However, the time-series of this survey is still short (4 years) and the weight given to this survey has a large effect on the assessment. The index from this survey for 2007 indicates that the stock remained high but the precision of the 2007 index is much lower than in previous years. There are also internal inconsistencies in this survey, which have to be further investigated. The main problem in the assessment comes from the contradiction between the signals from the survey and the commercial catches. This problem was not resolved during the meeting. The WG brought one assessment from the “stable F” family of assessment into forecast as a likely stock development. Other assessments indicate however, that fishing mortality may have increased sharply. Such large increases in fishing mortality are not uncommon in pelagic stocks which concentrate in schools and remain highly accessible to the fishery at low stock density.

All available information from surveys indicate that the recruiting year classes 2005 and 2006 for blue whiting are poor, and their contribution to the spawning stock in the coming years will be small. In all scenarios explored by the Working Group the spawning stock of blue whiting is expected to decrease sharply when the present high level of TAC is maintained.

A working prototype of a new joint Russian-Norwegian assessment model for Norwegian spring spawning herring (TACSACS) was presented to WGNPBW. The Working Group discussed the model and gave suggestions for further improvement. It was recommended to

take account of the developments in FLR and make it possible to use the model in this framework.

1 Introduction

1.1 Participants

NAME	E-MAIL
Frans A. van Beek (co-chair)	frans.vanbeek@wur.nl
Sergei Belikov	belikov@pinro.ru
Afra Egan	afra.egan@marine.ie
Asta Gudmundsdóttir	asta@hafro.is
Ane Iriondo	airiondo@suk.azti.es J
an Arge Jacobsen	janarge@frs.fo
Alexander Krysov	a_krysov@pinro.ru
Manolo Meixide	manolo.meixide@vi.ieo.es
Eugene Mullins	eugine.mullins@marine.ie
Mark Payne	mpa@difres.dk
Are Salthaug	ares@imr.no
Dankert Skagen	dankert.skagen@imr.no
Åsmund Skålevik	aasmund.skaalevik@imr.no
Nikolay M. Timoshenko	timoshenko@atlant.baltnet.ru
Sigurd Tjelmeland	sigurd.tjelmeland@imr.no
Dimitri A. Vasilyev	dvasilyev@vniro.ru
Morten Vinther (co-chair)	mv@dfu.min.dk
Sytse Ybema	sytse.ybema@wur.nl

Terms of reference

The **Northern Pelagic and Blue Whiting Fisheries Working Group** met in Vigo (Spain) from 27 August to 1 September 2007 with the following terms of reference:

a) assess the status of and provide management options for 2008 for:
   1) Norwegian spring-spawning herring
   2) blue whiting

b) provide as detailed information as possible on the age/size composition in different segments of the blue whiting fishery;

c) review the catch statistics of blue whiting especially from 1978 to 1990 and resolve differences between ACFM landings, EuroStat and ICES Fishstat data;

d) review recent maturity data for Norwegian spring spawning herring and consider the need to update the maturity data in the assessment;

e) for the stocks mentioned in a) perform the tasks described in C. Res. 2006/2/ACFM01;

WGNPBW will report by 2 September 2007 to the attention of ACFM.

In ToR e) referring to C. Res. 2006/2/ACFM01 is given below:

WGNSSK, WGSSDS, WGHMM, WGMHSA, WGBFAS, WGNSDS, AFWG, HAWG, NWWG, WGNPBW and WGPAND will, in addition to the tasks listed by individual group in 2006:

In addition the Working Group was asked to report on progress made in the joint Russian-Norwegian project on developing new assessment tools for blue whiting and Norwegian Spring Spawning (Atlanto-Scandian) herring. This item has been dealt with in Section 5 of the report.

The terms of reference of the meeting were discussed at the Annual Meeting of Assessment-related Working Group Chairs (AMAWGC). The annotated terms of reference are given in the table below. It is also indicated in which section the terms of reference is dealt with in this rapport.

TERM OF REFERENCE (WGNPBW)	COMMENT	DEALT WITH IN SECTION
1) set appropriate deadlines for submission of data. Data submitted after the deadline can be disregarded at the discretion of the WG Chair.	Data should be submitted to the stock coordinators by 1st June. Data will be collated as soon as possible and before 1st July and copied to the SharePoint to allow an evaluation of data quality and raising procedure.	Section 1.3.1
2) compile all relevant fisheries data, including data on different catch components (landings, discards, bycatch) and data on fishing effort. Data should be disaggregated by fisheries/fleets.	Data have to be provided in the traditional way using the Salloc exchange spreadsheets. Effort data are less relevant for the stocks but an overview of capacity must be provided. In the future national data will be exchanged through InterCatch. For training/experience purposes data should also be uploaded to the InterCatch before or during the WGNPBW.	Section 1.3.1
3) assess the state of the stocks according to the schedule for benchmark and update assessments as shown below.	A similar approach as applied for 2006 will probably be applied for 2007. If new Assessment methodology becomes available for blue whiting and Norwegian Spring Spawning (request from NEAFC) it will be evaluated.	herring: Chapter 3 blue whiting: Chapter 4 new methodoly: Chapter 5
4) provide specific information on possible deficiencies in the 2007 assessments and forecasts, • any major inadequacies in the data on landings, effort or discards; • any major expertise that was lacking • any major inadequacies in research vessel surveys data, • any major difficulties in model formulation or available software. The consequences of these deficiencies for both the assessment of the status of the stocks and the projection should be clarified.	Specific tasks: The PGNAPES will be asked to produce maps with distribution of survey effort and resources. This is needed as basis for and *a priori* decision on exclusion of surveys and data years in assessment data.	Section 3.2.5
5) consider knowledge on important environmental drivers for stock productivity (based on input from e.g. WGRED and for the North Sea NORSEPP). If such drivers are considered important for management advice, incorporate such knowledge into assessment and prediction and comment on the consequences for long term targets of high yield and low risk.	The results from the newest survey in the Norwegian Sea will be presented. The results are used when predicting weight-at-age for the NSSH	not dealt with
6) consider existing knowledge of important impacts of fisheries on the ecosystem.	No specific activities are planned	not dealt with

TERM OF REFERENCE (WGNPBW)	COMMENT	DEALT WITH IN SECTION
7) Evaluate existing management plans and develop options for management strategies including target and limit reference points. If mixed fisheries are considered important consider the consistency of target reference points and management strategies.	The management plan for blue whiting was evaluated in 2006 and no further evaluations is planned for 2007 so far. The mixed fisheries issue is not considered to be relevant for the stocks.	no action required
8) assess the influence of individual fleet activities on the stocks. For mixed fisheries, assess the technical interactions.	The mixed fisheries issue is not considered relevant for the stocks.	no action required
9) provide an overview of major regulatory changes (technical measures, TACs, effort control and management plans) and evaluate or assess their (potential) effects.	Is done annually and will be updated.	Sections 3.1.4 and 4.1.4
10) where misreporting and/or discarding is considered significant provide qualitative, and where possible quantitative information, by fisheries and the describe the methods used to obtain the information and its influence on the assessment and predictions.	Not considered relevant for the stocks.	no action required
11) present an overview of the sampling on a national basis of the basic assessment data for the stocks considered according to the template that is supplied by the Secretariat	Will be done.	Tables 3.2.1.1.1., 3.2.1.1.2., 4.2.1.2.1. and 4.2.1.2.2.
12) implement the roadmap for medium and long term strategy of the group as developed in AMAWGC.	not dealt with	
a) assess the status of and provide management options for 2008 for Norwegian spring spawning herring and blue whiting.	provide assessments for each stock with full documentation for final assessment. Results of alternative assessments can be presented as summaries of in comparison (see also Comment 3).	Chapters 3 and 4
b) provide as detailed information as possible on the age/size composition in different segments of the blue whiting fishery	This information has to be prepared in advance of the meeting. It is required to support advice to reduce fishing on juvenile blue whiting in areas where it occurs. Length distribution of the catch by area are requested as part of the catch reporting.	Section 4.2.2.
c) review the catch statistics of blue whiting especially from 1978 to 1990 and resolve differences between ACFM landings, EuroStat and ICES Fishstat data.	The Chairs will prepare an overview of the differences between the various data sources before 1 May and distribute it to WG members for comments and clarification of differences. Based on the outcome of this exercise, the stock assessment numbers might be updated during the WG meeting in 2007 or 2008.	Section 4.2.1.1
d) review recent maturity data for Norwegian spring spawning herring and consider the need to update the maturity data in the assessment.	Is required to support the large change in maturity used in last year assessment for year class 2003. Action by Norway to prepare data to the meeting.	postponed to next meeting; data not available to the WG

1.2 Agenda items

1.2.1 Data exchange

Last year it was decided to exchange data using two systems, the new InterCatch system and the traditional procedure.

The deadline for submitting the catch data and corresponding biological information was set by the Chairs as the 1st of June. This was done to give the data coordinators time to combine the data and to allow for exploratory assessments in advance of the meeting. Data were exchanged using e-mail or the SharePoint of the meeting.

For blue whiting, updated input files for the assessments including the 2006 data became available a few days before the meeting. For Norwegian spring spawning herring the input files became available at the first day of the meeting.

During the meeting the national data for both blue whiting were imported in InterCatch. Fleet data could only be provided at the fleet or aggregation level they have been collected by the different nations. Therefore, for the time being, they will remain to be provided in the present aggregation structure. One fleet called "TrawlPlus" is currently used for Blue Whiting data. This fleet is a general trawl fleet but can include other gears. It is used for all countries. This was set up because the fleet data are provided at the fleet or the aggregation level they are collected at, in the different nations. Additional fleets will have to be set up because in some areas and quarters two fleets from one country could report catches.

For Norwegian spring spawning herring, the data were not available in a convenient format for import in InterCatch. It will be attempted to import these data after the meeting.

InterCatch Recommendations

- It would be useful if the stock coordinator could set up fleets without having to contact ICES.
- The stock column which is part of the species information input is currently not set up. This would be useful for Norwegian Spring spawning herring because there are different stock components.
- In the case of species widely distributed and captured by many countries, as it is the case of Blue whiting, the process used in InterCatch to do the allocations is very complicated (one by one). The number of records is too big to work with it in the way Intercatch is built, consuming long time and having great possibilities of committing errors. The possibility of copying schemes between zones or trimesters could not be investigated by the work group by lack of time. Also the posibility of printing or extracting in any format the allocations information would be very useful for checking.

1.2.2 Presentations

Presentations were given of the meeting of AMAWGC (Morten Vinther) and the conclusions of the meeting of WKRED (Frans van Beek) with regard to the evaluation of the reference stocks for blue whiting and Norwegian spring spawning herring. Alexander Krysov presented the results of the surveys considered by PGNAPES. Further a presentation was given by Dankert Skagen on the progress of the development of new assessments tools for blue whiting and Norwegian spring spawners. The tools are developed in a joint Norwegian-Russian research project. Finally, Jan Arge Jacobsen presented a paper on the influence of the environment on the spawning distribution and migration pattern of northern blue whiting. The paper will be submitted to the 2007 ASC.

1.2.3 Data requests

ICES has received a request to make catch data available for blue whiting for the period 1996–2004. The data will be used for and academic research into discard utilization by seabirds carried out at the University of Plymouth. The requested data are total catches in weight per rectangle for countries combined. These data are annually processed by the Working Group to produce maps of the spatial distribution of the catches. The Working Group has no objections to provide these data for scientific studies.

2 Ecological considerations

In previous reports an extensive chapter was provided with a description of the ecosystems in the eco-regions relevant to the stocks considered by WGNPBW. In addition, recent developments in these ecosystems were discussed. This year, no expert was present at the meeting. Also no new information has been submitted to the WG. The Chapter has therefore not been updated and included in the present report.

3 Norwegian spring spawning herring

The stock of Norwegian spring spawning herring is on the observation list. Starting point for selecting a final assessment was a SPALY run (same procedure as last year). In addition the effect of including or excluding data sets was explored. Also exploration with other models was carried out. The SPALY was selected as the final assessment.

3.1 General

3.1.1 Stock description

The Norwegian spring spawning herring (*Clupea harengus*) is the largest herring stock in the world. It is highly migratory and distributed throughout large parts of the NE Atlantic during its lifespan. It is a herring type with high number of vertebrae, large size at age, large maximum size, different scale characteristics from other herring stocks and large variation in year-class strength. The herring spawns along the Norwegian west coast in February-March. Large variations in the north-south distribution of the spawning areas have been observed through the centuries. The larvae drift north and northeast and distribute as 0–group in fjords along the Norwegian coast and in the Barents Sea. The Barents Sea is by far the most important juvenile area for the large year classes, which form the basis for the large production-potential of the stock. Some year classes are in addition distributed into the Norwegian Sea basin as 0–group. Examples of this are the 1950 and 2002 year classes. Most of the young herring leave the Barents Sea as 3 years old and feed in the north-eastern Norwegian Sea for 1–2 years before recruiting to the spawning stock. Large year classes typically mature at a higher mean age due to density dependent distribution and growth. However, exceptions occur and the 2002 year class is a large year class, which has shown quick growth and a relatively early maturation. Juveniles growing up in the Norwegian Sea grow faster than those in the Barents Sea and mature one year earlier. With maturation the young herring start joining the adult feeding migration in the Norwegian Sea. The feeding migration starts just after spawning with the maximum feeding intensity and condition increase occurring from late May until early July. The feeding migration is in general length dependent, meaning that the largest and oldest fish perform longer and typically more western migrations than the younger ones. After the dispersed feeding migration the herring concentrate in one or more wintering areas in September-October. These areas are unstable and since 1950 the stock has used at least 6 different wintering areas in different periods. During the 1950s and 1960s they were situated east of Iceland and since around 1970 in Norwegian fjords. In 2001–2002 a new wintering area was established off the Norwegian coast between 69º30’N and 72ºN. After wintering, the spawning migration starts around mid January.

3.1.1.1 Changes in migration

A characteristic feature of this herring stock is a very flexible and varying migration pattern. The migration is characterised as relatively stable periods and periods characterised by large changes occurring at varying time intervals. The changes may or may not be correlated between the major distribution areas: Spawning, feeding and wintering. At present we see a period of large changes in both the wintering and feeding area. Until about 2002 the bulk of the adult herring wintered in fjords in northern Norway. The 1998 and 1999 year classes were expected to enter the fjords around 2002, but were instead observed wintering off the coast in the ocean off Vesterålen/Troms, between 69º30’N–72ºN. This continued in the years to come and in 2005 also the 2002 year class was observed wintering in the same area. During these years, the amount of older herring wintering in the fjords has decreased rapidly and was down to about 700 000 tonnes during the winter 2005–2006 (12% of the estimated spawning stock in 2006). The survey covering the oceanic wintering area in November 2003–2006 have shown a strong decrease in the biomass in the wintering stock in the area, indicating that a third and so for unknown wintering area could be under establishment somewhere else. Such a development is supported by the western feeding distribution in recent years, and the fact that the return migration of the smaller herring feeding in the west could be too long compared with comparable return migration distances observed in earlier periods. It is also supported by the fact that the international survey in May did not show any such negative trend in the stock.

With regard to the feeding area there has been a western trend, where the oldest and largest herring has been migrating further west in recent years. The plasticity of the herring migration could be regarded an adaptive trait enabling the stock to optimally exploiting the ever varying climate and planktonic resources of its potential range in the NE Atlantic.

During the autumn in the period 2004–2006 Norwegian spring spawning herring has been caught as bycatch in smaller concentrations in catches of Icelandic summer spawning herring off the Icelandic east coast. This feature is probably linked to the western movement of the south-western summer feeding area. It is not known whether Norwegian spring spawning herring are wintering in this area. Two surveys carried out by Faroes in January and November 2006 in the area north of Faroes and international waters indicate that herring is absent. From this observation it can be concluded that it is unlikely that Norwegian spring spawning herring are wintering in western waters at present.

3.1.2 Ecosystem considerations

Feeding and growth

This Section has been copied from the Ecosystem chapter of the WGNPBW report of the 2006 meeting. There was no expertise available at the 2007 to update it. References to tables and figures available in the previous report were deleted.

Individual growth of the Norwegian spring spawning herring, as measured by condition or length specific weight after the summer feeding period in the Norwegian Sea, has been characterised by large fluctuations during the 1990s. During 1991 and 1993 individual condition was good, but from 1994 on the condition of the herring started to decline and by 1997 it reached the lowest level during the 1990s. The level observed in 1997 corresponds with the absolute long-term low level observed during the period 1935–1994 (Dr. scient. thesis J. C. Holst 1996, University of Bergen). Following a recovery during 1998 and 1999, the condition of the herring decreased again. From 2001 to 2005 the condition remained at a low level, showing very little variation.

Since 1995 the large-scale migration pattern of the herring has been mapped during two annual cruises, May and July-August (terminated in 2002). During this period the herring have been feeding most heavily in Atlantic water, and the herring condition index obtained after the feeding period in the Norwegian Sea is related to average zooplankton biomass of Atlantic water. This relationship could be improved by defining herring feeding areas more precisely, because large variations in herring migration routes and in zooplankton distribution have been observed over the years. Extreme changes in herring migration occurred during the summers 2004 and 2005 when increasing amounts of herring started to feed in the south-western Norwegian Sea, north of the Faroes and east of Iceland. At the same time we observed that increasing numbers of herring were not wintering in the fjords of northern Norway, but in the deep waters off the shelf. The herring which are still wintering inside the fjords had much better condition than the herring outside, probably due to differences in migration route and feeding conditions between the two groups of wintering herring. Since 2004 we have used the condition factor of the herring outside the fjord.

A regression of herring condition on two-month averages of the NAO indices showed that the relationship was strongest between herring condition and the NAO during the March-April period. The prediction for 2006 and 2007 based on equation (2) is 0.812, somewhat below average. The condition factor for 2004 and 2005 was calculated for the fraction of the stock wintering outside the fjords, and the predictions for 2006 and 2007 are probably valid only for the same part of the stock.

Condition (yr2) =0.021*NAO yr1 + 0.82 *(2)*
R2 = 0.44, P=0.007

Recruitment

This Section has been copied from the Ecosystem chapter of the WGNPBW report of the 2006 meeting. There was no expertise available at the 2007 to update it. References to tables and figures available in the previous report were deleted.

Predictions of the recruitment in fish stocks are essential for future harvesting of fish stocks. Traditionally, prediction methods have not included effects of climate variability. Multiple linear regression models can be used to incorporate both climate and fish parameters. Especially interesting are the cases where there exists a time lag between the predictor and response variables as this gives the opportunity to make a prediction. A model for the number of three year old recruits of Norwegian spring spawning herring using the herring 0–group log index and the NCEP skin temperature describes ~80% of the variation in the recruitment.

The model is:

$$\mathrm{Re}\,c_t = 8.3 \times skin_{t-3} + 16 \times 0group_{t-3} - 44$$

where Rec is the number (in 10^9) of 3 year old recruits of Norwegian spring spawning herring from the WGNPBW, 2003 SEASTAR assessment (ICES, 2004), skin the NCEP skin (sea surface) temperature in °C in the Norwegian Sea (64–70°N, 6°W–8°E) averaged from January to March 3 years earlier and the 0–group log index of herring larvae from the survey in the autumn 3 years earlier. The subscripts denote the time lag in years. Further details can be found in Stiansen *et al.* (2002).

The dominant variable in the model is the 0–group index, which has a correlation coefficient of 0.84 with the Recruitment (3 years later). When the model was tested on the 0–group index alone it gave an R^2 of 0.71. Still the model explained 9% more of the variability when adding the skin temperature.

The prognosis shows a steady increase in recruitment for the period 2005–2007, ending at a historic high level in 2007 (Recruits 3 years old: 2005–9.9*10^9, 2006–15.8*10^9, 2007–26.8*10^9).

Other ecosystem consideration

The food for herring is zooplankton of which *Calanus finmarchicus* is the most important. In earlier reports of this WG it was stated that the zooplankton biomass in May and herring condition in the autumn is directly related to the average NAO index for March-April of the previous year. It is likely that the changes in distribution/migration of Norwegian spring spawning herring are related to the distribution of zooplankton. However, this has not been investigated.

Norwegian spring spawning herring is a straddling stock. The juveniles and adults of this stock occur in different eco-regions. Most of the juveniles grow up in the Barents Sea where they have large impact on the ecosystem reducing capelin recruitment. At age 3 most of them migrate to the Norwegian Sea and stay there for the rest of their life.

Herring is an important source of food for different whale species. In the Norwegian Sea at least killer whales are known to know to use herring as their major source for food. They are also food for minkey whales in the Barents Sea.

Not much information is available on the impact of the herring fishery on the ecosystem. The fishery is entirely pelagic. There is little quantitative information on the bycatches in the fisheries for herring but these are thought to be small. Therefore unintended effects of the fishery on the ecosystem are probably small or absent. Since herring is a major source of food for some populations of other species, overfishing of the herring stock could affect these populations. This is presently not the case since the herring stock is very abundant and is exploited at a low rate.

3.1.3 ICES advice

In 2005 ACFM stated that "Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and being harvested sustainable. The 1998 and 1999 year classes dominate the current spawning stock which is estimated around 6.3 million t in 2005. The 2002 year class is estimated to be strong and will recruit to the fishery in 2006 and 2007. Preliminary indications show that the 2004 year class may also be strong." The management plan implies maximum catches of 732 000 t in 2006 which is expected to lead to spawning stock of 7.7 million tonnes in 2007. Further ACFM considered that the absence of an international agreement on quota allocations in the two last years had led to an escalation in the fishing mortality exerted on the stock (F2005 >Fpa), with the fisheries in 2005 probably ending close to 1 million tonnes, over 100 000 tonnes more than the TAC recommended under the long-term management plan (F=0.125).

In 2006 ACFM stated that “Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and being harvested sustainable. The estimate of the spawning stock biomass, although uncertain, is around 10.3 million t in 2006. Several good year classes contribute to the present spawning biomass: the spawning stock is now dominated by the strong 2002 year class, as well as by the 1998 and 1999 year classes and surveys indicate that recruitment from the 2003 year class is moderate, while the 2004 year class is also strong (of the order of 1998 year class). The management plan implies maximum catches of 1 280 000 t in 2007, which is expected to leave a spawning stock of 10.2 million tonnes in 2008. The target defined in the management plan is consistent with high long-term yield and has a low risk of depleting the production potential. The current long-term management plan is considered to be consistent with the precautionary approach.

3.1.4 Management

EU, Faroe Islands, Iceland, Norway, and Russia agreed in 1996 to implement a long-term management plan for Norwegian spring-spawning herring. The management plan was part of the international agreement on total quota setting and sharing of the quota during the years 1997–2002. The plan consists of the following elements:

1) Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the critical level (Blim) of 2 500 000 t.

2) For the year 2001 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of less than 0.125 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of this fishing mortality rate.

3) Should the SSB fall below a reference point of 5 000 000 t (Bpa), the fishing mortality rate, referred under Paragraph 2, shall be adapted in the light of scientific estimates of the conditions to ensure a safe and rapid recovery of the SSB to a level in excess of 5 000 000 t. The basis for such an adaptation should be at least a linear reduction in the fishing mortality rate from 0.125 at Bpa (5 000 000 t) to 0.05 Blim (2 500 000 t).

4) The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES.

ICES considers that the objectives of this agreement are consistent with the precautionary approach.

As in years 2003–2005, there was also no agreement in 2006 between the Coastal States regarding the allocation of the quota. Quotas in 2006 were set unilaterally and in some countries quota were raised during the year. The sum of the total national quotas for 2006 amounts to about 967 000 t.

For 2007, the Coastal States have agreed to set a TAC of 1.28 million tons. The TAC corresponds to the Management Plan. The shares of the Parties are 6.51% for the European Community, 5.16% for Faroes, 14.51% for Iceland, 61% for Norway and 12.82% for the Russian Federation.

3.1.5 Description and development of the fisheries

Like in earlier years the fishing pattern in 2006 followed the clockwise migration pattern of the herring. As last year, the westerly trend in the southwest area continued with more fish taken in the Icelandic zone as well as a prolonged summer fishery in the Faroese zone target the largest and oldest fish. The rich 2002 year class completely left Barents Sea and began to play the important role in a fishery in northern Norway in the autumn and winter.

The distribution of the fisheries of Norwegian spring-spawning herring by all countries in 2006 by ICES rectangles is shown in Figure 3.1.5.1 (total whole year) and in Figure 3.1.5.2 (by quarter). In 2006 the data provided as catch by rectangle represented more than 99% of the total WG catch.

Due to limitations by some countries to enter the EEZs of other countries in 2006 the fisheries do not necessarily depict the distribution of herring in the Norwegian Sea and the preferred fishing pattern of the fleets given free access to any zone.

A special feature of the summer fishery in 2005 and 2006 was the prolonged fishery in the Icelandic and Faroese zones during summer, where the oldest age groups were present (second and third quarter, Figure 3.3.2). The usual pattern previously has been that the fishery moved gradually northwards towards the Jan Mayen zone in June.

The migration pattern, together with environmental factors, was mapped in 2006 and 2007 during the ICES PGNAPES (Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys) investigations (ICES 2006/D:09 and ICES 2007/RMC:08).

3.1.5.1 Information on bycatches in the herring fishery

With the exception of the Faroes, no information was provided to the Working Group on bycatches in the fishery for herring. In 2006, the Faroese summer fishery for Norwegian spring spawning herring north of the Faroes was hampered by large amounts of mackerel present in the same area and often mixed within the herring schools in the upper layers. In order to avoid bycatches of mackerel, the fishermen moved northwards to get clean catches of herring. The reason they avoided the bycatch was the low marketing value of mackerel in the summer months, the mackerel is too soft due to its high fat content. This would prevent the usually high income they get from mackerel if the quota was taken later in year, usually in the fourth quarter. As the bycatch of mackerel was subtracted from the individual vessel quotas, thus the bycatch is a result of legal activity.

Again in 2007 the Faroese vessels had to move northwards out of the Faroese area in August due to large quantities of mackerel northeast of the Iceland-Faroe Ridge. Bycatch of mackerel in the Icelandic fishery for herring was also reported.

3.1.5.2 Denmark

The Danish fishery of Norwegian spring spawning herring in 2006 carried out by purse seiners and trawlers was 18 500 t. The fishery took place in the first quarter (12 300 t), the third quarter (3900 t) and fourth quarter (2200 t). Half of the landings were landed in Denmark (8400 t.) half in Norway (8700 t) and the test of the landings were landed at the Faroes, Iceland.

3.1.5.3 Germany

Germany reported 9957 tonnes of herring caught in 2006. No description of the fishery was given.

3.1.5.4 Faroe Islands

The Faroese quota for herring was set at 65 071 tonnes for 2006. As in summer 2005 the summer fishery in 2006 lasted for an extended period (late April to August) in the Faroese zone as well as in the Icelandic zone (Vb and IIa, to a lesser extent in Va). The catches mostly consisted of large (old) herring, however with varying proportions of the abundant 2002 year class in the catches. The usual pattern was that the fishery gradually moved northwards towards the Jan Mayen zone in June, thus they seem to use the southern area more extensively during their oceanic feeding phase.

The Faroese fishery (8 large vessels and 3 smaller vessels) started in late April in the area north of the Faroes in the Faroese EEZ (Vb and IIa) and continued in May north of the Faroes and extended north into the eastern part of the Icelandic zone. In the beginning of June there was still some small fishery in the Faroe zone close to the isles, and later in June a fishery developed in the Icelandic zone. In July the fishery continued north and northeast of the Faroes, and it should be noted that feeding herring was targeted east of the Faroes, just south of 62°N, which is usually considered as the southern most limit during their feeding migration. Later in July some vessels also targeted the herring north in the International area around 70–71°N. The fisheries continued in the northern area as well as north of the Iceland-Faroe Ridge in August. The rest of the quota was taken in the International zone around 69–71°N in September and finished in the beginning of October.

The catch method has changed since 2005 with an increasing number of vessels now pair-trawling instead of single trawling. In 2005 and 2006 about 44% and 60% of the catches were taken with pelagic pair-trawls, respectively, 48% and 35% with single pelagic trawls, respectively, and only 8% and 5% with purse seines, respectively.

3.1.5.5 Iceland

The Icelandic catch quota for Norwegian spring-spawning herring in 2006 was set at 153 800 tonnes. The Icelandic fishery began in the first week of May in the Icelandic and Faroes zone but moved gradually during the summer to the international zone in the Norwegian Sea, E and SE of Jan Mayen. In May to July, almost the entire fishery took place in the Icelandic and the Faroes waters (58 300 t), in August around one third of the total catch (32 700 t) came from the International zone, and then in September and October all of the catch (65 700 t) came from the International waters. Only 53 t were taken within the Spitsbergen zone (in August).

As in previous years, the Norwegian spring-spawning herring was mixed with the Icelandic summer-spawners in the autumn fishery east of Iceland. The estimated catch of NSSH in that fishery (750 t) was less than earlier which reflects probably much more westerly distribution of the fishery of the Icelandic summer-spawners that season.

The total catch was 157 474 tonnes of which 146 120 tonnes were caught in mid-water trawl and about 11 354 tonnes in purse-seine. A total of 25 trawlers/purse-seiners participated in the herring fishery, as compared to 30 vessels in 2005. The length range of the vessels was 55–

105 meters with a mean length of 67 meters. The engine power range of the fleet was 1325–5920 kW (1800–8051 HP) with a mean of 3125 KW (4246 HP). The average engine power has increased by almost 14% since 2004.

3.1.5.6 Ireland

The Irish fishery for NSSH began in February off the Norwegian coast. A total of 5 vessels participated in the fishery and recorded landings in the region of 4500 tonnes.

The fleet is comprised of 5 pelagic licensed trawlers with RSW tanks. NSSH from the Irish fleet is landed primarily for reduction to fishmeal and processed for human consumption. Landings were made into Norwegian ports for reduction to fishmeal and a UK port for processing.

Fishing took place in an area to the North and North-west of the port of Ålesund with good fishing reported. Mid-water trawls were used by all vessels. Fishing took place on spawning aggregations in ICES Area IIa and was concentrated on the shelf.

3.1.5.7 Netherlands

The fishery for Norwegian spring spawning herring in 2006 was conducted by 4 trawlers (6500–10 000 HP) using large pelagic trawls. In total 4 trips were made in the second half of September in ICES Division IIa.

3.1.5.8 Norway

The Norwegian fishery is carried out by many size categories of vessels. Of the total national quota approximately 50% is allocated to purse seiners, 10% to trawlers and 40% to smaller coastal purse seiners.

Due to the significant changes in the migration pattern of the herring recently, there have been large changes in the fishing patterns of the Norwegian fleet as compared to the last years, in particular during the autumn season. The main change in the distribution is related to the wintering areas. The Vestfjorden system, including Tysfjorden and Ofotfjorden, in northern Norway, have been used as wintering grounds for since the rebuilding of the stock after the recruitment of the 1983 year class. However, after the recruitment of the 1998–99 year classes the wintering also started to occur in oceanic waters off northern Norway, and this development progressed when the large 2002 year class recruited. Hence, the fishery in the Vestfjorden wintering area in recent years has mostly been based on large herring pre-dominated by the 1991–1992 year classes and partly the 1998–99 year classes. This fjord fishery has rapidly decreased, and in 2006 this trend was very evident in the fishery starting after New Year.

Only 22 523 t was caught in the fjords in Quarter 1, whereas 42 339 t was caught in the oceanic wintering area during the same period. It was apparent that the fleet was waiting for the herring to move southwards towards the spawning grounds closer to the coast, because as much as 137 787 t was taken in the spawning areas during January-February.

Traditionally the Norwegian purse seine fleet do not put in any effort during the summer, when the NSS herring is wide spread in the Norwegian Sea. This was also the case in 2006. Only 1199 t was caught during Quarter 2, and 10 615 t during Quarter 3.

It is after the summer feeding, when the herring returns towards the Norwegian coast, that the main Norwegian fishery occurs. A total of 352 644 t was caught in the wintering areas during Quarter 4, but only 63 219 t was caught in the Vestfjord system, demonstrating the importance of oceanic versus fjord wintering grounds.

Only negligible quantities (626 tonnes) were caught in the areas south of 62°N in 2005. These were not sampled. It is likely that most of these herring belonged to local fjord herring stocks but is registered as NSSH in the statistical records. The same applies to some catches taken in more northern fjords during the oceanic summer feeding period of the stock.

The total Norwegian catch in 2006 was 567 238 tonnes.

3.1.5.9 Russia

In 2006 the Russian fishery started within the shelf region of the Norwegian EEZ, in the Vesterålen area and Trena Bank (approximately 12–15°E) at the end of January and Sklina and Trena Bank (approximately 63–66°N) at the beginning of February. At the beginning of March the fishing was in progress in the southern direction. In February and March the catch was 27 912 t. In May-June the some commercial vessels conducted fishing in the international area in the Norwegian Sea. In May-June the catch was 1436 t. In July-September vessels caught herring in the international area in the Norwegian Sea, Norwegian EEZ and Faroese EEZ. In July-September the catch was 79 069 t. In October the herring fishery was finished in the Norwegian EEZ, the zone of Spitsbergen and international area. In October the catch was 12 419 t. The total Russian catch of Norwegian spring spawning was 120 836 tonnes.

The Russian fishery is carried out by many types of vessels, mainly using trawls. The entire Russian catch was utilized for human consumption.

3.1.5.10 Sweden

Sweden caught 2946 tonnes in 2006. No description of the fishery was given.

3.1.5.11 UK (Scotland)

In 2006 Scottish vessels landed around 11 900 t of herring into ports in Denmark, Norway and Scotland. All of the landings were reported in quarter 1 and were from ICES area IIa. A total of 13 boats participated in this fishery and used single and pair pelagic trawls.

3.1.5.12 Poland

No catches were taken by Poland in 2006.

3.1.5.13 France

France caught 80 tonnes in 2006. No description of the fishery was given.

3.1.5.14 UK (Northern Ireland)

UK (Northern Ireland) caught 550 tonnes in 2006. No description of the fishery was given.

3.2 Data available

This Section describes in sub-sections the available data for assessment.

The WGNPBW ToR (b) “provide as detailed information as possible on the age/size composition in different segments of the blue whiting fishery” should be considered when data are presented.

3.2.1 Catch

The total annual catches of Norwegian spring-spawning herring for the period 1972–2006 (2006 preliminary) are presented in Table 3.2.1.1 (by country).

The Working Group noted that in this fishery an unaccounted mortality caused by fishing operations and underreporting probably exists. Now it was not possible to assess the magnitude of these extra removals from the stock, and taking into account the large catches taken in recent years, the relative importance of such additional mortality is probably low. Therefore, no extra amount to account for these factors has been added in 1994 and later years. In previous years, when the stock and the quotas were much smaller, an estimated amount of fish was added to the catches.

The Working Group has no accessible data to estimate possible discards of the herring. Although discarding may occur on this stock, it is considered to be a minor problem to the assessment.

3.2.1.1 Sampling intensity

Information on the sampling intensity for the age structure and weight-at-age in the catch is provided in Table 3.2.1.1.1 and Table 3.2.1.1.2. About 93% fisheries in 2006 are covered by a biological sampling programme. The age structure of the catches provided by the Germany and Denmark for 3 and 4 quarters was presented up to a lower plus group as used in the assessment. Therefore these could not be used and an age structure for these countries has been used from other countries. The data has already been resubmitted from Denmark and will be resubmitted from the Germany to the Working Group with the full age structure next year.

Sampling intensity for age and weight of herring and blue whiting are made in proportion to landings according to CR 1639/2001 and apply to EU member states only. For other countries there are no guidelines. Current precision levels of the sampling intensity are unknown and therefore the group recommends reviewing of the sampling frequency and intensity on scientific basis and provide guidelines for sampling intensity.

3.2.2 Length and age compositions

To derive the age composition of the total international catches of Norwegian spring spawning herring in 2006 the program SALLOC (ICES 1998/ACFM:18) was used. Samples were provided from Denmark, Faroe Islands, Iceland, Norway, UK and Russia. Catch in numbers at age are computed with 15 as a plus group. In the samples from Germany and Denmark for 3 and 4 quarter the plus group was set at a lower age, so those samples were excluded. Unsampled catches were allocated to sampled ones with the knowledge of where and when the catches were taken. About 95% catches were sampled. The allocations used and the results are shown in Table 3.2.1.1.1. The most abundant year class in the catches in 2006 was the 1998 year class (24%) followed with the 1999 and 2002 year classes (23% each). Other year classes were only minor in the catches. The catch in numbers is shown in Table 3.2.2.1.

Denmark and the Netherlands resubmitted age compositions for 2005 with a complete age range. Therefore the age composition for 2005 was recalculated including the Danish and Dutch information and used in stock assessment Norwegian spring spawning herring.
Data on the combined length composition of the 2006 commercial catch by quarter of the year from the directed fisheries in the Norwegian Sea were provided by Faroe Islands, Norway, Germany, Scotland and Russia. Length composition of the herring varied from 16 to 40 cm, with 91% of fish ranging from 29–36 cm. (Table 3.2.2.2.). Length-at-age data are available from several countries. They are not used in the assessment.

3.2.3 Weight-at-age

The weight in catches in 2006 was taken from the total international weight-at-age (Table 3.2.3.1), which were produced using the computer programme SALLOC, standard ICES software. Long term trends in weight-at-age were presented in last year report (WGNPBW, 2006, Figure 3.5.5.1.). Main conclusion was in recent years the weight-at-age is at an average level with a slight increasing trend. Weight 2006 was very similar with last two year as result similar selectivity in the fleet.

Weight-at-age in the stock for 2007 (January 1st) (Table 3.2.3.2) was taken from Norwegian samples taken in the wintering areas in December 2006. In recent years the weight-at-age is at an average level with a slight decreasing trend.

Trends in weight-at-age in the stock are given in Figure 3.5.5.2 in last years report (WGNPBW, 2006). The weight-at-age of the stock from the eighties onwards for the older age groups originate from surveys carried out in the wintering areas. In the period before 1980, in the absence of observations, assumptions have been on the stock weights for most age groups. These are documented in Toresen and Østvedt (2002)[1]. In the absence of observations, weight-at-age for the younger age groups is based on expert judgement.

3.2.4 Maturity and natural mortality

Except for year class 2002, for the maturity at age in the last 10 years, in general, the same values have been used each year.

The growth rate of the 2002 year class has been higher than usually seen in large year classes of this stock. One reason for this is that a large part of the juveniles stayed in the Norwegian Sea as juveniles, favouring quicker growth than in the Barents Sea, which is the area where juveniles normally are distributed.

The proportion mature of this year class was calculated from samples collected during the surveys in the wintering area in November (before spawning) and in the Norwegian Sea in May (after spawning). The proportion of fishes in maturation stage 3 or larger (fish to spawn) in November 2005 was used as a first proxy to the proportion maturing. The proportion maturing according to these data was 0.85. The proportion in stages >5 (spent) in May was used as a proxy for the proportion having spawned. The proportion having spawned according to these data was 0.92. Based on these observations and calculations 0.9 was adopted as proportion mature of the 2002 year class at age 4. Based on this 1.0 instead of 0.9 was adopted as proportion mature of the 2002 year class at age 5. All other year classes in the later years were set at the standard 0.3 at age 4, 0.9 at age 5 and 1.0 at age 6 both in the assessment and predictions.

The Working Group judges the present values as acceptable but with potential for improvement. In its terms of reference, the Working Group was asked to investigate the maturity data available from surveys in recent years. However, the data were not made available to the Working Group and it is suggested dealing with this agenda point next year, in or prior to the Working Group.

Proportion mature at age is shown in Table 3.2.4.1.

No changes were made to the values of natural mortalities applied in the assessment, 0.9 for 0 to 2 years old, 0.15 for 3 years and older. The values M=0.9 for ages 0–2 were based on a comparison between estimates of young herring in the Barents Sea from acoustic observations and estimates of year class strength from the assessment at older age. The value of 0.9 is an

[1] Variation in abundance of Norwegian spring-spawning herring (*Clupea harengus*, Clupeidae) throughout the 20th century and the influence of climatic fluctuation. Fish and Fisheries. 2000, 1 231–256.

average over the juvenile period. The method and the rationale are explained in an earlier WG report.

3.2.5 Catch, effort and research vessel data

Eight surveys directed to Norwegian spring spawning herring have been continued and four new survey abundance indices were used in the assessment. Survey indices from past surveys for different periods were also used in assessment. The criteria for the selection of data are briefly described in the following paragraphs.

3.2.5.1 International ecosystem survey in the Nordic Seas

Background and status

The international ecosystem survey in the Nordic Seas is aimed at observing the pelagic ecosystem in the area, with particular focus on herring, blue whiting, mackerel (Norway), zooplankton and hydrography. The observations on herring and blue whiting are done by acoustic observation with main focus on Norwegian spring-spawning herring and blue whiting in the Norwegian Sea. The survey is carried out in May since 1995 by the Faroes, Iceland, Norway, and Russia, and since 1997 (except 2002 and 2003) also the EU (Denmark, Germany, Ireland, The Netherlands, Sweden and UK). The high effort in this survey with such a broad international participation allowed for broad spatial coverage as well as a relatively dense net of trawl and hydrographic stations.

Estimates in 2000–2007 are available for the total survey area (Figure 3.2.5.1). Since 2005 this survey has extended into the Barents Sea where the main focus of investigations has been young herring and capelin larvae. The survey is coordinated by PGNAPES (ICES CM 2006/RMC:08).

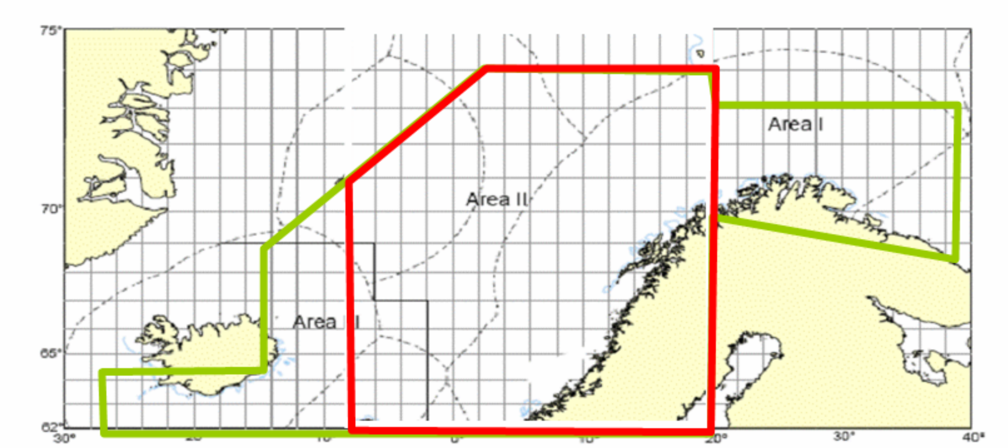


Figure 3.2.5.1. Areas defined for acoustic estimation of blue whiting and Norwegian spring spawning herring. The dark red box in the middle represents the standard area (8°W–20°E and north of 63°N) of which blue whiting data is used for assessment. The outer green box represents the total survey area used for both herring and blue whiting.

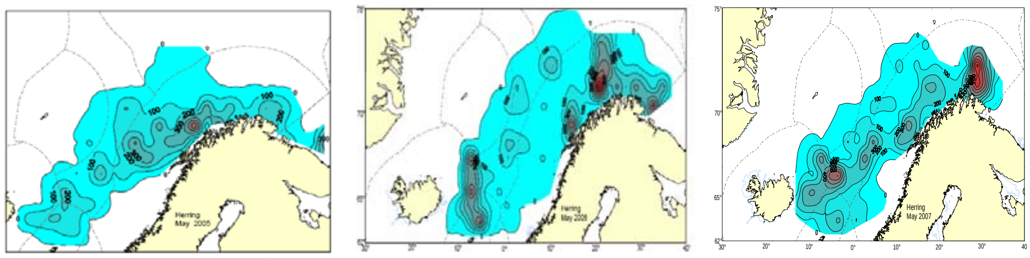
Use of this survey in stock assessment

From the area west of 20°E the age groups 3 and older are used for the assessment, whereas the Barents Sea area east of 20°E supplies the recruitment age groups 1 and 2 for the assessment. The part of the survey covering the Barents Sea has been used in the final assessment from 2005 onwards. The performance of this survey in predicting recruitment is not yet well known, as the overlap with the assessment estimate is limited and the latter in general is plagued by uncertainties that reflect scarcity of data on the most recent year classes.

However, the result is in line with the recruitment index from the Barents Sea where the index in 2006 was the lowest one since 1999.

Results for herring

Survey coverage was considered adequate in 2007 and it was a huge benefit that the Barents Sea was again included in the coverage, as this allows complete spatial coverage of the whole distribution area of the Norwegian spring spawning herring. Herring were recorded throughout most of the surveyed area as shown in Figure 3.2.5.2 Distribution was similar to that observed in 2006.



2005 **2006** **2007**

Figure 3.2.5.2. Schematic map of herring acoustic density (sA, m2/nm2) found during the survey in spring 2005, 2006 and 2007.

The recorded concentrations of herring in the central Norwegian Sea (Area II) were limited compared to the recordings in the Barents Sea and especially in the south western part (Area III) of the surveyed area. The highest values were recorded at the eastern edge of the cold waters of the East Icelandic Current. A more southern displacement is reflected in a more southern centre of gravity of the acoustic recordings in 2007 as compared to 2006 and 2005.

As in previous years there was a clear structure in size of herring throughout the area of distribution; smallest fish are found in the north eastern area, size and age were found to increase to the west and south (Figure 3.2.5.3). It was mainly older herring that appeared in the Icelandic waters, while in Faroese waters also the 2002 year class appeared in addition to the 1999 and 1998 year classes contributed equally to the biomass. Older herring (15+) were also observed in the south western area.

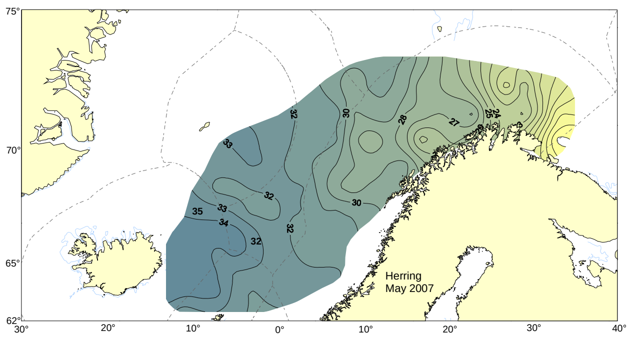


Figure 3.2.5.3. Mean lengths by area of Norwegian spring spawning herring derived from trawl samples in April-June 2007. Increasing mean length corresponds with increasing colour darkness.

Recruitment surveys in the Barents Sea have been conducted in the Norwegian and Russian Sea in May-June since 1991. In 2005 this survey became part of the ecosystem survey. No surveys were carried out in the years 2003–2004. The plan was to cover all of the relevant parts of the Barents Sea, as was done in 2005 and to include all of the immature part of the stock. Unfortunately, due to technical and administrative difficulties, the Russian EEZ could not be surveyed in May 2006. As result only the immature herring in the areas east to the Russian EEZ were covered. The estimate of young herring is therefore a definite underestimate, in particular with regard to the 2004 and 2005 year classes.

The herring were composed of the four year classes 2003, 2004, 2005 and 2006. In 2006, herring of the 2004 year class dominated (62%) in this area. This indicates a strong 2004 year class. Others year classes were less abundant overall.

The herring stock in the Norwegian Sea is now dominated by the 2002 year class and the 1999 and 1998 year classes respectively representing 20%, 25% and 25% of the total stock in weight. The high numbers (biomass) of the 2002 year class recorded this year reconfirm that this year class is very strong and has now completed its annual migration west and south to join the adult herring in their annual migration.

The age-disaggregated time-series of abundance for the Norwegian Sea is presented in Table 3.2.5.1 and for the Barents Sea in Table 3.2.5.2. Age and length distributions from the three last years in the Norwegian Sea and Barents Sea are shown in Figures 3.5.2.4 and 3.2.5.5.

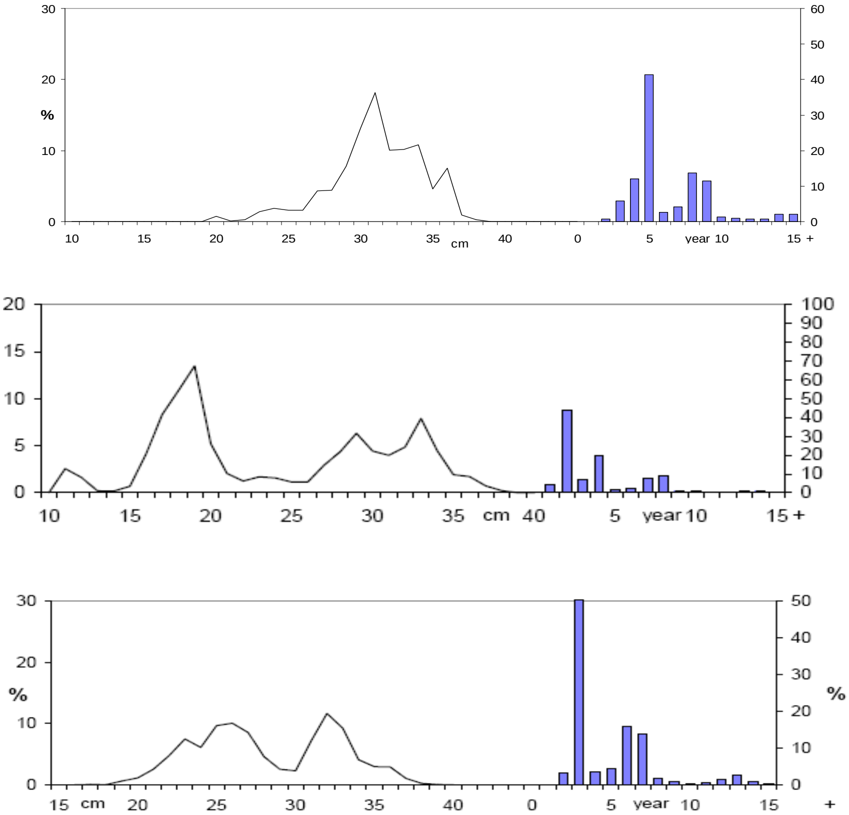


Figure 3.5.2.4. Length and age distribution of Norwegian spring spawning herring in the area in the Norwegian Sea, spring 2007 (upper panel), 2006 (middle panel) and 2005 (lower panel).

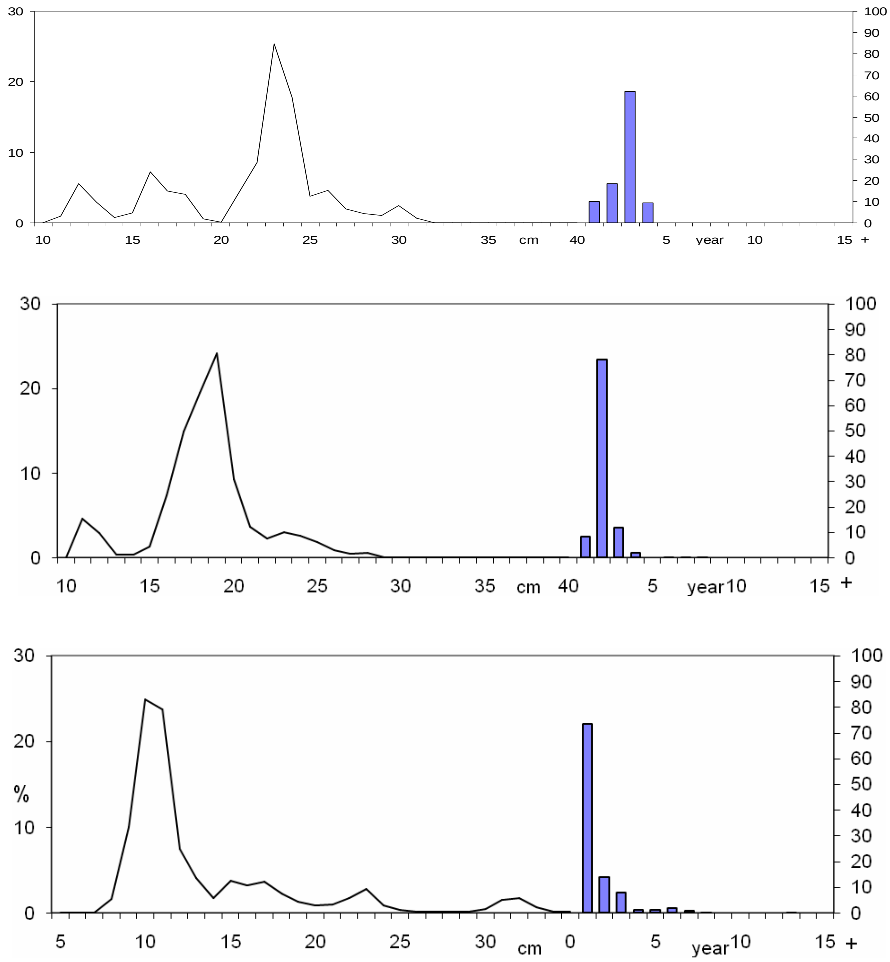


Figure 3.5.2.5. Length and age distribution of Norwegian spring spawning herring in the area in the Barents Sea, spring 2007 (upper panel), 2006 (middle panel) and 2005 (lower panel).

3.2.5.2 Norwegian acoustic survey on spawning grounds in February/March

Background and status

In 2007 a Norwegian acoustic survey was undertaken to estimate the abundance of herring in the spawning areas in February and March. The survey has been carried out since 1988 but not in every year.

Use of this survey in stock assessment

The age groups 5–15+ have been used in the assessment for the years 1994 to 2005. An estimate was not used for the 2006 and 2007 surveys in the assessment because of the incomplete coverage of the survey of the spawning grounds.

Results

Results can be found in Table 3.2.5.3 and Figure 3.5.2.6.

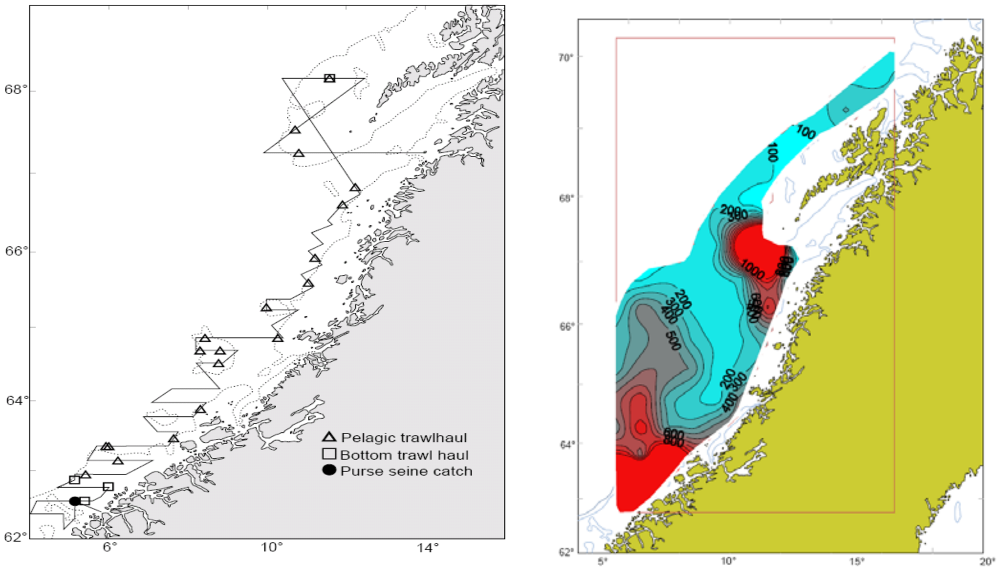


Figure 3.5.2.6. NSSH Acoustic survey on spawning grounds in February March, 2006 left and 2007 right.

3.2.5.3 Norwegian acoustic survey in November/December

Background and status

The survey is carried out by Norway since 1992 in the Norwegian fjords where the adult herring winter. Since 2004 also the Norwegian coast is included in the survey to take account of changes in the wintering area.

Use of this survey in stock assessment

Given the large changes in the wintering pattern of herring and the possibility of a third and undescribed wintering area, it was decided not to use this survey for the period following the new wintering pattern of the herring in the assessment. The survey should be reintroduced, possibly as a new survey index in the assessment, as soon as possible after the new wintering pattern of the herring has been described and accounted for in the survey strategy.

For this reason the surveys from 2003–2006 were not used in the assessment. The age groups 4–15+ for the other years are used in the assessment.

Results

In 2007 the RV G. O.Sars carried out an acoustic survey in the fjordic and oceanic wintering area in northern Norway (Figure 3.5.2.7). The results of this survey are shown in Table 3.2.5.4. This survey covers the known wintering area of the mature part of the stock.

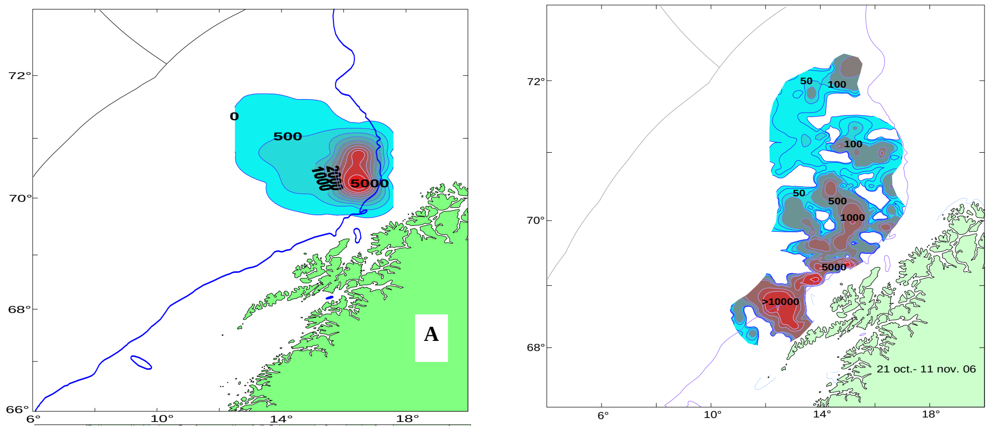


Figure 3.5.2.7. NSSH Acoustic survey in November/December 2005 (left panel here) and 2006 (right panel).

The survey has shown a strong negative trend in the development of the 1998 and 1999 year classes since 2003. The decrease of these year classes is far outside the range seen in other surveys later in the year and is not considered to be reflecting the abundance.

3.2.5.4 Norwegian acoustic survey in January

Background and status

This survey was carried out by Norway in the fjord in the period 1991–1999.

Use of this survey in stock assessment

Although the survey series has ended, the data are still used in the assessment. The age groups 5–15+ from 1991 to 1999 are currently used.

Results

The results of the survey in the wintering area in January can be found in Table 3.2.5.5.

3.2.5.5 Joined Russian-Norwegian ecosystem autumn survey in the Barents Sea

Background and status

The survey consists of a trawl survey catching 0–group herring amongst other species and an acoustic survey estimating one and two year old herring. In 2001, the Working Group decided to include data on immature herring obtained during the Russian-Norwegian survey in August-October in estimating the younger year classes in the Barents Sea.

Use of this survey in stock assessment

The age groups 1 and 2 are used in the assessment. The log index of 0–group herring has been used in the assessment up to 2004 and then replaced by a new abundance index, which was included in the assessment since 2006.

Results

The results from these surveys on 0–group herring are given in Table 3.2.5.7; those of the 1 to 3 age groups are given in Table 3.2.5.8. The youngest age groups (0+ to 3+) of the Norwegian spring spawning herring stock are found in the Barents Sea at irregular intervals. It is difficult to access the stock size during autumn, due to various reasons. The age groups 1 to 3 are found mixed with 0–group herring and are difficult to catch in the sampling trawl used in this survey. The stock size estimates of herring are therefore considered less reliable than those for capelin and polar cod. The distribution of young herring is shown in Figure 3.5.2.8. Distribution of 0–group herring is presented in Figure 3.5.2.9.

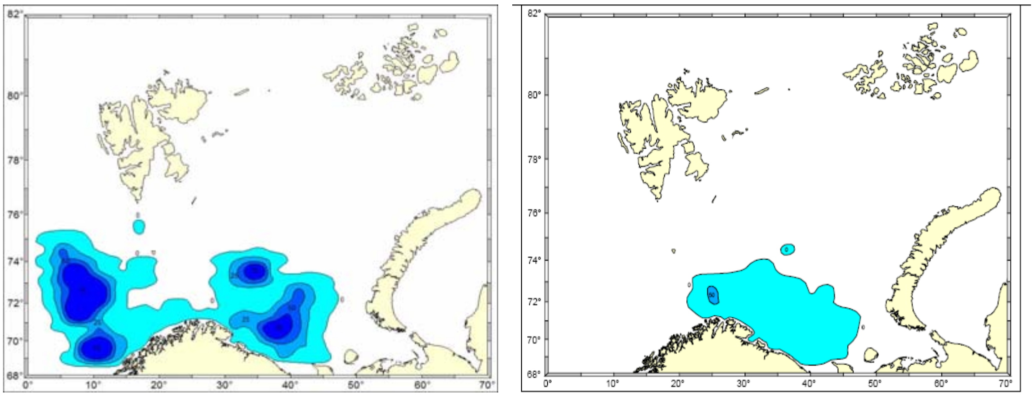


Figure 3.5.2.8. Estimated total density of herring (tonnes/nautical mile²) in August-October 2005 (left panel) and 2006 (right panel).

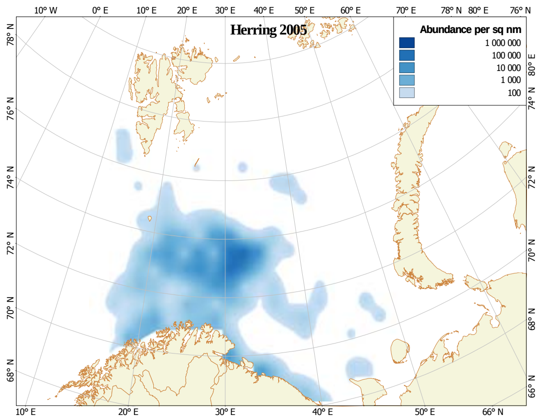


Figure 3.5.2.9. NSSH O–group surveys in August/September in the Barents Sea.

3.2.5.6 Norwegian herring larvae survey on the Norwegian shelf

Background and status

A Norwegian herring larvae survey has been carried out on the Norwegian shelf since 1981 during March-April. The objectives of the survey are to map the distribution of herring larvae and other fish larvae on the Norwegian shelf and to collect data on hydrography, nutrients, chlorophyll and zooplankton. The larval indices are used as indicator of the size of the spawning stock. Two indices are available from this survey (Table 3.2.5.9).

Use of this survey in stock assessment

The "Index 1" is used in the assessment as representative for the size of the spawning stock.

Results

In 2007 the survey was carried out from 28 March to 7 April. Severe weather conditions during the survey significantly impacted the results. At times, the weather was too bad to conduct sampling operations and the vessel had to dock for five days waiting for better conditions. Therefore, there was not time enough to cover the whole area and the survey which normally covers the shelf from Møre to Tromsø had to end just north of Sklinnabanken. Hence, the total distribution of herring larvae was not covered. Due to the reduced coverage, the herring larvae distribution was not covered completely. The spawning stock survey which was conducted in February/March found relatively high concentrations of spawning herring north of the area covered on the larval survey. Because of that, the larvae index calculated here is not representative for the total larvae abundance, but only for the area from 62°N to 66°N. The index was therefore an underestimate of the larval abundance along the coast. The index, however, was still high ($93.8*10^{12}$) and the second highest in the time-series. Most of the larvae were in early first feeding stages and few older larvae were found. High concentrations of herring larvae were observed at the Møre spawning grounds. On one station in this area more than 30 000 larvae per square meter surface was observed, indicating that the spawning had been successful at the traditional spawning grounds.

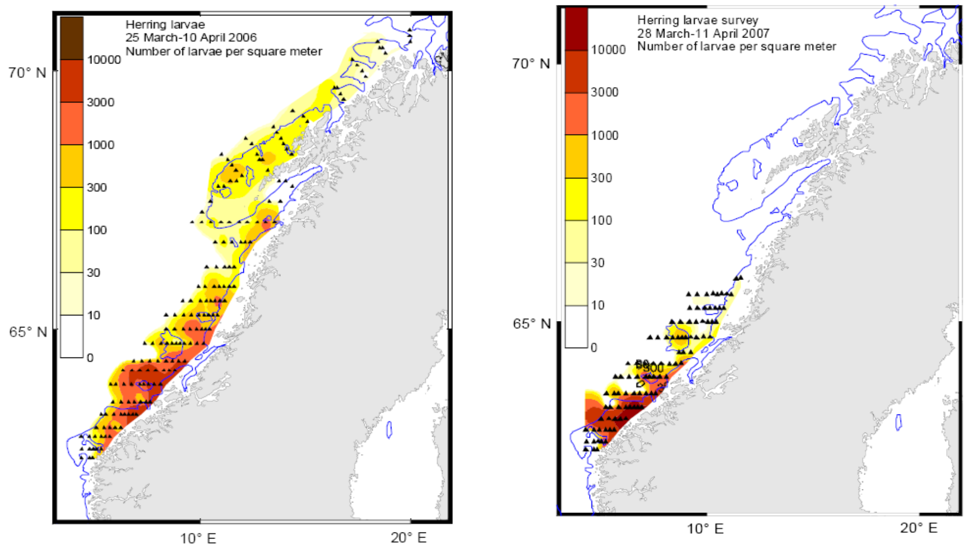


Figure 3.2.5.10. NSSH. Distribution of herring larvae on the Norwegian shelf in 2006 (left panel) and 2007 (right panel). The 200 m depth line is also shown.

3.2.5.7 Norwegian tagging data

Background and status

With the exception of 1999, 2001 and 2005, tagging has been carried out annually since 1975. Recovery of tags from supervised detector plants has continued, as well as recovery from the standard magnets in the production line of fish processing plants and from individuals. For stock assessment purposes, tags are only used from supervised detector plants where detector efficiency has been tested, and where it is known that the detectors have been working as intended. Three factories filled these criteria in 2005, and a total of 68.2 million herring were screened in these factories.

Use of this survey in stock assessment

The use of the tagging data was discontinued in the assessment since 2006 due to a low number of recaptures. This comes as a result of too low tag density in the stock given the high stock size and amount of fish screened. It should be mentioned that the removal of 2 tags in the exploratory assessment runs made in 2006 changed the size of the spawning stock with approximately 2 million tonnes. In exploratory runs made in 2007 in- or exclusion of tagging information in the assessment resulted in absurd results (see Section 3.3.3).

Results

The tables with tagging data are presented in the appendix of this report.

3.3 Data analyses

In former years a number of models, SeaStar, ISVPA. TISVPA and Adapt were used to assess the stock. This year only SeaStar and TISVPA were used. This was mainly because of the available expertise at the meeting and the available time. In addition, depletion of year class cohorts in surveys and catch data were investigated through catch curves.

3.3.1 Reviews of last year's assessment

Last year, the reviewer of the assessment encouraged the WG to explore how the tagging data could be used in future assessments, given change in fishing pattern. In exploratory runs the WG explored the use of tagging data in SeaStar. Several periods of tagging data were included in the assessment. In all cases this lead to absurd results. The assessment appeared very sensitive to the tagging information. In the explored examples inclusion of tagging data lead to estimates of the SBB two to four times higher than without.

The reviewers noted that the WG changed the fraction of F and M before spawning from 0.1 to 0 when assessing the SSB but these changes were not implemented in the projections. Taking into account that both fishing and natural mortality of mature component are low at present this will have only small impact on recent SSB estimates (ca 2%), but it introduces inconsistencies. So during Review Group, the SSBs from stock summaries were corrected by calculating them at spawning time (as in previous years 10% of F and M before spawning was assumed). Of course, the WG is free to calculate SSB at 1 January in next years, but that should be accompanied by projections with the same parameters and appropriate recalculation of biomass reference points. This year, all estimates of the SSB in the report refer to January 1st.

Again trends in fishing mortality and SBB indicated in the final assessment were consistent with previous years. Also again SSB values were higher than in the previous years. The main reason may be the low rate of depletion of year class cohorts in the international survey on the feeding grounds. This survey is has a big impact on the assessment. Also the year class cohorts in the catch-at-age data show slow depletion. This leads to very low estimates of fishing mortality. It should be noted here that, in the exploratory runs, the SeaStar assessment was only sensitive to the use of tagging data. Inclusion or exclusion of different surveys in the assessment had very minor effects.

3.3.2 Evaluation of data underlying the assessment

Catches

Figure 3.3.2.1. shows age disaggregated catch in numbers of Norwegian spring spawning herring plotted on a log scale. For comparison lines corresponding to Z=0.4 are drawn. How to interpret such curves is difficult. Gradually increasing fishing effort makes the slopes lower than the real value of Z. Assuming that the fishing effort has being relatively constant in recent years then the figure indicates that year class 1991 has been decreasing in numbers at a rate close to Z=0.4, but year class 1992 at lower rate than 0.4, but both of them disappeared in 2006 (being 15 and 14 years old) at larger rate. Using the same logic of relatively constant effort then the figure indicates that year classes 1998 and 1999 are still not fully recruited to the fishery. It can also be said that year classes 1992 to 1997 have been disappearing from the catches at a lower rate than 0.4 since the year 2002. From this figure nothing can though be said about year classes 2000 and younger. The difference in the pattern of the year classes 1992 and older and pattern seen in year classes 1993 and younger is striking.

Surveys

Similar figures were also made for age disaggregated abundance indices from the acoustic surveys, see Figures 3.3.2.2–3.3.2.5. Only few points are available for each year class in the spawning survey in February-March (Figure 3.3.2.5), but the last two points for year classes 1991 and younger show a huge drop, which support the conclusion that the survey has not covered the whole stock. The survey seems though to be measuring more this year than last year. Figure 3.3.2.3 shows the indices from the acoustic survey in the wintering areas in November-December. It indicates that the 1991 and 1992 year classes have been disappearing at a rate close to Z of 0.4. Eye-catching are the low values for the 1998 and 1999 year classes at age 4 and 3 correspondingly in 2002. These are due to the fact that in 2002 these year classes did not winter in the Fjord system as the older part of the stock did, but resided outside in the ocean and were not covered by this survey. Even though the surveys in 2004 and 2005 indicate that the 1998 and 1999 year classes are disappearing at a rate much higher than 0.4 then another message is seen if one looks at a longer period. Then it can be said that these year classes are still recruiting to the survey. In the last year's survey on the wintering area (2006) then the year classes 1994, 1996 and 1997 are disappearing at high rate, which is neither seen in the catches nor in the survey on the feeding grounds. In Figure 3.3.2.4 the indices from the survey in the wintering areas in January are shown. This survey has not been conducted since 1999. The age disaggregated abundance indices from the international survey in the feeding area are shown in Figure 3.3.2.5. At large they tell a similar story as is drawn from the catches that is the older year classes (1992 and older) are disappearing after a very different pattern than the younger ones (1993 and younger).

3.3.3 Data exploration with SeaStar

SeaStar is maximum likelihood based, i.e. the probability of the observations is calculated using assumed error distributions where uncertainty parameters are estimated. There is thus no exogenous weighting of data sources. The Norwegian spring spawning herring stock exhibits recruitment fluctuations over 3 orders of magnitude, and the weakest year classes may be represented in a survey with only a few scale readings, which invalidates common error distributions like the log-normal and gamma. For this reason, the weakest year classes are excluded from the tuning, and are determined by interpolating the terminal F-values between year classes that are estimated. For year classes younger than the youngest estimated, the terminal F-values are linearly interpolated down to 0.0 at age -1. The information on juvenile herring in the Barents Sea is considered more uncertain than the information from surveys in the Norwegian Sea and along the Norwegian coast. Therefore the estimation is done in two stages. First, the terminal F-values for the oldest year classes are estimated using the latter information sources. Next, these F-values are fixed and the terminal F-values for the youngest year classes are estimated using information from the Barents Sea. In SeaStar the catches are not modeled, so a possible signal of year class strength from the catches is not utilized. The reason for this is that strong year classes emerging from the Barents Sea may affect the fishing pattern in an unpredictable way. The choice of error distributions, the year classes for which to estimate the terminal F and the year classes that are estimated from Barents Sea information, are subjective elements in the method.

SeaStar was run with the same settings as applied last year, see Table 3.3.3.1, except that the 0–group index has been revised (WD by Eriksen, Prozorkevitch and Dingsør) and the 2005 year class has been included among those estimated from Barents Sea data.

The data used are:

INFORMATION	SURVEY NUMBER	YEARS USED	AGES USED IN THE ASSESSMENT	OUTLIERS EXCLUDED
Spawning grounds along the Norwegian coast	1	1994–2005		
Except 2001–2004	5 and older			
Wintering areas in November/December	2	1992–2002	4 and older	1998 year class in 2002
Wintering areas in January	3	1991–1999	5 and older	
Juvenile herring in the Barents Sea in May/June	4	1990–2007	1 and 2	1999 year class in 2000
Feeding grounds in the Norwegian Sea	5	1996–2007	3 and older	
Juvenile herring in the Barents Sea in September	6	1990–2006		
Except 2002	1 and 2			
Larval survey		1981–2007		
Except 2003				
Zerogroup survey in the Barents Sea		1980–2006		

Problems connected to the use of tag data encountered at the 2006 WG meeting persisted also at the 2007 meeting. Initial exploratory runs showed that the influence form the tagging data also this year was opposite to what has earlier been the case, and the tagging data drove the stock beyond reasonable limits (30–40 million tonnes). No intersessional work on the tagging data hade been performed apart from updates of the data. The WG was not able to reveal the cause of the erratic influence from tags and decided to not use the tagging data also this year.

Exploratory runs

Given the fact that surveys carried out by Norway have not covered the entire herring stock in the wintering areas and spawning grounds in recent years, the Working Group made an *a priori* decision to exclude the data from these years from the assessment. The configuration of last year's final assessment was the basis for exploration this year.

With respect to the SPALY run (same procedure as last year), the following deviations were explored:

- The larval series was left out. Due to poor weather conditions the larvae survey in 2007 had not been completed. Although the largest part of the distribution area had been covered, significant parts were not and the estimate of larvae production is an underestimate.
- The 2006 estimate in the November/December survey was retained. This year, almost all of the stock wintered outside the fjords and was probably mostly covered by the survey in 2006. However, it was argued that the catchability of the survey may have changes when it moved from the fjords to off the coast in the ocean off Vesterålen/Tromsø.
- The effect of excluding the 0–group information from the Barents Sea surveys was investigated.

The biomass in 2007 for these exploratory runs is shown in the text table below:

RUN	SSB IN ASSESSMENT YEAR
SPALY and also final	12.35
excluding larvae survey	11.66
including winter 2006 survey	11.24
excluding 0–group survey in Barents Sea	12.43
The difference between the runs is small.	

The age distribution of the stock in 2007 is very similar in the exploratory runs and is shown in Figure 3.3.3.1. Figure 3.3.3.2 shows the spawning biomass time-series and Figure 3.3.3.3 shows the population weighted F time-series.

Survey fits

Figures 3.3.3.4–3.3.3.9 show the fit between the VPA in the SPALY run and the acoustic surveys for the year classes for which the terminal F is estimated as free parameters in the tuning. Overall, the trend in the model fits the survey data well. Important exceptions are the 1998, 1999 and 2002 year classes in the survey on the feeding grounds in May-June (survey 5). It seems like the 1998 and 1999 year classes recruited fully to the survey at a later age than the other year classes used in the tuning. Both these year classes have a marked drop from 2004 to 2005. However, in later years neither of these year classes shows a decreasing trend. The 2002 year class is included with only 3 points, without any trend. In the tuning process the slow decrease of these year classes is met by increasing the terminal numbers (reducing the effect of the catches), thus lifting the assessment of these year classes and through the effect on the catchability also for other year classes in the tuning. The effect of the 1998 and 1999 year classes cannot explain the higher assessment this year as compared to last year's assessment, as removal of these year classes from this survey increased the perceived spawning stock in 2007 slightly to 13.2 million tonnes. Inclusion of the 2007 data point for the 2002 year class, however, has a dramatic effect. Without the last data point this year class exhibits a slightly more than normal decrease in the survey. Removing this data point reduced the perceived spawning stock to 11.7, a reduction of about 0.5 million tonnes from this single data point. Removing this year class from the year classes that are estimated in stage 1 and letting this year class be determined by Barents Sea data only, reduced the perceived spawning stock to 8.6 million tonnes. The 2002 year class is without doubt stronger than perceived from the Barents Sea information, but its irregular recruitment to the feeding ground survey poses problems for the assessment.

It is also seen that some of the year classes seem to recruit to the surveys at a later age than assumed in the model, the most striking example being the year class 1991 in the survey on the wintering grounds.

The fit to the two surveys in the Barents Sea (Surveys 4 and 6) seems to be less good with the 1992 and 1998 year classes as underestimates in survey 4 and the 2002 year class as an underestimate in Survey 6.

Figure 3.3.3.10 shows the fit to the larval data, where the trend seems to have been captured by the model. Figure 3.3.3.11 shows the fit to the 0–group data where the general trend also is captured by the model, but the year to year fit seems rather poor, especially for the 1996, 1997 and 2002 year classes. Figures 3.3.3.12 and 3.3.3.13 shows the quantile-quantile plots for Surveys 1, 2, 3 and 5 and Surveys 4 and 6, respectively. The survey points should fall along a straight line and the points from different surveys should intermix well along the line if the assumption about the error structure is met by the data. This is achieved for the surveys used in the stage 1 estimation (Figure 3.3.3.12) and less well for the Barents Sea data.

3.3.4 Data exploration with TISVPA

This year the same version of the ISVPA model named Triple Instantaneous Separable VPA (or TISVPA), which was first presented to the Working Group in 2006, was applied. The model can represent fishing mortality coefficients (more precisely-exploitation rates) as a product of three parameters: f(year)*s(age)*g(cohort). The purpose is to better reflect in the selection pattern possible systematic effects of higher or lower availability to fishery of different year classes (generations). Such an effect can originate from changes in spatial distribution of very abundant or poor generations, from higher attitude to fish more abundant schools composed of species from more abundant generations, or caused by any other reasons, like errors in aging, etc.

In the model the generation-dependent g-factors can be applied not to all age groups, but to some age “window”. This helps (1) to be closer to real situations (when it is known that only some range of age groups have peculiarities in their distribution) and (2) to diminish the influence of age groups having data of lower quality (usually-youngest and oldest ages). As in the last year assessment, the age range for estimation (and application) of g-factors, giving in preliminary experiments the best fit, was stated as from 4 to 8.

The main model settings were used the same as before: the catch-controlled version of the ISVPA with constraint of unbiased model approximation of logarithmic catch-at-age.

For the first run the same settings of measures of closeness of fit for components of the model loss function (for catch-at-age and for 6 surveys) as in the assessment in 2006 were used (TISVPA SPALY run). Unfortunately some of components now revealed no clear minima (Figure 3.3.4.1.). The numbering of the surveys corresponds to numbering is the SeaStar assessments. This may be explained by the change in informational situation from year to year, which implies the necessity to find the better choice of most informative and robust measure of closeness for each source of data. Figure 3.3.4.2 illustrates this procedure. The simplest loss functions-sum of squared residuals in logarithmic catch-at-age and abundance-at-age (the first column on the Figure 3.3.4.2) reveals good minima only for 3 data sources-Surveys 1, 2 and 5. For Survey 5 (feeding areas in May) it is not surprising, because it is the most representative survey with respect to the stock. If to change the traditional sum of squared residuals to such more robust measure as the absolute median deviation (AMD), which is able to diminish the influence of outliers in the data, better minima (at least local, but which is more or less in line with the others) appears also for catch-at-age and for Surveys 3 and 4 (see second column of the Figure). But Survey 6 still reveals no signal about the “best” stock size estimate. The third column of the Figure represents the profiles of loss functions for surveys when the closeness of fit is now measured not in abundance estimates, but in age proportions. The measure is classic sum of squared residuals in logarithmic data. The change to fit to age proportions may help in situations when surveys may have very different effective catchability from year to year. And this approach really helped to get distinct minima and in reasonable place for Survey 3 (Column 3 of the Figure 3.3.4.2.) So, for the TISVPA run the following loss functions were chosen: absolute median deviation of logarithmic catches-for catch-at-age data; sum of squared residuals in logarithmic abundance estimates-for Surveys 1, 2 and 5; absolute median deviation for Surveys 3 and 4, and sum of squared residuals in logarithmic age proportions for Survey 6.

The TISVPA run with these settings gave the profiles of the components and the total loss function, shown on Figure 3.3.4.3. Figure 3.3.4.4 compares the results of this run to the results of the TISVPA SPALY run and the results of the TISVPA model obtained last year. As it can be seen, the results are in good agreement with the last year result, also it can be seen that the results obtained with best settings are very close to the results of the SPALY run-despite of difference in the measures of closeness fit for some surveys and the shape profiles of the loss functions. It may be explained by domination of the signals form catch-at-age, Surveys 1 and

5 in the SPALY run (in the final run other sources are giving signals more or less similar to Surveys 1 and 5 and catch-at-age).

As it can be concluded, most of the data sources contain similar information about the stock size, but with different level of noise (for some of them it is high enough to require application of robust approaches); some data may have strongly different representation for different years and may require some special things, like tuning on age proportion instead of tuning on abundance-at-age.

Figure 3.3.4.5 represents the model residuals in logarithmic catch-at-age and in surveys. Figure 3.3.4.6 represents the results of retrospective runs. Figure 3.3.4.7 represents the results of bootstrap. Results of NSS herring stock assessment by means of TISVPA are given in Tables 3.3.4.1–3.3.4.3.

3.3.5 Comparison of results of different assessments

The results of the TISVPA and SeaStar SPALY assessment are compared in Figure 3.3.5.1. The trends in SSB and fishing mortality in both assessments are the same. Like last year, the estimates of SSB in recent years of TISVPA are somewhat lower and the estimates for fishing mortality are somewhat higher than in the SearStar assessment. Both assessment models estimate the stock in recent years higher compared to last year.

3.4 Final assessment

The procedure adopted by the Working for selecting the final assessment, was the final assessment of last year updated with one year of extra information. Examination of other configurations of this assessment or alternative assessments gave no reasons for deviation from this assessment this year. So the SeaStar assessment using the same sources of information as last year was selected as the final assessment. Also in the previous 5 years, a SeaStar assessment was selected as the final assessment of the Working Group.

The settings for the final run for the preferred model are described in Section 3.3.3.

The results of the assessment are presented in Tables 3.4.1 (stock in numbers) and 3.4.2 (fishing mortality) and Figure 3.4.1. Table 3.4.3 is the summary table of the assessment.

The assessment indicates that the fishing mortality in recent years has declined and is estimated around 0.10. A number of large year classes have appeared in recent years of which two year classes 2002 and 2004 will fully recruit in the spawning stock and in the fisheries in the coming years. The estimate of the 2004 year class remains uncertain but the available information indicate this is a strong year class. As a result of these large year classes, in particular those born in 1998 and 1999, and the low fishing mortality, the SSB has increased in recent years and is estimated near 12 million tonnes in 2006.

3.4.1 Comparison with last year

Figure 3.4.1.1 shows the results of the present assessment compared with those made in the previous two years. The estimates of fishing mortality are almost the same as last year. The estimates of SSB in the present assessment are higher, probably caused by the abnormal perception of the recent strong year classes from the survey on the feeding grounds, which show virtually no decline in cohorts in recent years.

3.4.2 Retrospective analysis

Implementing the subjective element of choosing which year classes to be estimated with the terminal F as a free parameter and which year classes to be entered into the likelihood function is not straight forward. In previous years this has been done on an ad hoc basis, guided by which year classes actually have been used earlier. This year the following algorithm has been implemented, consistent with the selection made at this year's assessment:

- The medium to strong year classes (the same in all runs) older than 3 years in the assessment year were selected to have free terminal F-values in stage 1. These year classes also were used in the likelihood function in stage 1.
- All younger year classes older than 1 year in the assessment year were selected to have free terminal F-values in stage 2. These year classes were used in addition to the former in the likelihood function in stage 2.

Figure 3.4.2.1 shows the result of the retrospective analysis. There is considerable variation the last 5 years, but with no consistent trend. Runs started in 2001 and earlier fall into a separate group with higher assessments. In these runs the 1998 year class is not estimated in stage 1.

3.5 Historic stock trends

The trends indicated by the assessment are presented in Table 3.4.3 and Figure 3.4.1.

The fishing mortality in the past 20 years has been relatively stable and has been very low in recent years. In the years 2003–2006, it is estimated around 0.10. This is below the target fishing mortality agreed in the management plan. In the historic period the very high fishing mortalities up to 3.5 have been observed which are associated with a collapse of the stock.

A number of large year classes have appeared in recent years of which two year classes 2002 and 2004 will fully recruit in the spawning stock and in the fisheries in the coming years. The estimate of the 2004 year class is still uncertain but all available information indicates this is also a strong year class. In general, it can be observed that the productivity in the stock in the last 20 years has increased by producing more frequently above average and strong year classes.

As a result of these large year classes, in particular those born in 1998, 1999 and 2002, and the low fishing mortality, the SSB has increased in recent years and is estimated at around 12 million tonnes in 2006. This is the highest SSB since the beginning of the fifties.

3.6 Recruitment estimates

Recruitment in this stock shows large annual variation and also periods with very low or abundant production. Presently the stock appears to be in a productive period. In the last 10 years a number of abundant year classes have occurred. Information from the surveys and catches indicate that the 2002 and 2004 year classes are (very strong) year classes.

In the period over which the assessment was carried out (1950–2005) recruitment varied between 0.077 and 302 billion 1–year olds. The average recruitment at age 1 in this period was 43 (AM) or 11 (GM) 1–year old. The average recruitment in the last 20 years (recent period 1986–2005) was 68 (AM) or 35 (GM) 1–year olds.

2002 year class: Except for the 0–group surveys in the Norwegian Sea and Barents Sea, the indices of this year class are the highest or amongst the highest in all surveys. The estimate from the SeaStar assessment of this year class is 182 billion at age 1 and was accepted by the Working Group. The estimate is higher than last year when it was estimated at 145 billion at age 1.

2003 year class: The estimate of this year class in the present assessment of 96 billion at age 1 is well above average. The 0–group survey in Norwegian coastal waters indicates this year class as the most abundant in the time-series. However, subsequent surveys indicate this year class as a moderate to average year class. The estimate from the assessment was replaced by the Working Group with GM mean recruitment of the recent period (35 billion 1–year olds).

2004 year class: This is a very abundant year class. O–group surveys estimate this year class as very abundant. In the Barents Sea it was very abundant as 1– and 2–year old. In the Norwegian Sea, it is not fully recruited yet. The estimate in the assessment was 225 million 1–year olds and is the 2nd highest in the time-series and remains uncertain. This estimate was replaced by the Working Group with 135 billion at age 1, similar as the large 1998 year class.

2005 year class: For this year class only survey observations are available at age 0 and 1 and 2. The indices of this year class are near or below the average of the time-series. The estimation of this year class has no impact on the forecast. The year class has not been estimated by the Working Group.

2006 year class: For this year class only a few observations are available from surveys at age 0 and 1. The indices of this year class are near or below the average of the time-series. The estimation of this year class has no impact on the forecast. The year class has not been estimated by the Working Group.

3.7 Short-term forecasts

The input values for the forecast are given in Table 3.7.1. The exploitation pattern in the forecast was taken as the average of the last 3 years (2004–2006). For the weight-at-age in the stock, the values for 2007 were obtained from the winter surveys (Table 3.2.3.2). For the other years the average of the last 3 years were taken. For catch weight-at-age the average of the last 3 years were taken. Except for the 2002 year class at age 5 in 2007 the standard values for maturity-at-age have been taken in all years. The numbers in the stock in 2007 of year classes 2003 and 2204 have been replaced as a consequence of the revision of the recruit estimates (see Chapter 3.6). As a consequence of the change made to the 2003 year class, (which contributes to the SSB from age 4 onwards, the estimate of SSB in 2007 in the prediction table is slightly lower than in the output table from the assessment (Table 3.4.3) where this revision was not implemented.

The Management Option Table with the results of the forecast is presented in Table 3.7.2. Assuming that the TAC of 1 280 000 tonnes is taken in 2007, it is expected that the SSB will remain near 12 million tonnes in 2008. The TAC in 2008, corresponding with the fishing mortality of 0.l25 in the agreed Management Plan, is 1 266 000 tonnes. The expected SSB in 2009 remains near to 12 million tonnes.

3.8 Medium-term forecasts

No medium-terms forecasts were carried out.

3.9 Biological reference points

3.9.1 Precautionary and limit reference points:

The reference points for herring were considered by the Workshop on Limit and Target Reference Points (WKREF) held in Gdynia earlier this year. Although it was the intention to review and update the biological basis of limit reference point taking into account the possible effects of species interactions and regime shifts, this has not been done because of lack of data. Instead, the breakpoint of a segmented regression applied to the stock recruitment plot was investigated. This breakpoint gives an indication at which SSB recruitment starts to decline and is a candidate for B_{lim}. The breakpoint in the stock recruit data from the 2002 assessment was estimated slightly above 2 million t. This is close to the present B_{lim}. Based on the most recent available assessment (from the 2006 WGNPBW meeting[2]) the breakpoint was estimated close to 4 million t. It appeared that the large change in breakpoint was not caused by including information of new data points but to revisions of a few points from older years close to the origin of the S/R plot.

WKREF could not explain the sensitivity of the break point to the very small changes in the position of a few points in the S/R plot close to the origin and considered this behaviour of the model highly undesirable. WKREF decided to ask the Methods Working Group to investigate this observation further. Given this, the use of segmented regression technique to establish a limit biomass reference point for Norwegian spring spawning herring was not considered appropriate until the observed methodological issue has been resolved.

The presently used values originate from an analysis carried out in 1998.

	ICES CONSIDERS THAT:	ICES PROPOSED THAT:
Precautionary Approach reference points	**B_{lim} is 2.5 million t**	**B_{pa} be set at 5.0 million t**
	F_{lim} is not considered relevant for this stock	**F_{pa} be set at F = 0.15**

Technical basis:

B_{lim}: MBAL	B_{pa}: =<B>B<B\>$_{lim}$ * exp(0.4*1.645) (ICES Study Group 1998)
F_{lim}:	F_{pa}: ICES Study Group 1998

3.9.2 Fmax and F

The Working Group attempted to estimate Fmax and F0.1. This was not possible with existing software since mean fishing mortality in this stock is calculated weighted over stock number and the available software does not have these facilities. The input data for the Y/R calculation are shown in Table 3.9.2.1. The Yield per Recruit curve is shown in Figure 3.9.1. Fmax is undefined. F0.1 is estimated at 0.27.

3.9.3 Target reference points

The Coastal States have agreed a target reference point defined at F=0.125. (Note that the average fishing mortality is calculated as a weighted mean over the age groups 5–14 (weighted over abundance).

[2] ICES 2006. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group [WGNPBW], ices Headquarters Copenhagen 24–30 August 2006, ICES CM 2007/ACFM:34.

3.10 Quality of the assessment

A comparison of the final assessment with previous assessments is given in Section 3.4.1. There is little doubt that the stock is presently at a high level and that fishing mortality is low. All data sources point to that conclusion. The actual estimates of SSB and F, however, remain uncertain. The last 3 years show a successive upgrading of SSB estimates. The signals in the catch data and survey data suggest slow depletion of the year classes which are present in the catch. This may be an artefact caused by several factors such as immigration of fish from the Barents Sea to the Norwegian Sea or the observed changes in the distribution of herring in the Norwegian Sea in combination with survey design. Surveys on the wintering stock and spawning stock in recent years and herring larvae survey have not always covered the entire stock. The assessment relies mostly on survey data.

The situation does not differ from last year. Last year, it was said that the results of the assessment appear to be not very sensitive to the choice of the assessment model. The assessment appears to be more sensitive to the choice of the data used. Many sources of information are available which have contributed to the assessments in the past. The assessment carried out last year appeared to be in particular sensitive to:

- use of tagging data;
- exclusion of recent years in winter survey;
- uncertainty in maturity parameters.

Returns of tagging programmes are relatively low. The low number of returns suggest that the stock is large but may be also be affected by changes in the distribution of herring relative to the fisheries which are sampled for tags. The change in the wintering areas has caused that surveys on the wintering stock have not covered the whole stock in previous years. Including these in the assessment would lead to underestimation of the stock. However, it is thought that this was not the case with the most recent survey. The maturity parameters have not been evaluated due to the fact that the data were not available to the Working Group.

The sensitivity of the assessment to the other surveys used in the assessment has been investigated and seems to be relatively low. The maturity data have not been evaluated yet.

The impact of large year classes on the stock, which cannot be estimated precisely, the low fishing mortality and the changing behaviour of the herring in recent years in migration and wintering will affect the quality of the assessment.

3.11 Status of the stock

The stock is considered to be within safe biological limits. Fishing mortality is lower than the defined limit and target reference points. SSB is well above all reference points and is estimated near the highest in the time-series. The stock contains a number of good year classes. The productivity of the stock presently is high. In the last 10 years, four large year classes have been produced (1998, 1999, 2002 and 2004). The 2004 year class has not been recruited yet in the catches and in the spawning stock in the Norwegian Sea.

3.12 Management considerations

This stock has shown a large dependency on the occasional appearance of very strong year classes. In recent years, the stock has tended to produce strong year classes more regularly.

In recent years, the migration behaviour of the stock has changed significantly, particularly in geographical locations of the wintering and feeding areas. These, in turn, affect the distribution of the fisheries.

Catches, taken from the stock in recent years, have been taken with a low fishing mortality close to the agreed target fishing mortality in the Management Plan. This has contributed to a rapid recovery of the stock.

3.13 Recommendations

- Sampling intensity for age and weight of herring and blue whiting are made in proportion to landings according to CR 1639/2001 and apply to EU member states. For other countries there are no guidelines. Current precision levels of the sampling intensity are unknown and therefore the group recommends reviewing of the sampling frequency and intensity on scientific basis and provide guidelines for sampling intensity.
- The terms of reference to review the maturity at age data for herring has not been dealt with. This term of reference should be forwarded to the next meeting.

Table 3.2.1.1. Total catch of Norwegian spring-spawning herring (tons) since 1972. Data provided by Working Group members.

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Ireand	Netherlands	Greenland	UK (Scotland)	Germany	France	Poland	Sweden	Total
1972	13,161	-	-	-	-	-	-	-	-	-	-	-	-	13,161
1973	7,017	-	-	-	-	-	-	-	-	-	-	-	-	7,017
1974	7,619	-	-	-	-	-	-	-	-	-	-	-	-	7,619
1975	13,713	-	-	-	-	-	-	-	-	-	-	-	-	13,713
1976	10,436	-	-	-	-	-	-	-	-	-	-	-	-	10,436
1977	22,706	-	-	-	-	-	-	-	-	-	-	-	-	22,706
1978	19,824	-	-	-	-	-	-	-	-	-	-	-	-	19,824
1979	12,864	-	-	-	-	-	-	-	-	-	-	-	-	12,864
1980	18,577	-	-	-	-	-	-	-	-	-	-	-	-	18,577
1981	13,736	-	-	-	-	-	-	-	-	-	-	-	-	13,736
1982	16,655	-	-	-	-	-	-	-	-	-	-	-	-	16,655
1983	23,054	-	-	-	-	-	-	-	-	-	-	-	-	23,054
1984	53,532	-	-	-	-	-	-	-	-	-	-	-	-	53,532
1985	167,272	2,600	-	-	-	-	-	-	-	-	-	-	-	169,872
1986	199,256	26,000	-	-	-	-	-	-	-	-	-	-	-	225,256
1987	108,417	18,889	-	-	-	-	-	-	-	-	-	-	-	127,306
1988	115,076	20,225	-	-	-	-	-	-	-	-	-	-	-	135,301
1989	88,707	15,123	-	-	-	-	-	-	-	-	-	-	-	103,830
1990	74,604	11,807	-	-	-	-	-	-	-	-	-	-	-	86,411
1991	73,683	11,000	-	-	-	-	-	-	-	-	-	-	-	84,683
1992	91,111	13,337	-	-	-	-	-	-	-	-	-	-	-	104,448
1993	199,771	32,645	-	-	-	-	-	-	-	-	-	-	-	232,457

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Iread	Netherlands	Greenland	UK (Scotland)	Germany	France	Poland	Sweden	Total
1994	380,771	74,400	-	2,911	21,146	-	-	-	-	-	-	-	-	479,228
1995	529,838	101,987	30,577	57,084	174,109	-	7,969	2,500	881	556	-	-	-	905,501
1996	699,161	119,290	60,681	52,788	164,957	19,541	19,664	-	46,131	11,978	-	-	22,424	1,220,283
1997	860,963	168,900	44,292	59,987	220,154	11,179	8,694	-	25,149	6,190	1,500	-	19,499	1,426,507
1998	743,925	124,049	35,519	68,136	197,789	2,437	12,827	-	15,971	7,003	605	-	14,863	1,223,131
1999	740,640	157,328	37,010	55,527	203,381	2,412	5,871	-	19,207	-	-	-	14,057	1,235,433
2000	713,500	163,261	34,968	68,625	186,035	8,939	-	-	14,096	3,298	-	-	14,749	1,207,201
2001	495,036	109,054	24,038	34,170	77,693	6,070	6,439	-	12,230	1,588	-	-	9,818	766,136
2002	487,233	113,763	18,998	32,302	127,197	1,699	9,392	-	3,482	3,017	-	1,226	9,486	807,795
2003*	477,573	122,846	14,144	27,943	117,910	1,400	8,678	-	9,214	3,371	-	-	6,431	789,510
2004	477,076	115,876	23,111	42,771	102,787	11	17,369	-	1,869	4,810	400	-	7,986	794,066
2005*	580,804	132,099	28,368	65,071	156,467	-	21,517	-	-	17,676	0	561	680	1,003,243
2006**	567,237	120,836	18,449	63,137	157,474	4,693	11,625	-	12,523***	9,958	80	-	2,946	968,958

*__In 2003 the Norwegian catches were raised of 39433 to account for changes in percentages of water content.__

**__Preliminary, as provided by Working Group members.__

*****Scotland and Northern Irland combined.**

Table 3.2.1.1.1 Norwegian spring spawning herring. Output from SALLOC for 2006 data.

Summary of Sampling by Country

AREA : Vb

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Russia	0.00	578.00	0	0	0	0.00
Faroes	2062.00	2062.00	3	300	300	100.06
Total Vb	2062.00	2640.00	3	300	300	100.06

Sum of Offical Catches : 2640.00
Unallocated Catch : 0.00
Working Group Catch : 2640.00

AREA : Va

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Iceland	34045.00	34045.00	36	985	983	100.00
Faroes	0.00	5637.00	0	0	0	0.00
Total Va	34045.00	39682.00	36	985	983	100.00

Sum of Offical Catches : 39682.00
Unallocated Catch : 0.00
Working Group Catch : 39682.00

AREA : IVa

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Norway	600.00	626.00	83	9996	700	99.99
Total IVa	600.00	626.00	83	9996	700	99.99

Sum of Offical Catches : 626.00
Unallocated Catch : 0.00
Working Group Catch : 626.00

AREA : IIb

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Russia	1809.00	1809.00	9	1892	150	100.15
Germany	0.00	162.00	0	0	0	0.00
Total IIb	1809.00	1971.00	9	1892	150	100.15

Sum of Offical Catches : 1971.00
Unallocated Catch : 0.00
Working Group Catch : 1971.00

AREA : IIa

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	11973.00	11973.00	2	176	115	100.01
UK(NIRL)	0.00	550.00	0	0	0	0.00
Sweden	0.00	2946.00	0	0	0	0.00
Russia	105172.00	118449.00	145	41273	1846	100.00
Norway	566611.00	566611.00	320	34000	3580	100.00
Netherlands	0.00	11625.00	0	0	0	0.00
Ireland	0.00	4693.00	0	0	0	0.00
Iceland	112055.00	123429.00	22	4760	1458	100.00
Germany	0.00	9796.00	0	0	0	0.00
France	0.00	80.00	0	0	0	0.00
Faroes	55438.00	55438.00	6	600	600	99.92
Denmark	12359.00	18449.00	5	592	130	100.00
Total IIa	863608.00	924039.00	500	81401	7729	99.99

Sum of Offical Catches : 924039.00
Unallocated Catch : 0.00
Working Group Catch : 924039.00

PERIOD : 1

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	11973.00	11973.00	2	176	115	100.01
UK(NIRL)	0.00	550.00	0	0	0	0.00

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Russia	27912.00	27912.00	46	9680	749	100.00
Norway	202780.00	202780.00	88	11040	550	99.99
Ireland	0.00	4693.00	0	0	0	0.00
France	0.00	80.00	0	0	0	0.00
Denmark	12359.00	12359.00	5	592	130	100.00
Period Total	255024.00	260347.00	141	21488	1544	99.99

Sum of Offical Catches : 260347.00
Unallocated Catch : 0.00
Working Group Catch : 260347.00

PERIOD : 2

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Sweden	0.00	2946.00	0	0	0	0.00
Russia	0.00	1436.00	0	0	0	0.00
Norway	1199.00	1199.00	68	8840	330	100.00
Iceland	28617.00	28617.00	19	5116	1814	100.00
Faroes	7072.00	10007.00	2	200	200	99.86
Period Total	36888.00	44205.00	89	14156	2344	99.97

Sum of Offical Catches : 44205.00
Unallocated Catch : 0.00
Working Group Catch : 44205.00

PERIOD : 3

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Russia	79069.00	79069.00	108	33485	1247	100.00
Norway	10588.00	10614.00	113	11100	1500	99.99
Iceland	116739.00	116739.00	14	541	539	100.00
Germany	0.00	9450.00	0	0	0	0.00
Faroes	49772.00	52474.00	5	500	500	99.93
Denmark	0.00	3949.00	0	0	0	0.00
Period Total	256168.00	272295.00	240	45626	3786	99.99

Sum of Offical Catches : 272295.00
Unallocated Catch : 0.00
Working Group Catch : 272295.00

PERIOD : 4

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Russia	0.00	12419.00	0	0	0	0.00
Norway	352644.00	352644.00	134	13016	1900	100.00
Netherlands	0.00	11625.00	0	0	0	0.00
Iceland	744.00	12118.00	25	88	88	100.11
Germany	0.00	508.00	0	0	0	0.00
Faroes	656.00	656.00	2	200	200	99.94
Denmark	0.00	2141.00	0	0	0	0.00
Period Total	354044.00	392111.00	161	13304	2188	100.00

Sum of Offical Catches : 392111.00
Unallocated Catch : 0.00
Working Group Catch : 392111.00

Total over all Areas and Periods

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	11973.00	11973.00	2	176	115	100.01
UK(NIRL)	0.00	550.00	0	0	0	0.00
Sweden	0.00	2946.00	0	0	0	0.00
Russia	106981.00	120836.00	154	43165	1996	100.00
Norway	567211.00	567237.00	403	43996	4280	100.00
Netherlands	0.00	11625.00	0	0	0	0.00
Ireland	0.00	4693.00	0	0	0	0.00
Iceland	146100.00	157474.00	58	5745	2441	100.00
Germany	0.00	9958.00	0	0	0	0.00
France	0.00	80.00	0	0	0	0.00
Faroes	57500.00	63137.00	9	900	900	99.92
Denmark	12359.00	18449.00	5	592	130	100.00
Total for Stock	902124.00	968958.00	631	94574	9862	99.99

Sum of Offical Catches : 968958.00
Unallocated Catch : 0.00
Working Group Catch : 968958.00

DETAILS OF DATA FILLING-IN

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  Filling-in for record : (  7)   Norway                3 IVa
Using Only
  >>  (  8)  Norway                4 IVa

  Filling-in for record : ( 12)   Russia                4 IIa
Using Only
  >>  ( 11)  Russia                3 IIa

  Filling-in for record : ( 10)   Russia                2 IIa
Using Only
  >>  (  9)  Russia                1 IIa

  Filling-in for record : ( 14)   Russia                2 Vb
Using Only
  >>  (  9)  Russia                1 IIa

  Filling-in for record : ( 20)   Iceland               4 IIa
Using Only
  >>  ( 19)  Iceland               3 IIa

  Filling-in for record : ( 24)   Sweden                2 IIa
Using Only
  >>  ( 18)  Iceland               2 IIa

  Filling-in for record : ( 25)   Germany               3 IIa
Using Only
  >>  ( 11)  Russia                3 IIa

  Filling-in for record : ( 26)   Germany               4 IIa
Using Only
  >>  (  4)  Norway                4 IIa

  Filling-in for record : ( 27)   Germany               3 IIb
Using Only
  >>  ( 13)  Russia                3 IIb

  Filling-in for record : ( 16)   Denmark               3 IIa
Using Only
  >>  ( 19)  Iceland               3 IIa

  Filling-in for record : ( 29)   UK(NIRL)              1 IIa
Using Only
  >>  ( 28)  UK(Scot)              1 IIa

  Filling-in for record : ( 17)   Denmark               4 IIa
Using Only
  >>  (  4)  Norway                4 IIa

  Filling-in for record : ( 30)   Ireland               1 IIa
Using Only
  >>  (  1)  Norway                1 IIa

  Filling-in for record : ( 31)   France                1 IIa
Using Only
  >>  (  1)  Norway                1 IIa

  Filling-in for record : ( 35)   Faroes                2 Va
Using Only
  >>  ( 32)  Faroes                2 IIa

  Filling-in for record : ( 36)   Faroes                3 Va
Using Only
  >>  ( 33)  Faroes                3 IIa

  Filling-in for record : ( 39)   Netherlands           4 IIa
Using Only
  >>  (  4)  Norway                4 IIa
```

Catch Numbers at Age by Area

Ages	Vb	Va	IVa	IIb	IIa	Total
0	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	1967.90	1967.90
2	0.00	0.00	0.00	0.00	45438.43	45438.43
3	7.21	120.87	2.57	0.00	75692.96	75823.60
4	671.63	4302.97	223.57	2989.73	721709.63	729897.50
5	311.36	1937.03	44.29	361.73	79452.74	82107.16
6	616.40	7085.37	108.29	726.73	162832.75	171369.53
7	2909.43	31165.34	615.71	1535.18	689814.94	726040.56
8	2757.82	33950.36	612.71	938.10	733957.94	772216.94
9	333.46	4504.19	41.86	280.01	83541.34	88700.87
10	141.83	6102.45	52.43	1.09	70817.28	77115.08
11	118.92	3290.10	6.86	32.69	26890.21	30338.78
12	166.57	4427.54	37.57	1.09	53249.64	57882.42
13	276.73	12909.43	85.43	89.34	120304.24	133665.20
14	90.69	9291.58	150.71	30.51	132676.63	142240.11
15	10.50	3977.00	41.71	1.09	45097.25	49127.55

Mean Weight at Age by Area (Kg)

Ages	Vb	Va	IVa	IIb	IIa	Total
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0553	0.0553
2	0.0000	0.0000	0.0000	0.0000	0.1023	0.1023
3	0.1070	0.2111	0.2041	0.0000	0.1705	0.1705
4	0.2082	0.2487	0.2017	0.2506	0.2382	0.2383
5	0.2779	0.2681	0.2568	0.2543	0.2676	0.2676
6	0.2967	0.2844	0.2714	0.2893	0.2928	0.2924
7	0.3136	0.2969	0.2979	0.3167	0.3116	0.3110
8	0.3247	0.3108	0.3194	0.3363	0.3310	0.3301
9	0.3520	0.3301	0.3592	0.1875	0.3670	0.3645
10	0.3707	0.3470	0.3679	0.4138	0.3759	0.3736
11	0.3714	0.3619	0.3585	0.4350	0.3772	0.3755
12	0.3869	0.3645	0.3863	0.4338	0.3897	0.3878
13	0.3808	0.3702	0.3998	0.4420	0.3987	0.3959
14	0.3833	0.3728	0.3920	0.4408	0.4000	0.3982
15	0.4409	0.3991	0.3786	0.4409	0.4079	0.4072

Table 3.2.1.1.2. Norwegian Spring Spawning Herring; summary of sampling data of the catches in 2005 and 2006.

TOTAL OVER ALL AREAS AND PERIODS 2005

Country	SAMPLED CATCH	OFFICIAL CATCH	NO. OF SAMPLES	NO. MEASURED	NO. AGED	SOP %
Sweden	0	680	0	0	0	0
Russia	132099	132099	131	21891	4109	100.97
Poland	0	561	0	0	0	0
Norway	580804	580804	235	25512	9253	99.87
Netherlands	21517	21517	19	475	475	100.0
Iceland	127390	156467	100	2111	1342	99.83
Germany	0	17676	0	0	0	0
Faroes	36168	65071	3	203	202	99.97
Denmark	28368	28368	10	1124	228	100
Total for Stock	904829	1003243	469	49717	14906	96.9

TOTAL OVER ALL AREAS AND PERIODS 2006

COUNTRY	SAMPLED CATCH	OFFICIAL CATCH	NO. OF SAMPLES	NO. MEASURED	NO. AGED	SOP %
UK(Scot)	11973	11973	2	176	115	100.01
UK(NIRL)	0	550	0	0	0	0
Sweden	0	2946	0	0	0	0
Russia	105172	118449	145	41273	1846	100
Norway	566611	566611	320	34000	3580	100
Netherlands	0	11625	0	0	0	0
Ireland	0	4693	0	0	0	0
Iceland	112055	123429	22	4760	1458	100
Germany	0	9796	0	0	0	0
France	0	80	0	0	0	0
Faroes	55438	55438	6	600	600	99.92
Denmark	12359	18449	5	592	130	100
Total for Stock	863608	924039	500	81401	7729	99.99

Table 3.2.2.1. Norwegian spring spawning herring. Catch in numbers (billions).

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1950	5.113	2	0.6	0.276	0.185	0.186	0.547	0.629	0.08	0.089	0.11	0.087	0.195	0.368	0.066	0.107	0.237
1951	1.636	7.608	0.4	0.007	0.384	0.172	0.164	0.516	0.602	0.077	0.083	0.103	0.108	0.254	0.348	0.047	0.305
1952	13.72	9.15	1.233	0.039	0.061	0.602	0.136	0.205	0.38	0.378	0.079	0.086	0.108	0.107	0.187	0.256	0.308
1953	5.697	5.055	0.581	0.74	0.047	0.101	0.356	0.082	0.111	0.314	0.395	0.062	0.091	0.094	0.099	0.216	0.515
1954	10.68	7.071	0.855	0.266	1.436	0.143	0.236	0.49	0.128	0.2	0.44	0.461	0.088	0.101	0.133	0.127	0.676
1955	5.176	2.871	0.51	0.093	0.276	2.045	0.114	0.19	0.275	0.085	0.193	0.296	0.203	0.059	0.085	0.104	0.477
1956	5.364	2.024	0.627	0.117	0.252	0.314	2.555	0.11	0.204	0.264	0.131	0.198	0.273	0.163	0.063	0.089	0.476
1957	5.002	3.291	0.22	0.023	0.373	0.154	0.229	1.985	0.072	0.127	0.183	0.088	0.121	0.149	0.132	0.034	0.248
1958	9.667	2.798	0.666	0.018	0.018	0.111	0.089	0.194	0.973	0.071	0.123	0.201	0.099	0.077	0.071	0.069	0.186
1959	17.9	0.199	0.326	0.015	0.027	0.026	0.147	0.115	0.241	1.104	0.089	0.124	0.198	0.089	0.077	0.085	0.151
1960	12.88	13.58	0.393	0.122	0.018	0.028	0.024	0.096	0.073	0.204	1.163	0.085	0.13	0.154	0.057	0.047	0.122
1961	6.208	16.08	2.885	0.031	0.008	0.004	0.015	0.019	0.062	0.049	0.136	0.728	0.05	0.045	0.063	0.022	0.038
1962	3.693	4.081	1.041	1.844	0.008	0.003	0.007	0.02	0.012	0.059	0.053	0.117	0.814	0.044	0.055	0.066	0.087
1963	4.807	2.119	2.045	0.76	0.836	0.005	0.002	0.004	0.018	0.009	0.108	0.093	0.174	0.924	0.08	0.06	0.125
1964	3.613	2.728	0.22	0.115	0.399	2.046	0.014	0.002	0.003	0.025	0.029	0.096	0.082	0.153	0.773	0.046	0.291
1965	2.303	3.781	2.854	0.09	0.256	0.571	2.2	0.02	0.015	0.007	0.019	0.04	0.101	0.108	0.139	0.704	0.179
1966	3.927	0.663	1.678	2.049	0.027	0.467	1.306	2.885	0.038	0.014	0.017	0.026	0.011	0.069	0.072	0.097	0.46
1967	0.427	9.877	0.07	1.392	3.254	0.027	0.421	1.132	1.721	0.009	0.006	0.004	0.008	0.009	0.018	0.014	0.09
1968	1.784	0.437	0.388	0.099	1.881	1.387	0.014	0.094	0.134	0.345	0.002	0.001	0	0.003	0.003	0.002	0.015
1969	0.561	0.507	0.142	0.188	0	0.009	0.005	0	0.012	0.034	0.036	0	0	0	0	0	0.002
1970	0.119	0.529	0.033	0.006	0.019	0	0.003	0.003	0.001	0.013	0.026	0.028	0	0	0	0	0.002
1971	0.031	0.043	0.085	0.002	0.001	0.001	0	0.001	0.001	0	0.004	0.007	0.005	0	0	0	0
1972	0.347	0.041	0.02	0.035	0.003	0.004	0.002	0	0.001	0	0	0	0	0	0	0	0
1973	0.029	0.004	0.002	0.002	0.025	0	0.002	0	0	0	0	0	0	0	0	0	0
1974	0.066	0.008	0.004	0	0	0.025	0	0	0	0	0	0	0	0	0	0	0
1975	0.031	0.004	0.002	0.003	0	0	0.031	0	0	0	0	0	0	0	0	0	0
1976	0.02	0.002	0.001	0.023	0.005	0	0	0.013	0	0	0	0	0	0	0	0	0
1977	0.043	0.006	0.003	0.022	0.024	0	0	0	0.011	0	0	0	0	0	0	0	0
1978	0.02	0.002	0.001	0.003	0.012	0.02	0	0	0	0.005	0	0	0	0	0	0	0
1979	0.033	0.004	0.002	0.006	0.002	0.007	0.011	0	0	0	0.003	0	0	0	0	0	0
1980	0.007	0	0	0.006	0.006	0.002	0.008	0.016	0	0	0	0.003	0	0	0	0	0
1981	0.008	0.001	0.012	0.004	0.005	0.009	0.002	0.005	0.008	0	0	0	0	0	0	0	0

	AGE																
YEAR	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1982	0.023	0.001	0	0.014	0.008	0.005	0.006	0.002	0.005	0.006	0	0	0	0	0	0	0
1983	0.127	0.005	0.002	0.003	0.021	0.01	0.006	0.007	0.001	0.005	0.007	0	0	0	0	0	0
1984	0.034	0.002	0.002	0.004	0.005	0.062	0.018	0.013	0.016	0.007	0.016	0.006	0	0	0	0.002	0
1985	0.029	0.013	0.207	0.022	0.016	0.017	0.13	0.059	0.055	0.063	0.01	0.031	0.05	0	0	0	0.003
1986	0.014	0.001	0.003	0.54	0.018	0.015	0.016	0.105	0.075	0.042	0.077	0.019	0.066	0.08	0	0	0.002
1987	0.014	0.006	0.036	0.02	0.501	0.019	0.004	0.007	0.028	0.012	0.01	0.005	0.008	0.007	0.007	0	0
1988	0.015	0.003	0.009	0.063	0.025	0.55	0.009	0.004	0.006	0.015	0.009	0.003	0.003	0.003	0.002	0	0
1989	0.007	0.002	0.025	0.003	0.004	0.006	0.324	0.003	0	0	0.003	0.001	0	0	0	0	0
1990	0.001	0	0.016	0.019	0.003	0.012	0.011	0.226	0.001	0.002	0.002	0.002	0	0	0	0	0
1991	0	0.003	0.003	0.008	0.003	0.001	0.015	0.009	0.219	0.002	0	0	0	0	0	0	0
1992	0.002	0	0.001	0.013	0.033	0.005	0.001	0.012	0.006	0.226	0.002	0	0	0.001	0	0	0
1993	0.007	0	0.007	0.028	0.107	0.087	0.009	0.004	0.03	0.019	0.41	0	0	0	0	0	0
1994	0	0	0.008	0.033	0.11	0.364	0.165	0.016	0.008	0.037	0.036	0.645	0.003	0	0	0.002	0
1995	0	0	0.001	0.058	0.346	0.623	0.638	0.231	0.016	0.016	0.07	0.084	0.912	0.004	0	0	0
1996	0	0	0.03	0.034	0.714	1.571	0.941	0.406	0.103	0.006	0.007	0.066	0.018	0.837	0	0	0
1997	0	0	0.022	0.13	0.271	1.796	1.994	0.761	0.326	0.061	0.02	0.032	0.091	0.019	0.37	0	0
1998	0	0	0.083	0.07	0.242	0.368	1.76	1.264	0.381	0.13	0.043	0.025	0.003	0.113	0.006	0.109	0
1999	0	0	0.005	0.138	0.036	0.135	0.429	1.605	1.164	0.291	0.106	0.015	0.04	0.007	0.089	0	0.064
2000	0	0	0.014	0.084	0.56	0.035	0.111	0.404	1.299	1.045	0.217	0.072	0.016	0.023	0.023	0.005	0.067
2001	0	0	0.002	0.102	0.161	0.427	0.039	0.096	0.296	0.839	0.507	0.074	0.024	0.004	0.003	0	0.022
2002	0	0	0.062	0.198	0.643	0.256	0.326	0.03	0.094	0.265	0.663	0.339	0.053	0.012	0.007	0	0.01
2003	0.000	0.003	0.005	0.075	0.324	0.730	0.176	0.168	0.023	0.074	0.217	0.567	0.219	0.039	0.008	0.006	0
2004	0.000	0.002	0.044	0.024	0.092	0.430	0.714	0.111	0.138	0.027	0.052	0.169	0.402	0.211	0.028	0.008	0.004
2005	0.000	0.000	0.020	0.448	0.094	0.171	0.644	0.930	0.122	0.123	0.038	0.065	0.139	0.345	0.127	0.011	0.005
2006	0	0.002	0.045	0.076	0.730	0.082	0.171	0.726	0.772	0.089	0.077	0.030	0.058	0.134	0.142	0.039	0.010

Table 3.2.2.2. Norwegian Spring Spawning Herring Landings in numbers ('000) by length group and quarters in the Norwegian Sea 2006.

Length (cm)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	All year
16				112	112
17		4	207	78	289
18		8	422	483	913
19		25	1 370	346	1741
20		23	1 259	635	1917
21		27	1 499	1 831	3357
22	21	17	924	3 180	4142
23	31	9	513	3 626	4179
24	10	10	569	3 175	3764
25	51	20	1 132	5 131	6334
26	481	48	2 816	13 016	16361
27	3 077	97	5 395	19 501	28070
28	14 572	180	8 160	39 553	62465
29	30 977	364	17 794	100 626	149761
30	42 594	723	35 155	163 372	241844
31	59 127	898	39 734	133 890	233649
32	148 492	1 154	32 900	114 626	297172
33	226 032	1 567	44 560	149 189	421348
34	158 430	1 473	55 127	161 002	376032
35	80 125	813	37 386	121 682	240006
36	43 989	375	17 033	75 172	136569
37	20 188	158	7 227	35 221	62794
38	4 103	36	1 627	6 798	12564
39	200	4	199	412	815
40	21	1	40	-	62
TOTAL numbers	832 521	8 033	313 050	1 152 657	2306260
Official Catch (t)	242 534	12 263	142 131	365 628	762 556

Table 3.2.3.1. Norwegian spring spawning herring. Weight-at-age in the catch (kg).

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1950	0.007	0.025	0.058	0.110	0.188	0.211	0.234	0.253	0.266	0.280	0.294	0.303	0.312	0.32	0.323	0.331	0.335
1951	0.009	0.029	0.068	0.130	0.222	0.249	0.276	0.298	0.314	0.330	0.346	0.357	0.368	0.377	0.381	0.390	0.395
1952	0.008	0.026	0.061	0.115	0.197	0.221	0.245	0.265	0.279	0.293	0.308	0.317	0.327	0.335	0.339	0.346	0.351
1953	0.008	0.027	0.063	0.120	0.205	0.230	0.255	0.275	0.290	0.305	0.320	0.330	0.34	0.347	0.351	0.359	0.364
1954	0.008	0.026	0.062	0.117	0.201	0.225	0.250	0.269	0.284	0.299	0.313	0.323	0.333	0.341	0.345	0.352	0.357
1955	0.008	0.027	0.063	0.119	0.204	0.229	0.254	0.274	0.289	0.304	0.318	0.328	0.338	0.346	0.350	0.358	0.363
1956	0.008	0.028	0.066	0.126	0.215	0.241	0.268	0.289	0.304	0.320	0.336	0.346	0.357	0.365	0.369	0.378	0.383
1957	0.008	0.028	0.066	0.127	0.216	0.243	0.269	0.290	0.306	0.322	0.338	0.348	0.359	0.367	0.371	0.380	0.385
1958	0.009	0.030	0.070	0.133	0.227	0.255	0.283	0.305	0.321	0.338	0.355	0.366	0.377	0.386	0.390	0.399	0.404
1959	0.009	0.030	0.071	0.135	0.231	0.259	0.287	0.310	0.327	0.344	0.360	0.372	0.383	0.392	0.397	0.406	0.411
1960	0.006	0.011	0.074	0.119	0.188	0.277	0.337	0.318	0.363	0.379	0.360	0.420	0.411	0.439	0.450	0.444	0.448
1961	0.006	0.010	0.045	0.087	0.159	0.276	0.322	0.372	0.363	0.393	0.407	0.397	0.422	0.447	0.465	0.452	0.452
1962	0.009	0.023	0.055	0.085	0.148	0.288	0.333	0.360	0.352	0.350	0.374	0.384	0.374	0.394	0.399	0.411	0.416
1963	0.008	0.026	0.047	0.098	0.171	0.275	0.268	0.323	0.329	0.336	0.341	0.358	0.385	0.353	0.381	0.386	0.386
1964	0.009	0.024	0.059	0.139	0.219	0.239	0.298	0.295	0.339	0.350	0.358	0.351	0.367	0.375	0.372	0.427	0.434
1965	0.009	0.016	0.048	0.089	0.217	0.234	0.262	0.331	0.360	0.367	0.386	0.395	0.393	0.404	0.401	0.429	0.437
1966	0.008	0.017	0.040	0.063	0.246	0.260	0.265	0.301	0.410	0.425	0.456	0.460	0.467	0.446	0.459	0.465	0.474
1967	0.009	0.015	0.036	0.066	0.093	0.305	0.305	0.310	0.333	0.359	0.413	0.446	0.401	0.408	0.439	0.427	0.431
1968	0.010	0.027	0.049	0.075	0.108	0.158	0.375	0.383	0.364	0.382	0.441	0.410		0.517	0.491	0.464	0.487
1969	0.009	0.021	0.047	0.072		0.152	0.296		0.329	0.329	0.341						0.429
1970	0.008	0.058	0.085	0.105	0.171		0.216	0.277	0.298	0.304	0.305	0.309					0.376
1971	0.011	0.053	0.121	0.177	0.216	0.250		0.305	0.333		0.366	0.377	0.388				
1972	0.011	0.029	0.062	0.103	0.154	0.215	0.258		0.322								
1973	0.006	0.053	0.106	0.161	0.213		0.255										
1974	0.006	0.055	0.117			0.249											
1975	0.009	0.079	0.169	0.241			0.381										
1976	0.007	0.062	0.132	0.189	0.250			0.323									
1977	0.011	0.091	0.193	0.316	0.350				0.511								
1978	0.012	0.100	0.210	0.274	0.424	0.454				0.613							
1979	0.010	0.088	0.181	0.293	0.359	0.416	0.436				0.553						
1980	0.012			0.266	0.399	0.449	0.460	0.485				0.608					
1981	0.010	0.082	0.163	0.196	0.291	0.341	0.368	0.380	0.397								
1982	0.010	0.087	0.159	0.256	0.312	0.378	0.415	0.435	0.449	0.448							

Table 3.2.3.1. cont. Norwegian spring spawning herring. Weight at age in the catch (kg).

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1983	0.011	0.090	0.165	0.217	0.265	0.337	0.378	0.410	0.426	0.435	0.444						
1984	0.009	0.047	0.145	0.218	0.262	0.325	0.346	0.381	0.400	0.413	0.405	0.426				0.415	
1985	0.009	0.022	0.022	0.214	0.277	0.295	0.338	0.360	0.381	0.397	0.409	0.417	0.435				0.435
1986	0.007	0.077	0.097	0.055	0.249	0.294	0.312	0.352	0.374	0.398	0.402	0.401	0.410	0.410			0.410
1987	0.010	0.075	0.091	0.124	0.173	0.253	0.232	0.312	0.328	0.349	0.353	0.370	0.385	0.385	0.385		
1988	0.008	0.062	0.075	0.124	0.154	0.194	0.241	0.265	0.304	0.305	0.317	0.308	0.334	0.334	0.334		
1989	0.010	0.060	0.204	0.188	0.264	0.260	0.282	0.306			0.422	0.364					
1990	0.007		0.102	0.230	0.239	0.266	0.305	0.308	0.376	0.407	0.412	0.424					
1991		0.015	0.104	0.208	0.250	0.288	0.312	0.316	0.330	0.344							
1992	0.007		0.103	0.191	0.233	0.304	0.337	0.365	0.361	0.371	0.403			0.404			
1993	0.007		0.106	0.153	0.243	0.282	0.320	0.330	0.365	0.373	0.379						
1994			0.102	0.194	0.239	0.280	0.317	0.328	0.356	0.372	0.390	0.379	0.399	0.403			
1995			0.102	0.153	0.192	0.234	0.283	0.328	0.349	0.356	0.374	0.366	0.393	0.387			
1996			0.136	0.136	0.168	0.206	0.262	0.309	0.337	0.366	0.360	0.361	0.367	0.379			
1997			0.089	0.167	0.184	0.207	0.232	0.277	0.305	0.331	0.328	0.344	0.343	0.397	0.357		
1998			0.111	0.150	0.216	0.221	0.249	0.277	0.316	0.338	0.374	0.372	0.366	0.396	0.377	0.406	
1999			0.096	0.173	0.228	0.262	0.274	0.292	0.307	0.335	0.362	0.371	0.399	0.396	0.400		0.404
2000			0.124	0.175	0.222	0.242	0.289	0.303	0.310	0.328	0.349	0.383	0.411	0.410	0.419	0.409	0.409
2001			0.105	0.166	0.214	0.252	0.268	0.305	0.308	0.322	0.337	0.363	0.353	0.378	0.400		0.427
2002			0.056	0.128	0.198	0.255	0.281	0.303	0.322	0.323	0.334	0.345	0.369	0.407	0.410		0.435
2003		0.062	0.068	0.169	0.218	0.257	0.288	0.316	0.323	0.348	0.354	0.351	0.363	0.372	0.376	0.429	0.429
2004	0.022	0.066	0.143	0.18	0.227	0.26	0.29	0.323	0.355	0.375	0.383	0.399	0.395	0.405	0.429	0.439	0.439
2005		0.092	0.106	0.181	0.235	0.266	0.290	0.315	0.344	0.367	0.384	0.372	0.384	0.398	0.402	0.413	0.413
2006		0.055	0.102	0.171	0.238	0.268	0.292	0.311	0.330	0.365	0.374	0.376	0.388	0.396	0.398	0.407	0.407

Table 3.2.3.2. Norwegian spring spawning herring. Weight at age in the stock (kg).

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1950	0.001	0.008	0.047	0.100	0.204	0.230	0.255	0.275	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1951	0.001	0.008	0.047	0.100	0.204	0.230	0.255	0.275	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1952	0.001	0.008	0.047	0.100	0.204	0.230	0.255	0.275	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1953	0.001	0.008	0.047	0.100	0.204	0.230	0.255	0.275	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1954	0.001	0.008	0.047	0.100	0.204	0.230	0.255	0.275	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1955	0.001	0.008	0.047	0.100	0.195	0.213	0.260	0.275	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1956	0.001	0.008	0.047	0.100	0.205	0.230	0.249	0.275	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1957	0.001	0.008	0.047	0.100	0.136	0.228	0.255	0.262	0.290	0.305	0.315	0.325	0.330	0.340	0.345	0.362	0.365
1958	0.001	0.008	0.047	0.100	0.204	0.242	0.292	0.295	0.293	0.305	0.315	0.330	0.340	0.345	0.352	0.360	0.365
1959	0.001	0.008	0.047	0.100	0.204	0.252	0.260	0.290	0.300	0.305	0.315	0.325	0.330	0.340	0.345	0.355	0.360
1960	0.001	0.008	0.047	0.100	0.204	0.270	0.291	0.293	0.321	0.318	0.320	0.344	0.349	0.370	0.379	0.375	0.380
1961	0.001	0.008	0.047	0.100	0.232	0.250	0.292	0.302	0.304	0.323	0.322	0.321	0.344	0.357	0.363	0.365	0.370
1962	0.001	0.008	0.047	0.100	0.219	0.291	0.300	0.316	0.324	0.326	0.335	0.338	0.334	0.347	0.354	0.358	0.358
1963	0.001	0.008	0.047	0.100	0.185	0.253	0.294	0.312	0.329	0.327	0.334	0.341	0.349	0.341	0.358	0.375	0.375
1964	0.001	0.008	0.047	0.100	0.194	0.213	0.264	0.317	0.363	0.353	0.349	0.354	0.357	0.359	0.365	0.402	0.402
1965	0.001	0.008	0.047	0.100	0.186	0.199	0.236	0.260	0.363	0.350	0.370	0.360	0.378	0.387	0.390	0.394	0.394
1966	0.001	0.008	0.047	0.100	0.185	0.219	0.222	0.249	0.306	0.354	0.377	0.391	0.379	0.378	0.361	0.383	0.383
1967	0.001	0.008	0.047	0.100	0.180	0.228	0.269	0.270	0.294	0.324	0.420	0.430	0.366	0.368	0.433	0.414	0.414
1968	0.001	0.008	0.047	0.100	0.115	0.206	0.266	0.275	0.274	0.285	0.350	0.325	0.363	0.408	0.388	0.378	0.378
1969	0.001	0.008	0.047	0.100	0.115	0.145	0.270	0.300	0.306	0.308	0.318	0.340	0.368	0.360	0.393	0.397	0.397
1970	0.001	0.008	0.047	0.100	0.209	0.272	0.230	0.295	0.317	0.323	0.325	0.329	0.380	0.370	0.380	0.391	0.391
1971	0.001	0.015	0.080	0.100	0.190	0.225	0.250	0.275	0.290	0.310	0.325	0.335	0.345	0.355	0.365	0.390	0.390
1972	0.001	0.010	0.070	0.150	0.150	0.140	0.210	0.240	0.270	0.300	0.325	0.335	0.345	0.355	0.365	0.390	0.390
1973	0.001	0.010	0.085	0.170	0.259	0.342	0.384	0.409	0.404	0.461	0.520	0.534	0.500	0.500	0.500	0.500	0.500
1974	0.001	0.010	0.085	0.170	0.259	0.342	0.384	0.409	0.444	0.461	0.520	0.543	0.482	0.482	0.482	0.482	0.482
1975	0.001	0.010	0.085	0.181	0.259	0.342	0.384	0.409	0.444	0.461	0.520	0.543	0.482	0.482	0.482	0.482	0.482
1976	0.001	0.010	0.085	0.181	0.259	0.342	0.384	0.409	0.444	0.461	0.520	0.543	0.482	0.482	0.482	0.482	0.482
1977	0.001	0.010	0.085	0.181	0.259	0.343	0.384	0.409	0.444	0.461	0.520	0.543	0.482	0.482	0.482	0.482	0.482
1978	0.001	0.010	0.085	0.180	0.294	0.326	0.371	0.409	0.461	0.476	0.520	0.543	0.500	0.500	0.500	0.500	0.500
1979	0.001	0.010	0.085	0.178	0.232	0.359	0.385	0.420	0.444	0.505	0.520	0.551	0.500	0.500	0.500	0.500	0.500
1980	0.001	0.010	0.085	0.175	0.283	0.347	0.402	0.421	0.465	0.465	0.520	0.534	0.500	0.500	0.500	0.500	0.500
1981	0.001	0.010	0.085	0.170	0.224	0.336	0.378	0.387	0.408	0.397	0.520	0.543	0.512	0.512	0.512	0.512	0.512
1982	0.001	0.010	0.085	0.170	0.204	0.303	0.355	0.383	0.395	0.413	0.453	0.468	0.506	0.506	0.506	0.506	0.506

Table 3.2.3.2. cont. Norwegian spring spawning herring. Weight at age in the stock (kg).

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1983	0.001	0.010	0.085	0.155	0.249	0.304	0.368	0.404	0.424	0.437	0.436	0.493	0.495	0.495	0.495	0.495	0.495
1984	0.001	0.010	0.085	0.140	0.204	0.295	0.338	0.376	0.395	0.407	0.413	0.422	0.437	0.437	0.437	0.437	0.437
1985	0.001	0.010	0.085	0.148	0.234	0.265	0.312	0.346	0.370	0.395	0.397	0.428	0.428	0.428	0.428	0.428	0.428
1986	0.001	0.010	0.085	0.054	0.206	0.265	0.289	0.339	0.368	0.391	0.382	0.388	0.395	0.395	0.395	0.395	0.395
1987	0.001	0.010	0.055	0.090	0.143	0.241	0.279	0.299	0.316	0.342	0.343	0.362	0.376	0.376	0.376	0.376	0.376
1988	0.001	0.015	0.050	0.098	0.135	0.197	0.277	0.315	0.339	0.343	0.359	0.365	0.376	0.376	0.376	0.376	0.376
1989	0.001	0.015	0.100	0.154	0.175	0.209	0.252	0.305	0.367	0.377	0.359	0.395	0.396	0.396	0.396	0.396	0.396
1990	0.001	0.008	0.048	0.219	0.198	0.258	0.288	0.309	0.428	0.370	0.403	0.387	0.440	0.440	0.440	0.440	0.440
1991	0.001	0.011	0.037	0.147	0.210	0.244	0.300	0.324	0.336	0.343	0.382	0.366	0.425	0.425	0.425	0.425	0.425
1992	0.001	0.007	0.030	0.128	0.224	0.296	0.327	0.355	0.345	0.367	0.341	0.361	0.430	0.470	0.470	0.470	0.450
1993	0.001	0.008	0.025	0.081	0.201	0.265	0.323	0.354	0.358	0.381	0.369	0.396	0.393	0.374	0.403	0.400	0.400
1994	0.001	0.010	0.025	0.075	0.151	0.254	0.318	0.371	0.347	0.412	0.382	0.407	0.410	0.410	0.410	0.410	0.410
1995	0.001	0.018	0.025	0.066	0.138	0.230	0.296	0.346	0.388	0.363	0.409	0.414	0.422	0.410	0.410	0.405	0.447
1996	0.001	0.018	0.025	0.076	0.118	0.188	0.261	0.316	0.346	0.374	0.390	0.390	0.384	0.398	0.398	0.398	0.398
1997	0.001	0.018	0.025	0.096	0.118	0.174	0.229	0.286	0.323	0.370	0.378	0.386	0.360	0.393	0.391	0.391	0.391
1998	0.001	0.018	0.025	0.074	0.147	0.174	0.217	0.242	0.278	0.304	0.310	0.359	0.340	0.344	0.385	0.363	0.375
1999	0.001	0.018	0.025	0.102	0.150	0.223	0.240	0.264	0.283	0.315	0.345	0.386	0.386	0.386	0.382	0.382	0.407
2000*	0.001	0.018	0.025	0.119	0.178	0.225	0.271	0.285	0.298	0.311	0.339	0.390	0.398	0.406	0.414	0.422	0.431
2001	0.001	0.018	0.025	0.075	0.178	0.238	0.247	0.296	0.307	0.314	0.328	0.351	0.376	0.406	0.414	0.425	0.425
2002	0.001	0.010	0.023	0.057	0.177	0.241	0.275	0.302	0.311	0.314	0.328	0.341	0.372	0.405	0.415	0.467	0.409
2003	0.001	0.010	0.055	0.098	0.159	0.211	0.272	0.305	0.292	0.331	0.337	0.347	0.356	0.381	0.414	0.425	0.441
2004	0.001	0.010	0.055	0.106	0.149	0.212	0.241	0.279	0.302	0.337	0.354	0.355	0.360	0.371	0.400	0.412	0.445
2005	0.001	0.010	0.046	0.112	0.156	0.234	0.267	0.295	0.330	0.363	0.377	0.414	0.406	0.308	0.420	0.452	0.452
2006	0.001	0.010	0.042	0.107	0.179	0.232	0.272	0.297	0.318	0.371	0.365	0.393	0.395	0.399	0.415	0.422	0.434
2007	0.001	0.010	0.036	0.086	0.155	0.226	0.265	0.312	0.310	0.364	0.384	0.352	0.386	0.304	0.420	0.412	0.412

***values in 2000 changed to values in the report from 2000.**

Table 3.2.4.1. Norwegian spring spawning herring. Proportion mature at age.

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1950	0	0	0	0	0.1	0.3	0.6	0.9	1	1	1	1	1	1	1	1	1
1951	0	0	0	0	0.1	0.3	0.6	0.9	1	1	1	1	1	1	1	1	1
1952	0	0	0	0	0.1	0.3	0.6	0.9	1	1	1	1	1	1	1	1	1
1953	0	0	0	0	0.1	0.3	0.6	0.9	1	1	1	1	1	1	1	1	1
1954	0	0	0	0	0.1	0.3	0.6	0.9	1	1	1	1	1	1	1	1	1
1955	0	0	0	0.08	0.22	0.37	0.85	1	1	1	1	1	1	1	1	1	1
1956	0	0	0	0.08	0.22	0.37	0.85	1	1	1	1	1	1	1	1	1	1
1957	0	0	0	0	0	0.5	0.6	1	1	1	1	1	1	1	1	1	1
1958	0	0	0	0.08	0.22	0.37	0.85	1	1	1	1	1	1	1	1	1	1
1959	0	0	0	0.08	0.22	0.37	0.85	1	1	1	1	1	1	1	1	1	1
1960	0	0	0	0.08	0.22	0.37	0.85	1	1	1	1	1	1	1	1	1	1
1961	0	0	0	0.04	0.35	0.68	0.94	1	1	1	1	1	1	1	1	1	1
1962	0	0	0	0	0.11	0.67	1	1	1	1	1	1	1	1	1	1	1
1963	0	0	0	0.04	0.03	0.32	0.9	1	1	1	1	1	1	1	1	1	1
1964	0	0	0	0.02	0.06	0.28	0.32	1	1	1	1	1	1	1	1	1	1
1965	0	0	0	0	0.34	0.35	0.76	1	1	1	1	1	1	1	1	1	1
1966	0	0	0	0.01	0.15	1	0.96	1	1	1	1	1	1	1	1	1	1
1967	0	0	0	0	0.01	0.23	1	1	1	1	1	1	1	1	1	1	1
1968	0	0	0	0	0	0.01	0.76	1	1	1	1	1	1	1	1	1	1
1969	0	0	0	0.62	0.89	0.95	1	1	1	1	1	1	1	1	1	1	1
1970	0	0	0	0.06	0.13	0.31	0.17	1	1	1	1	1	1	1	1	1	1
1971	0	0	0	0.1	0.25	0.6	0.9	1	1	1	1	1	1	1	1	1	1
1972	0	0	0	0	0.1	0.25	0.6	0.9	1	1	1	1	1	1	1	1	1
1973	0	0	0	0.5	0.9	1	1	1	1	1	1	1	1	1	1	1	1
1974	0	0	0	0.5	0.9	1	1	1	1	1	1	1	1	1	1	1	1
1975	0	0	0	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1
1976	0	0	0	0.5	0.9	1	1	1	1	1	1	1	1	1	1	1	1
1977	0	0	0	0.73	0.89	1	1	1	1	1	1	1	1	1	1	1	1
1978	0	0	0	0.13	0.9	1	1	1	1	1	1	1	1	1	1	1	1
1979	0	0	0	0.1	0.62	0.95	1	1	1	1	1	1	1	1	1	1	1
1980	0	0	0	0.25	0.5	0.97	1	1	1	1	1	1	1	1	1	1	1
1981	0	0	0	0.3	0.5	0.9	1	1	1	1	1	1	1	1	1	1	1
1982	0	0	0	0.1	0.48	0.7	1	1	1	1	1	1	1	1	1	1	1
1983	0	0	0	0.1	0.5	0.69	0.71	1	1	1	1	1	1	1	1	1	1
1984	0	0	0	0.1	0.5	0.9	0.95	1	1	1	1	1	1	1	1	1	1
1985	0	0	0	0.1	0.5	0.9	1	1	1	1	1	1	1	1	1	1	1
1986	0	0	0	0.1	0.2	0.9	1	1	1	1	1	1	1	1	1	1	1
1987	0	0	0	0.1	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
1988	0	0	0	0.1	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
1989	0	0	0	0.1	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
1990	0	0	0	0.4	0.8	0.9	0.9	0.9	1	1	1	1	1	1	1	1	1
1991	0	0	0	0.1	0.7	1	1	1	1	1	1	1	1	1	1	1	1
1992	0	0	0	0.1	0.2	0.8	1	1	1	1	1	1	1	1	1	1	1
1993	0	0	0	0.01	0.3	0.8	1	1	1	1	1	1	1	1	1	1	1
1994	0	0	0	0.01	0.3	0.8	1	1	1	1	1	1	1	1	1	1	1
1995	0	0	0	0	0.3	0.8	1	1	1	1	1	1	1	1	1	1	1
1996	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
1997	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
1998	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
1999	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1

Table 3.2.4.1. cont. Norwegian spring spawning herring. Proportion mature at age.

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2000	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
2001	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
2002	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
2003	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
2004	0	0	0	0	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
2005	0	0	0	0.1	0.3	0.9	1	1	1	1	1	1	1	1	1	1	1
2006	0	0	0	0	0.9	0.9	1	1	1	1	1	1	1	1	1	1	1
2007	0	0	0	0	0.3	1	1	1	1	1	1	1	1	1	1	1	1

Table 3.2.5.1. Norwegian spring spawning herring. Estimates from the international acoustic surveys on the feeding areas in the Norwegian Sea in May. Numbers in millions. Biomass in thousands. Biomass in thousands. Data in black box are used in assessment. The yellow highlighted cells are treated in the program with relation to the ratio between the 1983 and 1985 yearclasses.

		Age														Total
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total	Biomass
1996	0	0	4114	22461	13244	4916	2045	424	14	7	155	0	3134			50514	8532
1997	0	0	1169	3599	18867	13546	2473	1771	178	77	288	415	60	2472		44915	9435
1998	24	1404	367	1099	4410	16378	10160	2059	804	183	0	0	112	0	415	37415	8004
1999	0	215	2191	322	965	3067	11763	6077	853	258	5	14	0	158	128	26016	6299
2000	0	157	1353	2783	92	384	1302	7194	5344	1689	271	0	114	0	1135	21857	6001
2001	0	1540	8312	1430	1463	179	204	3215	5433	1220	94	178	0	0	85	23353	3937
2002	0	677	6343	9619	1418	779	375	847	1941	2500	1423	61	78	28	26	26142	4628
2003	32073	8115	6561	9985	9961	1499	732	146	228	1865	2359	1769		287	45	75625	6653
2004	0	13735	1543	5227	12571	10710	1075	580	76	313	362	1294	1120	10	88	48704	7687
2005	0	1293	19679	1353	1765	6205	5371	651	388	139	262	526	1003	364	115	39114	5109
2006	0	19	306	14560	1396	2011	6521	6978	679	713	173	407	921	618	243	35545	9100
2007	0	411	2889	5877	20292	1260	1992	6780	5582	647	488	372	403	1048	1010	49051	12161

Table 3.2.5.2. Norwegian spring-spawning herring. Acoustic estimates (billion individuals) of immature herring in the Barents Sea in May/June. No survey in 2003, 1990-2002. See footnotes. Data in black box used in the assessment except the yellow highlighted cell.

	AGE				
YEAR	1	2	3	4	5
1991	24.3	5.2			
1992	32.6	14	5.7		
1993	102.7	25.8	1.5		
1994	6.6	59.2	18	1.7	
1995	0.5	7.7	8	1.1	
1996[1]	0.1	0.25	1.8	0.6	0.03
1997[2]	2.6	0.04	0.4	0.35	0.05
1998	9.5	4.7	0.01	0.01	0
1999	49.5	4.9	0	0	0
2000	105.4	27.9	0	0	0
2001	0.3	7.6	8.8	0	0
2002	0.5	3.9	0	0	0
2003[3]					
2004[3]					
2005	23.3	4.5	2.5	0.4	0.3
2006	3.7	35.0	5.3	0.87	0
2007	2.1	3.7	12.5	1.9	0

[1] Average of Norwegian and Russian estimates

[2] Combination of Norwegian and Russian estimates as described in 1998 WG report, since then only Russian estimates

[3] No surveys

Table 3.2.5.3. Norwegian Spring-spawning herring. Estimates from the acoustic surveys on the spawning stock in February-March. Numbers in millions. Biomass in thousands. Data in black box are used in assessment. The yellow highlighted cells are treated in the program with relation to the ratio between the 1983 and 1985 year classes.

	AGE															Total
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total	Biomass
1988		255	146	6805	202										7408	
1989	101	5	373	103	5402	182									6166	
1990	183	187	0	345	112	4489	146								5462	
1991	44	59	54	12	354	122	4148	102							4895	
1992*																
1993*																
1994	16	128	676	1375	476	63	13	140	35	1820					4742	
1995		1792	7621	3807	2151	322	20	1	124	63	2573				18474	3514
1996	407	231	7638	11243	2586	957	471	0	0	165	0	2024			25756	4824
1997*																
1998			381	1905	10640	6708	1280	434	130	39	0	175	0	804	22496	5360
1999	106	1366	337	1286	2979	11791	7534	1912	568	132	0	0	392	437	28840	7213
2000	1516	690	1996	164	592	1997	7714	4240	553	71	3	0	6	361	19903	4913
2001**																
2002**																
2003**																
2004**																
2005	103	281	811	3310	7545	10453	887	563	159	122	610	1100	686	17	26649	6501
2006	13	75	10167	684	1103	4540	4407	133	47	11	113	120	323	135	21871	4858
2007	109	534	2097	14575	952	592	3270	3092	263	276	20	285	189	628	26882	6004

*** No estimate due to poor weather conditions.**

**** No surveys.**

Table 3.2.5.4. Norwegian Spring-spawning herring. Estimates obtained on the acoustic surveys in the wintering areas in November-December. Numbers in millions. Data in black box are used in assessment. The yellow highlighted cells are treated in the program with relation to the ratio between the 1983 and 1985 yearclasses.

	AGE															Total
YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	TOTAL	BIOMASS
1992		36	1247	1317	173	16	208	139	3742	69					6947	
1993	72	1518	2389	3287	1267	13	13	158	26	4435					13178	
1994		16	3708	4124	2593	1096	34	25	196	29	3239				15209	
1995	380	183	5133	5274	1839	1040	308	19	13	111	39	907			15246	
1996		1465	3008	13180	5637	994	552	92	0	7	41	15	393		25384	
1997	9	73	661	1480	6110	4458	1843	743	66	0	0	126	0	842	16411	
1998	65	1207	441	1833	3869	12052	8242	2068	629	111	14	0	392	221	31144	
1999	74	159	2425	296	837	2066	6601	4168	755	212	0	15	0	146	17754	
2000	56	322	1522	5260	165	497	1869	4785	3635	668	205	0	0	168	19152	
2001	362	522	3916	1528	2615	82	338	864	3160	2216	384	127	0	18	16132	
2002*	7	50	276	1659	624	1029	32	188	516	1831	911	184	0	0	7345	
2003**	586	406	2167	10670	13237	1047	678	41	134	301	1214	502	10	37	31030	
2004**	257	6814	1123	1596	5334	6731	363	280	37	42	187	761	392	83	24000	
2005	61	352	7173	465	685	2030	3101	177	190	57	46	184	476	327	15325	
2006	940	7785	3712	21320	1153	340	2879	4851	4	23	713	4	150	58	43778	

*** Much of the youngest yearclasses (-98,-99) wintered outside the fjords this winter and are not included in the estimate**

**** In 2003-2004 a combined estimate from the Tysfjord, Ofotfjord and oceanic areas off Vesterålen/Troms.**

Table 3.2.5.5. Norwegian spring spawning herring. Estimates obtained on the acoustic surveys in the wintering areas in January. Numbers in millions. Data in the black box are used in the assessment. The yellow highlighted cells are treated in the program with relation to the ratio between the 1983 and 1985 year classes.

	AGE														
YEAR	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	TOTAL
1991	90	220	70	20	180	150	5500	440							6670
1992		410	820	260	60	510	120	4690	30						6900
1993		61	1905	2048	256	27	269	182	5691	128					10567
1994	73	642	3431	4847	1503	102	29	161	131	3679					14598
1995		47	3781	4013	2445	1215	42	24	267	29	4326				16189
1996		315	10442	13557	4312	1271	290	22	25	200	58	1146			31638
1997*															-
1998	214	267	1938	4162	9647	6974	1518	743	16	4	0	181	7	314	25985
1999**	0	1358	199	1455	4452	12971	7226	1876	499	16	16	0	156	220	30444

*** No estimate due to poor weather conditions.**

**** No surveys since 1999.**

Table 3.2.5.7. Norwegian spring-spawning herring. Abundance indices for 0-group herring 1980-2007 in the Barents Sea, August-October. ***This index has been recalculated since 2006, these are the new values..***

YEAR	ABUNDANCE INDEX
1980	4
1981	3
1982	202
1983	40557
1984	6313
1985	7237
1986	7
1987	2
1988	8686
1989	4196
1990	9508
1991	81175
1992	37183
1993	61508
1994	14884
1995	1308
1996	57169
1997	45808
1998	79492
1999	15931
2000	49614
2001	844
2002	23354
2003	28579
2004	133350
2005	26332
2006	66819

Table 3.2.5.8. Norwegian spring-spawning herring. Acoustic estimates (billion individuals) of immature herring in the Barents Sea in August-October. Data in black boxes used in the assessment.

	AGE		
YEAR	1	2	3
2000	14.7	11.5	0
2001	0.5	10.5	1.7
2002	1.3	0	0
2003	99.9	4.3	2.5
2004	14.3	36.5	0.9
2005	46.4	16.1	7.0
2006	1.6	5.5	1.3

Table 3.2.5.9. Norwegian Spring-spawning herring. The indices for herring larvae on the Norwegian shelf for the period 1981-2007 ($N*10^{-12}$). Data in black box are used in the assessment.

YEAR	INDEX1	INDEX 2
1981	0.3	
1982	0.7	
1983	2.5	
1984	1.4	
1985	2.3	
1986	1	
1987	1.3	4
1988	9.2	25.5
1989	13.4	28.7
1990	18.3	29.2
1991	8.6	23.5
1992	6.3	27.8
1993	24.7	78
1994	19.5	48.6
1995	18.2	36.3
1996	27.7	81.7
1997	66.6	147.5
1998	42.4	138.6
1999	19.9	73
2000	19.8	89.4
2001	40.7	135.9
2002	27.1	138.6
2003	3.7	18.8
2004	56.4	215.1
2005	73.91	196.7
2006	98.9	389.0
2007*	93.8	

Index 1. The total number of herring larvae found during the cruise.

Index 2. Back-calculated number of newly hatched larvae with 10% daily moratlity. The larval age is estimated from the duration of the yolksac stages and the size of the larvae.

*** only representative for the area 62–66°N**

Table 3.3.3.1 Norwegian spring spawning herring. Settings used in SeaStar.

Year classes with free terminal Fs	1983,1990,1991,1992,1993,1996,1997, 1998,1999,2002,2003,2004,2005
Larvae observation model	Logistic, deletion of 2003 point

Use of tagging data	No
Proportion of year before spawning	0.0
Error distribution model for surveys	Gamma for surveys 1,2,3,5, lognormal for surveys 4 and 6
Error distribution model for zerogroup data	Lognormal
Error distribution model for larval data	Gamma
M	0.9 for ages 0,1,2, 0.5 for plus group, else 0.15

Table 3.3.4.1. Norwegian spring spawning herring. Results from TISVPA.

YEAR	B(1+)	SSB (JAN.1)	SSB (SP.TIME)	R(1)	F(5-14, W-D BY N(A))
1986	1647.84	406.25	341.69	13692.68	1.238
1987	2752.92	788.89	747.97	3030.64	0.378
1988	3055.63	2421.39	2308.77	3827.43	0.052
1989	3564.64	2941.42	2835.08	10592.28	0.033
1990	3982.15	3126.71	3014.62	27837.80	0.025
1991	4421.86	3243.43	3136.92	45194.98	0.028
1992	5375.71	3147.07	3039.27	122077.57	0.033
1993	6738.56	3088.19	2961.11	148611.66	0.076
1994	7903.56	3562.11	3396.27	48863.09	0.150
1995	8785.36	4419.78	4188.41	18037.51	0.258
1996	8841.21	5908.08	5576.12	6660.15	0.218
1997	8897.23	7182.84	6620.46	27025.56	0.201
1998	7698.99	6638.88	6174.75	19764.42	0.165
1999	9076.22	6288.43	5874.78	111311.44	0.205
2000	8971.58	5370.84	5002.64	89298.20	0.233
2001	7526.40	4448.77	4218.78	21528.77	0.190
2002	7753.07	4591.25	4293.32	11665.02	0.196
2003	9758.05	5930.21	5629.9	155547.91	0.120
2004	11378.49	6746.46	6413.61	41908.42	0.099
2005	11999.52	7208.25	6797.37	118259.28	0.136
2006	12811.47	9436.13	8961.82	19727.20	0.140
2007		9589.62			

Table 3.3.4.2. Norwegian spring spawning herring. Abundance (in millions) estimated by TISVPA.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1986	13692.68	1953.99	18690.68	173.09	63.27	63.14	222.5	117.79	64.92	95.86	35.7	82.55	93.22	0	0	2.01
1987	3030.64	5566.39	792.52	15586.24	132.28	40.54	39.5	94.1	31.8	16.92	11.07	13.1	9.82	6.01	0	0
1988	3827.43	1228.34	2240.17	663.58	12950.4	96.22	31.18	27.51	55.01	16.24	5.28	4.89	3.85	1.96	0	0
1989	10592.28	1554.2	493.67	1869.68	547.95	10636.25	74.47	23.13	18.11	33.44	5.63	0	0	0	0	0
1990	27837.8	4305.22	615.95	422.12	1605.54	466.06	8854.12	61.32	19.9	15.59	25.99	0	0	0	0	0
1991	45194.98	11318	1740.17	512.53	360.54	1370.77	390.94	7411.14	51.85	0	0	20.52	0	0	0	0
1992	122077.6	18372.99	4599.64	1490.36	438.35	309.39	1165.92	328.13	6175.65	42.77	0	0	17.66	0	0	0
1993	148611.7	49633.04	7469.26	3946.89	1252.15	372.65	265.37	992.38	276.86	5105.76	34.96	0	0	14.27	0	0
1994	48863.09	60420.99	20174.82	6402.88	3297.85	997.02	312.4	224.69	826.32	220.67	4014.2	30.09	0	0	12.28	0
1995	18037.51	19866.25	24560.24	17334.02	5408.96	2500.79	705.06	254.04	185.97	676.89	156.53	2856.66	23.11	0	0	0
1996	6660.15	7333.5	8076.38	21085.39	14598.53	4077.55	1560.55	392.55	203.81	145.22	517.66	56.8	1612.64	0	0	0
1997	27025.56	2707.81	2962.45	6919.86	17485.95	11107.58	2636.57	966.51	242.31	169.85	118.5	384.33	32.19	611.5	0	0
1998	19764.42	10987.77	1086.89	2429.2	5704.56	13384.07	7710.46	1563.31	529.44	151.97	127.64	72.31	246.37	10.08	183.05	0
1999	111311.4	8035.61	4414.37	870.55	1866.32	4568.55	9886.95	5463.79	992.08	335.09	90.91	86.67	59.45	107.22	0	150.54
2000	89298.2	45255.86	3263.85	3671.46	715.89	1481.11	3534.19	7020.75	3622.83	583.92	190.07	64.33	37.49	44.68	9.71	155.04
2001	21528.77	36305.94	18390.73	2731.29	2640.52	583.7	1171.82	2667.09	4837.67	2148.71	301.26	96.8	40.52	10.93	0	95.45
2002	11665.02	8752.95	14759.62	15734.42	2201.48	1876.57	466.22	919.53	2020.98	3385.45	1379.05	190.65	61.05	31.17	0	28.31
2003	155547.9	4742.64	3519.15	12520.03	12946.2	1657.33	1312.73	373.44	704.24	1493.62	2298.79	872.45	114.92	41.41	20.33	0
2004	41908.42	63239.15	1925.03	2959.38	10475.5	10465.65	1263.19	974.02	300.09	537.49	1084.25	1452.55	547.75	62.73	28.22	16.81
2005	118259.3	17037.42	25683.06	1634.62	2461.81	8617.42	8345.46	984.26	710.32	233.24	414.38	776.43	877.27	275.7	28.02	15.17
2006	19727.2	48080.64	6914.14	21689.99	1319.72	1960.25	6819.61	6320.2	733.97	497.26	165.5	296.36	539.33	435	119.47	36.49
2007		8019	19519	5881	17991	1060	1529	5196	4724	549	357	115	201	340	243	67

Table 3.3.4.3. Norwegian spring spawning herring. TISVPA Estimates of F(a,y).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1986	0.0001	0.0024	0.0316	0.1189	0.2951	0.3190	0.7106	1.1594	1.1950	2.0084	0.8525	1.9792	2.5910	0.0000	0.0000	1.2911
1987	0.0031	0.0102	0.0276	0.0353	0.1682	0.1125	0.2120	0.3867	0.5221	1.0140	0.6669	1.0736	1.4635	1.3670	0.0000	0.0000
1988	0.0012	0.0116	0.0308	0.0415	0.0469	0.1063	0.1488	0.2680	0.3480	0.9098	0.9473	1.0817	1.8272	2.2780	0.0000	0.0000
1989	0.0003	0.0256	0.0066	0.0023	0.0119	0.0334	0.0444	0.0000	0.0000	0.1017	0.2127	0.0000	0.0000	0.0000	0.0000	0.0000
1990	0.0000	0.0059	0.0338	0.0077	0.0081	0.0258	0.0279	0.0177	0.1146	0.1489	0.0866	0.0000	0.0000	0.0000	0.0000	0.0000
1991	0.0001	0.0004	0.0050	0.0063	0.0030	0.0119	0.0251	0.0324	0.0425	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1992	0.0000	0.0001	0.0031	0.0242	0.0124	0.0035	0.0112	0.0199	0.0402	0.0517	0.0000	0.0000	0.0630	0.0000	0.0000	0.0000
1993	0.0000	0.0002	0.0041	0.0297	0.0778	0.0264	0.0164	0.0331	0.0769	0.0905	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1994	0.0000	0.0002	0.0018	0.0187	0.1267	0.1965	0.0568	0.0391	0.0495	0.1934	0.1902	0.1137	0.0000	0.0000	0.1930	0.0000
1995	0.0000	0.0001	0.0026	0.0218	0.1326	0.3216	0.4356	0.0703	0.0973	0.1182	0.8638	0.4218	0.2065	0.0000	0.0000	0.0000
1996	0.0000	0.0064	0.0046	0.0372	0.1233	0.2860	0.3291	0.3324	0.0323	0.0534	0.1478	0.4179	0.8197	0.0000	0.0000	0.0000
1997	0.0000	0.0128	0.0485	0.0431	0.1173	0.2151	0.3727	0.4519	0.3166	0.1357	0.3440	0.2947	1.0114	1.0561	0.0000	0.0000
1998	0.0000	0.0119	0.0720	0.1136	0.0721	0.1529	0.1944	0.3048	0.3074	0.3638	0.2371	0.0458	0.6820	1.0268	1.0268	0.0000
1999	0.0000	0.0010	0.0343	0.0456	0.0812	0.1067	0.1924	0.2609	0.3800	0.4170	0.1958	0.6881	0.1357	2.2514	0.0000	0.7894
2000	0.0000	0.0005	0.0281	0.1796	0.0541	0.0842	0.1315	0.2224	0.3724	0.5118	0.5248	0.3121	1.0828	0.8095	0.8095	0.8095
2001	0.0000	0.0001	0.0060	0.0657	0.1915	0.0747	0.0925	0.1274	0.2070	0.2935	0.3076	0.3110	0.1125	0.3509	0.0000	0.3509
2002	0.0000	0.0112	0.0146	0.0451	0.1339	0.2073	0.0719	0.1167	0.1524	0.2371	0.3078	0.3562	0.2381	0.2772	0.0000	0.6044
2003	0.0000	0.0017	0.0232	0.0283	0.0627	0.1216	0.1484	0.0687	0.1202	0.1703	0.3091	0.3155	0.4554	0.2335	0.3829	0.0000
2004	0.0001	0.0011	0.0135	0.0341	0.0453	0.0764	0.0995	0.1657	0.1020	0.1101	0.1839	0.3543	0.5365	0.6561	0.3646	0.3646
2005	0.0000	0.0018	0.0190	0.0640	0.0778	0.0840	0.1280	0.1434	0.2066	0.1931	0.1852	0.2144	0.5515	0.6862	0.5503	0.5503
2006	0.0002	0.0015	0.0119	0.0370	0.0693	0.0988	0.1219	0.1412	0.1401	0.1826	0.2174	0.2369	0.3117	0.4337	0.4337	0.4337

Table 3.4.1. Norwegian spring spawning herring. Stock in numbers (billions).

	Age																
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1950	751.000	26.500	14.300	10.900	4.020	4.980	8.610	8.000	1.960	2.800	3.200	2.580	5.630	6.150	0.952	2.570	6.710
1951	146.000	302.000	9.480	5.420	9.100	3.290	4.110	6.900	6.310	1.620	2.330	2.660	2.140	4.670	4.950	0.757	5.390
1952	96.600	58.500	118.000	3.600	4.660	7.480	2.670	3.390	5.460	4.870	1.320	1.930	2.190	1.740	3.780	3.940	3.490
1953	86.100	30.500	17.900	47.200	3.060	3.960	5.880	2.170	2.730	4.350	3.840	1.060	1.580	1.790	1.400	3.080	4.100
1954	42.100	31.400	9.190	6.920	39.900	2.590	3.310	4.730	1.800	2.240	3.450	2.940	0.858	1.280	1.450	1.120	3.830
1955	25.000	10.300	8.250	3.190	5.710	33.000	2.100	2.630	3.620	1.430	1.750	2.560	2.100	0.656	1.010	1.120	2.630
1956	29.900	6.850	2.360	3.030	2.660	4.660	26.500	1.700	2.090	2.860	1.150	1.320	1.930	1.620	0.510	0.787	1.910
1957	25.400	8.720	1.500	0.559	2.500	2.060	3.720	20.400	1.360	1.610	2.210	0.867	0.955	1.410	1.240	0.381	1.440
1958	23.100	7.140	1.450	0.468	0.460	1.800	1.630	2.990	15.800	1.110	1.270	1.740	0.665	0.709	1.080	0.948	0.959
1959	412.000	3.230	1.120	0.163	0.387	0.379	1.450	1.320	2.390	12.700	0.886	0.976	1.310	0.480	0.539	0.860	1.040
1960	198.000	156.000	1.180	0.247	0.127	0.308	0.302	1.110	1.030	1.830	9.870	0.680	0.725	0.942	0.331	0.392	1.060
1961	76.100	72.100	54.900	0.231	0.099	0.092	0.239	0.237	0.868	0.817	1.390	7.420	0.506	0.503	0.669	0.233	0.849
1962	19.000	27.000	19.100	20.500	0.170	0.078	0.075	0.192	0.186	0.690	0.658	1.070	5.710	0.390	0.391	0.517	0.589
1963	169.000	5.370	8.370	7.080	15.900	0.139	0.064	0.058	0.146	0.149	0.539	0.517	0.813	4.160	0.294	0.286	0.573
1964	93.900	65.600	0.833	2.100	5.390	12.900	0.115	0.054	0.047	0.109	0.120	0.364	0.359	0.538	2.720	0.180	0.295
1965	8.490	35.900	24.900	0.198	1.700	4.270	9.220	0.086	0.045	0.038	0.071	0.076	0.224	0.233	0.321	1.630	0.148
1966	51.400	1.980	12.200	8.320	0.087	1.230	3.150	5.900	0.056	0.025	0.025	0.043	0.028	0.100	0.100	0.148	0.719
1967	3.950	18.400	0.384	3.880	5.260	0.050	0.622	1.500	2.400	0.013	0.008	0.006	0.013	0.014	0.022	0.020	0.455
1968	5.190	1.330	1.180	0.111	2.050	1.510	0.018	0.144	0.238	0.469	0.003	0.002	0.002	0.003	0.004	0.003	0.276
1969	9.780	0.972	0.263	0.233	0.004	0.018	0.011	0.003	0.037	0.080	0.083	0.001	0.000	0.001	0.000	0.001	0.168
1970	0.661	3.620	0.072	0.017	0.026	0.003	0.007	0.005	0.002	0.021	0.038	0.038	0.000	0.000	0.000	0.000	0.101
1971	0.236	0.193	1.130	0.008	0.008	0.005	0.002	0.003	0.002	0.000	0.006	0.008	0.007	0.000	0.000	0.000	0.061
1972	0.957	0.077	0.051	0.407	0.005	0.006	0.003	0.001	0.002	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.037
1973	12.900	0.168	0.005	0.008	0.317	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.023
1974	8.630	5.220	0.066	0.001	0.004	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014
1975	2.970	3.470	2.120	0.024	0.001	0.004	0.192	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008
1976	10.100	1.190	1.410	0.860	0.018	0.000	0.002	0.137	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005
1977	5.100	4.080	0.482	0.571	0.718	0.010	0.000	0.002	0.106	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
1978	6.200	2.040	1.660	0.194	0.471	0.596	0.009	0.000	0.001	0.081	0.000	0.000	0.000	0.000	0.000	0.000	0.002
1979	12.500	2.510	0.830	0.672	0.164	0.394	0.494	0.007	0.000	0.001	0.065	0.000	0.000	0.000	0.000	0.000	0.001
1980	1.470	5.060	1.020	0.336	0.573	0.139	0.333	0.415	0.005	0.000	0.000	0.054	0.000	0.000	0.000	0.000	0.001
1981	1.100	0.595	2.060	0.413	0.283	0.487	0.118	0.279	0.343	0.004	0.000	0.000	0.044	0.000	0.000	0.000	0.000

Table 3.4.1. cont. Norwegian spring spawning herring. Stock in numbers (billions).

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1982	2.340	0.442	0.241	0.829	0.352	0.240	0.412	0.099	0.236	0.287	0.003	0.000	0.000	0.037	0.000	0.000	0.000
1983	357.000	0.938	0.179	0.098	0.700	0.296	0.202	0.348	0.084	0.198	0.242	0.003	0.000	0.000	0.032	0.000	0.000
1984	11.500	145.000	0.378	0.072	0.081	0.583	0.246	0.168	0.294	0.071	0.167	0.201	0.002	0.000	0.000	0.026	0.000
1985	37.400	4.670	58.900	0.152	0.058	0.065	0.445	0.194	0.133	0.238	0.054	0.128	0.167	0.002	0.000	0.000	0.014
1986	6.040	15.200	1.890	23.800	0.111	0.035	0.041	0.262	0.113	0.064	0.147	0.038	0.082	0.098	0.002	0.000	0.007
1987	9.160	2.450	6.170	0.766	20.000	0.079	0.017	0.021	0.128	0.027	0.016	0.055	0.014	0.009	0.010	0.001	0.004
1988	31.800	3.710	0.991	2.490	0.641	16.700	0.051	0.011	0.011	0.085	0.012	0.005	0.043	0.005	0.002	0.002	0.003
1989	76.900	12.900	1.510	0.397	2.080	0.528	13.900	0.035	0.006	0.004	0.059	0.002	0.001	0.034	0.002	0.000	0.003
1990	126.000	31.300	5.260	0.597	0.339	1.790	0.449	11.700	0.027	0.005	0.003	0.048	0.001	0.001	0.029	0.001	0.002
1991	353.000	51.200	12.700	2.130	0.497	0.289	1.530	0.377	9.830	0.022	0.003	0.001	0.039	0.000	0.000	0.024	0.002
1992	418.000	144.000	20.800	5.170	1.820	0.425	0.248	1.300	0.316	8.260	0.017	0.002	0.000	0.033	0.000	0.000	0.016
1993	136.000	170.000	58.300	8.470	4.440	1.540	0.361	0.212	1.110	0.267	6.900	0.012	0.001	0.000	0.027	0.000	0.010
1994	49.400	55.400	69.100	23.700	7.260	3.720	1.240	0.303	0.179	0.927	0.212	5.560	0.010	0.001	0.000	0.023	0.006
1995	19.700	20.100	22.500	28.100	20.400	6.150	2.860	0.917	0.246	0.147	0.763	0.150	4.190	0.006	0.000	0.000	0.017
1996	75.400	7.990	8.160	9.150	24.100	17.200	4.710	1.870	0.575	0.198	0.112	0.592	0.051	2.760	0.002	0.000	0.011
1997	51.000	30.700	3.250	3.300	7.850	20.100	13.400	3.180	1.230	0.399	0.165	0.089	0.448	0.028	1.600	0.001	0.006
1998	332.000	20.700	12.500	1.310	2.720	6.500	15.600	9.660	2.030	0.760	0.287	0.123	0.047	0.302	0.006	1.030	0.005
1999	272.000	135.000	8.430	5.020	1.060	2.110	5.250	11.800	7.140	1.400	0.533	0.207	0.083	0.037	0.155	0.000	0.578
2000	68.600	111.000	54.900	3.420	4.190	0.879	1.690	4.120	8.680	5.060	0.932	0.361	0.165	0.034	0.025	0.052	0.298
2001	37.200	27.900	45.000	22.300	2.870	3.090	0.724	1.360	3.170	6.270	3.390	0.601	0.244	0.127	0.008	0.000	0.195
2002	448.000	15.100	11.300	18.300	19.100	2.320	2.260	0.588	1.080	2.460	4.620	2.450	0.449	0.188	0.106	0.004	0.111
2003	238.000	182.000	6.150	4.570	15.600	15.800	1.760	1.640	0.478	0.841	1.870	3.360	1.790	0.337	0.150	0.085	0.069
2004	554.000	96.900	74.000	2.500	3.860	13.100	13.000	1.350	1.260	0.390	0.655	1.410	2.370	1.340	0.254	0.122	0.090
2005	74.000	225.000	39.400	30.100	2.130	3.240	10.900	10.500	1.060	0.955	0.311	0.515	1.050	1.660	0.956	0.193	0.125
2006	0.031	30.100	91.600	16.000	25.500	1.740	2.630	8.760	8.170	0.800	0.707	0.233	0.382	0.779	1.110	0.705	0.185
2007	0.000	0.012	12.200	37.200	13.700	21.200	1.420	2.100	6.870	6.310	0.606	0.537	0.172	0.275	0.546	0.825	0.675

Table 3.4.2. Norwegian spring spawning herring. Fishing mortality.

	AGE																
YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1950	0.011	0.126	0.068	0.028	0.051	0.041	0.071	0.088	0.045	0.035	0.038	0.037	0.038	0.067	0.078	0.046	0.046
1951	0.018	0.040	0.068	0.001	0.047	0.058	0.044	0.084	0.109	0.053	0.039	0.043	0.056	0.060	0.079	0.070	0.070
1952	0.252	0.282	0.017	0.012	0.014	0.091	0.057	0.067	0.078	0.087	0.067	0.049	0.055	0.068	0.055	0.073	0.073
1953	0.110	0.301	0.052	0.017	0.017	0.028	0.067	0.041	0.045	0.081	0.117	0.065	0.064	0.059	0.079	0.078	0.078
1954	0.507	0.436	0.158	0.042	0.040	0.061	0.080	0.118	0.080	0.101	0.148	0.185	0.118	0.089	0.104	0.130	0.130
1955	0.393	0.575	0.102	0.032	0.054	0.069	0.061	0.081	0.085	0.067	0.127	0.133	0.110	0.101	0.095	0.104	0.104
1956	0.331	0.622	0.540	0.042	0.107	0.076	0.110	0.072	0.111	0.105	0.131	0.176	0.165	0.115	0.143	0.130	0.130
1957	0.369	0.896	0.262	0.046	0.176	0.084	0.069	0.111	0.059	0.089	0.093	0.116	0.147	0.121	0.121	0.100	0.100
1958	1.070	0.954	1.280	0.041	0.043	0.069	0.061	0.073	0.069	0.071	0.111	0.133	0.174	0.125	0.074	0.082	0.082
1959	0.071	0.102	0.611	0.105	0.078	0.077	0.115	0.099	0.115	0.099	0.114	0.148	0.178	0.221	0.168	0.113	0.113
1960	0.108	0.147	0.733	0.759	0.168	0.104	0.091	0.098	0.080	0.128	0.136	0.145	0.214	0.193	0.204	0.139	0.139
1961	0.137	0.430	0.086	0.157	0.092	0.049	0.070	0.092	0.080	0.067	0.112	0.112	0.112	0.101	0.107	0.106	0.106
1962	0.364	0.271	0.090	0.102	0.052	0.044	0.109	0.121	0.071	0.097	0.090	0.125	0.167	0.130	0.163	0.147	0.147
1963	0.046	0.964	0.483	0.123	0.058	0.042	0.031	0.069	0.145	0.070	0.243	0.214	0.263	0.274	0.344	0.257	0.257
1964	0.062	0.067	0.536	0.061	0.083	0.187	0.138	0.031	0.072	0.283	0.306	0.333	0.284	0.366	0.365	0.320	0.320
1965	0.554	0.181	0.198	0.672	0.177	0.156	0.297	0.280	0.444	0.239	0.344	0.838	0.659	0.691	0.627	0.620	0.620
1966	0.128	0.742	0.244	0.308	0.405	0.529	0.593	0.749	1.310	0.976	1.340	1.060	0.543	1.370	1.480	1.190	1.190
1967	0.186	1.850	0.339	0.489	1.100	0.853	1.310	1.690	1.480	1.330	1.450	1.080	1.260	1.130	1.990	1.480	1.480
1968	0.775	0.722	0.724	3.230	4.590	4.750	1.810	1.210	0.936	1.580	1.290	1.320	0.771	1.960	1.250	1.360	1.360
1969	0.094	1.710	1.870	2.050	0.259	0.756	0.599	0.347	0.419	0.600	0.626	0.612	0.867	0.394	0.843	0.578	0.578
1970	0.333	0.261	1.300	0.529	1.490	0.298	0.678	1.100	1.160	1.180	1.370	1.550	3.940	1.620	0.823	1.410	1.410
1971	0.226	0.429	0.125	0.283	0.140	0.308	0.277	0.476	1.630	2.550	1.960	2.280	1.840	0.217	2.800	2.030	2.030
1972	0.842	1.830	0.987	0.098	1.290	0.956	1.820	1.250	2.980	1.780	0.039	1.570	2.070	1.110	0.332	2.110	2.110
1973	0.004	0.033	0.769	0.405	0.090	0.857	1.520	1.120	1.370	0.015	0.029	0.047	0.009	0.014	1.260	0.603	0.603
1974	0.012	0.002	0.097	0.122	0.060	0.112	0.973	0.779	0.009	0.019	0.017	0.035	0.058	0.011	0.016	0.017	0.017
1975	0.016	0.002	0.001	0.157	0.222	0.319	0.189	0.038	0.014	0.010	0.023	0.021	0.043	0.072	0.012	0.019	0.019
1976	0.003	0.003	0.001	0.030	0.397	0.002	0.000	0.109	0.009	0.008	0.012	0.027	0.024	0.052	0.090	0.015	0.015
1977	0.013	0.002	0.010	0.043	0.036	0.036	0.003	0.266	0.116	0.011	0.010	0.014	0.033	0.029	0.064	0.116	0.116
1978	0.005	0.002	0.001	0.017	0.028	0.037	0.115	0.003	0.743	0.069	0.012	0.011	0.017	0.039	0.035	0.079	0.079
1979	0.004	0.002	0.004	0.010	0.012	0.019	0.025	0.055	0.003	0.002	0.043	0.015	0.013	0.020	0.048	0.042	0.042
1980	0.007	0.000	0.001	0.021	0.011	0.018	0.027	0.042	0.093	0.033	0.002	0.055	0.017	0.016	0.023	0.058	0.058
1981	0.012	0.003	0.009	0.011	0.018	0.019	0.020	0.018	0.026	0.092	0.692	0.384	0.024	0.021	0.019	0.028	0.028

Table 3.4.2. cont. Norwegian spring spawning herring. Fishing mortality.

	AGE																
YEAR	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1982	0.015	0.004	0.001	0.018	0.025	0.021	0.017	0.022	0.023	0.023	0.040	0.539	0.194	0.004	0.024	0.022	0.022
1983	0.001	0.008	0.015	0.036	0.033	0.035	0.034	0.021	0.017	0.025	0.033	0.058	2.280	3.310	0.030	0.029	0.029
1984	0.005	0.000	0.010	0.070	0.074	0.121	0.083	0.085	0.059	0.116	0.112	0.035	0.000	0.294	0.242	0.070	0.070
1985	0.001	0.004	0.006	0.165	0.343	0.320	0.378	0.396	0.590	0.336	0.221	0.302	0.389	0.001	0.506	0.379	0.379
1986	0.004	0.000	0.003	0.025	0.187	0.588	0.530	0.565	1.260	1.250	0.835	0.820	2.060	2.160	0.001	1.400	1.400
1987	0.002	0.004	0.009	0.028	0.027	0.293	0.254	0.461	0.268	0.639	1.060	0.093	0.903	1.520	1.520	0.417	0.417
1988	0.001	0.001	0.015	0.028	0.043	0.036	0.223	0.436	0.857	0.206	1.460	1.060	0.088	0.875	4.760	0.381	0.381
1989	0.000	0.000	0.027	0.008	0.002	0.012	0.026	0.113	0.149	0.198	0.062	0.912	0.744	0.010	0.171	0.090	0.090
1990	0.000	0.000	0.005	0.034	0.008	0.007	0.026	0.021	0.053	0.436	1.430	0.056	1.680	0.413	0.022	0.153	0.153
1991	0.000	0.000	0.000	0.004	0.006	0.005	0.010	0.026	0.024	0.130	0.214	0.172	0.019	1.650	1.990	0.024	0.024
1992	0.000	0.000	0.000	0.003	0.020	0.013	0.005	0.010	0.020	0.030	0.175	0.486	0.963	0.041	0.048	0.029	0.029
1993	0.000	0.000	0.000	0.004	0.026	0.063	0.026	0.019	0.029	0.078	0.066	0.000	0.001	0.008	0.000	0.059	0.059
1994	0.000	0.000	0.000	0.001	0.017	0.111	0.154	0.057	0.050	0.044	0.200	0.134	0.349	0.939	2.220	0.100	0.100
1995	0.000	0.000	0.000	0.002	0.019	0.116	0.275	0.317	0.070	0.124	0.104	0.924	0.268	1.200	4.050	0.100	0.100
1996	0.000	0.000	0.006	0.004	0.032	0.103	0.242	0.266	0.216	0.032	0.074	0.128	0.463	0.396	0.001	0.303	0.303
1997	0.000	0.000	0.011	0.044	0.038	0.101	0.175	0.298	0.336	0.180	0.140	0.497	0.245	1.370	0.288	0.262	0.262
1998	0.000	0.000	0.011	0.060	0.101	0.063	0.129	0.152	0.226	0.204	0.174	0.251	0.084	0.514	6.250	0.120	0.120
1999	0.000	0.000	0.001	0.030	0.037	0.071	0.092	0.158	0.193	0.255	0.241	0.079	0.740	0.236	0.953	0.112	0.112
2000	0.000	0.000	0.000	0.027	0.156	0.044	0.073	0.112	0.176	0.252	0.289	0.241	0.112	1.280	7.510	0.104	0.104
2001	0.000	0.000	0.000	0.005	0.062	0.161	0.059	0.079	0.106	0.156	0.176	0.142	0.111	0.030	0.591	0.095	0.095
2002	0.000	0.000	0.009	0.012	0.037	0.126	0.169	0.056	0.098	0.123	0.168	0.162	0.136	0.074	0.074	0.087	0.087
2003	0.000	0.000	0.001	0.018	0.023	0.051	0.114	0.117	0.053	0.100	0.134	0.201	0.141	0.132	0.060	0.079	0.079
2004	0.000	0.000	0.001	0.011	0.026	0.036	0.061	0.093	0.126	0.077	0.090	0.139	0.202	0.186	0.126	0.071	0.071
2005	0.000	0.000	0.001	0.016	0.049	0.058	0.066	0.100	0.132	0.150	0.141	0.147	0.154	0.253	0.154	0.062	0.062
2006	0.000	0.000	0.001	0.005	0.031	0.052	0.073	0.093	0.107	0.127	0.125	0.151	0.177	0.204	0.148	0.061	0.061

Table 3.4.3. Norwegian spring spawning herring. Stock summary table.

	RECRUITMENT	TOTAL BIOMASS	SPAWNING STOCK BIOMASS (JAN.1)	LANDINGS	WEIGHTED F
YEAR	AGE 1 IN YEAR	MILLION TONS	MILLION TONS	TONS	5–14
1950	26.500	20.013	14.653	826100	0.058
1951	302.000	19.274	12.913	1277900	0.070
1952	58.500	20.182	11.290	1254800	0.073
1953	30.500	17.419	9.671	1074400	0.066
1954	31.400	18.565	8.937	1644500	0.113
1955	10.300	15.725	9.556	1359800	0.078
1956	6.850	13.799	11.234	1659400	0.110
1957	8.720	11.088	9.913	1318500	0.103
1958	7.140	9.549	8.939	986300	0.079
1959	3.230	8.076	7.392	1111100	0.113
1960	156.000	7.634	6.022	1101800	0.136
1961	72.100	7.796	4.515	830100	0.104
1962	27.000	6.765	3.547	848600	0.146
1963	5.370	6.913	2.746	984500	0.253
1964	65.600	6.446	2.597	1281800	0.226
1965	35.900	5.935	3.164	1547700	0.278
1966	1.980	4.392	2.887	1955000	0.696
1967	18.400	3.018	1.515	1677200	1.519
1968	1.330	0.982	0.356	712200	3.493
1969	0.972	0.190	0.151	67800	0.590
1970	3.620	0.116	0.075	62300	1.320
1971	0.193	0.130	0.034	21100	1.525
1972	0.077	0.085	0.017	13161	1.497
1973	0.168	0.112	0.088	7017	1.173
1974	5.220	0.160	0.094	7619	0.114
1975	3.470	0.302	0.082	13713	0.190
1976	1.190	0.362	0.142	10436	0.106
1977	4.080	0.429	0.294	22706	0.111
1978	2.040	0.579	0.367	19824	0.043
1979	2.510	0.635	0.398	12864	0.024
1980	5.060	0.748	0.483	18577	0.034
1981	0.595	0.796	0.517	13736	0.022
1982	0.442	0.729	0.516	16655	0.020
1983	0.938	1.121	0.589	23054	0.029
1984	145.000	2.149	0.617	53532	0.090
1985	4.670	5.649	0.529	169872	0.379
1986	15.200	1.948	0.453	225256	1.074
1987	2.450	3.421	0.982	127306	0.404
1988	3.710	3.844	3.097	135301	0.040

Table 3.4.3. cont. Norwegian spring spawning herring. Stock summary table.

YEAR	RECRUITMENT AGE 1 IN YEAR	TOTAL BIOMASS MILLION TONS	SPAWNING STOCK BIOMASS (JAN.1) MILLION TONS	LANDINGS TONS	WEIGHTED F 5-14
1989	12.900	4.514	3.772	103830	0.026
1990	31.300	5.070	3.930	86411	0.020
1991	51.200	5.795	4.096	84683	0.022
1992	144.000	6.955	3.961	104448	0.026
1993	170.000	8.196	3.857	232457	0.060
1994	55.400	9.461	4.414	479228	0.120
1995	20.100	10.488	5.439	905501	0.206
1996	7.990	10.693	7.258	1220283	0.169
1997	30.700	10.837	8.839	1426507	0.160
1998	20.700	9.800	8.294	1223131	0.136
1999	135.000	11.501	7.918	1235433	0.160
2000	111.000	11.278	6.896	1207201	0.184
2001	27.900	9.658	5.890	766136	0.141
2002	15.100	10.432	6.106	807795	0.144
2003	182.000	12.742	7.840	750077	0.091
2004	96.900*	15.454	8.955	793666	0.074
2005	225.000**	16.947	9.629	1003243	0.099
2006	30.100***	****	12.327	968958	0.102

*** replaced with 35.000 in predictions**

**** replaced with 135.000 in predictions**

***** not used in predictions**

****** not calculated**

Table 3.7.1. Norwegian Spring-spawning herring. Input to short-term prediction.

2007

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef. spawn.	Prop. of M bef. spawn.	Weight in stock	Exploit. pattern	Weight in catch
1	0.000	0.9	0	0	0	0.010	0.000	0.071
2	0.000	0.9	0	0	0	0.036	0.010	0.117
3	22.320	0.15	0	0	0	0.086	0.105	0.177
4	4.948	0.15	0.3	0	0	0.155	0.346	0.233
5	21.200	0.15	1	0	0	0.226	0.477	0.265
6	1.420	0.15	1	0	0	0.265	0.654	0.291
7	2.100	0.15	1	0	0	0.312	0.935	0.316
8	6.870	0.15	1	0	0	0.310	1.193	0.343
9	6.310	0.15	1	0	0	0.364	1.157	0.369
10	0.606	0.15	1	0	0	0.384	1.163	0.380
11	0.537	0.15	1	0	0	0.352	1.428	0.382
12	0.172	0.15	1	0	0	0.386	1.742	0.389
13	0.275	0.15	1	0	0	0.304	2.101	0.400
14	0.546	0.15	1	0	0	0.420	1.399	0.410
15	0.825	0.15	1	0	0	0.412	0.634	0.420
16	0.675	0.5	1	0	0	0.412	0.634	0.420

2008 and 2009

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef. spawn.	Prop. of M bef. spawn.	Weight in stock	Exploit. pattern	Weight in catch
1	0.000	0.9	0	0	0	0.010	0.000	0.071
2	0.000	0.9	0	0	0	0.041	0.010	0.117
3		0.15	0	0	0	0.102	0.105	0.177
4		0.15	0.3	0	0	0.163	0.346	0.233
5		0.15	0.9	0	0	0.231	0.477	0.265
6		0.15	1	0	0	0.268	0.654	0.291
7		0.15	1	0	0	0.301	0.935	0.316
8		0.15	1	0	0	0.319	1.193	0.343
9		0.15	1	0	0	0.366	1.157	0.369
10		0.15	1	0	0	0.375	1.163	0.380
11		0.15	1	0	0	0.386	1.428	0.382
12		0.15	1	0	0	0.396	1.742	0.389
13		0.15	1	0	0	0.337	2.101	0.400
14		0.15	1	0	0	0.418	1.399	0.410
15		0.15	1	0	0	0.429	0.634	0.420
16		0.5	1	0	0	0.433	0.634	0.420

Table 3.7.2. Norwegian spring spawning herring. Short term prediction.

2007					2008					2009	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
	11898	1.53	0.127	1280		11742	0.0	0.000	0		13318
					.	11742	0.1	0.009	93		13232
					.	11742	0.2	0.018	186		13147
					.	11742	0.3	0.026	277		13062
					.	11742	0.4	0.035	369		12979
					.	11742	0.5	0.044	459		12896
					.	11742	0.6	0.053	549		12813
					.	11742	0.7	0.061	638		12731
						11742	0.8	0.070	726		12650
					.	11742	0.9	0.079	814		12570
					.	11742	1.0	0.088	901		12490
						11742	1.1	0.096	987		12411
					.	11742	1.2	0.105	1073		12332
					.	11742	1.3	0.114	1158		12254
					.	11742	1.43	0.125	1266		12155
					.	11742	1.5	0.131	1327		12100
					.	11742	1.6	0.140	1410		12023
					.	11742	1.72	0.150	1507		11935
					.	11742	1.8	0.158	1575		11873
					.	11742	1.9	0.166	1656		11798
					.	11742	2.0	0.175	1737		11724

Table 3.9.2.1. Norwegian Spring-spawning herring. Input data for yield per recruit calculations.

Age	Natural Mortality	Exploitation Pattern	Maturity ogive	Weight in catches	Weight in stock
1	0.9	0.000	0	0.071	0.010
2	0.9	0.010	0	0.117	0.041
3	0.15	0.105	0	0.177	0.102
4	0.15	0.346	0.3	0.233	0.163
5	0.15	0.477	0.9	0.265	0.231
6	0.15	0.654	1	0.291	0.268
7	0.15	0.935	1	0.316	0.301
8	0.15	1.193	1	0.343	0.319
9	0.15	1.157	1	0.369	0.366
10	0.15	1.163	1	0.380	0.375
11	0.15	1.428	1	0.382	0.386
12	0.15	1.742	1	0.389	0.396
13	0.15	2.101	1	0.400	0.337
14	0.15	1.399	1	0.410	0.418
15	0.15	0.634	1	0.420	0.429
16+	0.5	0.634	1	0.420	0.433

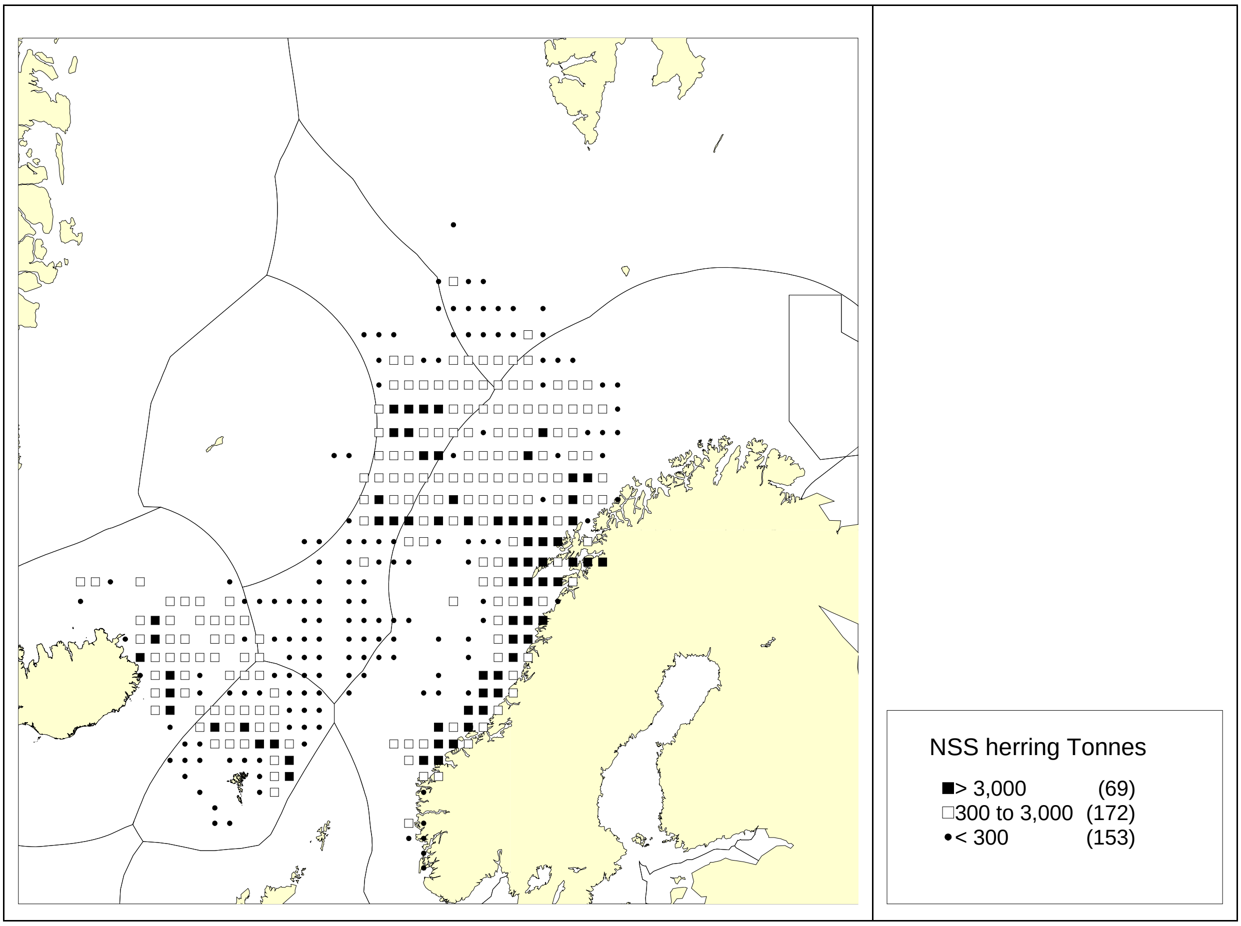
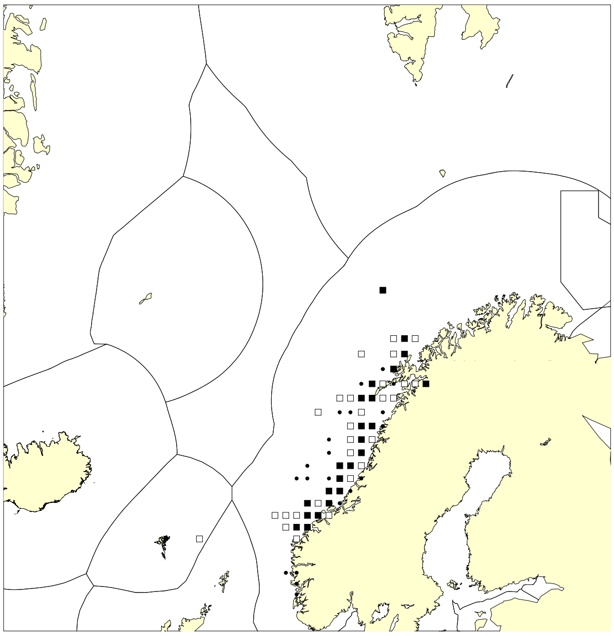
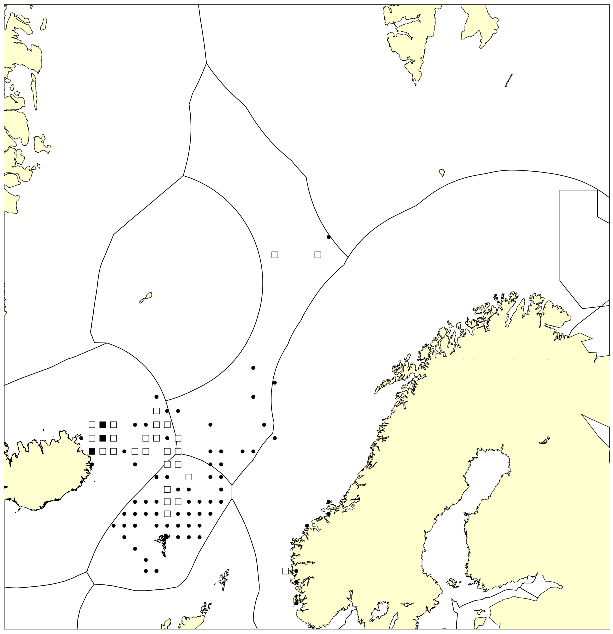


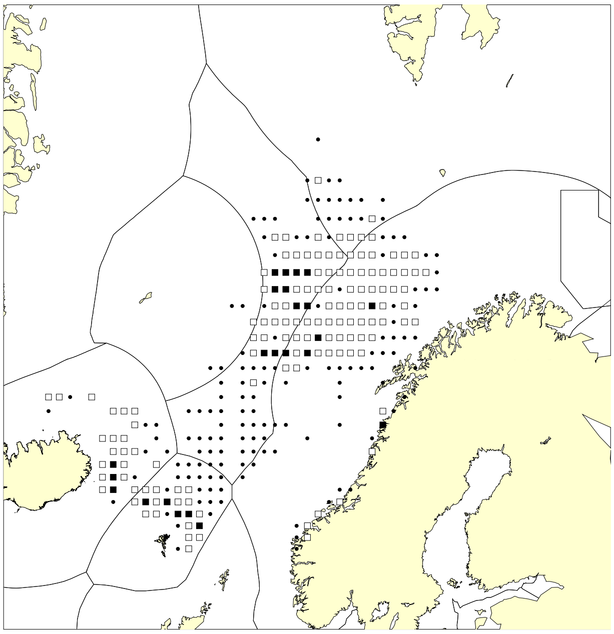
Figure 3.1.5.1. Total reported catches of Norwegian spring-spawning herring in 2006 by ICES rectangle. Grading of the symbols: black dots less than 300 t, open squares 300–3000 t, and black squares > 3000 t.



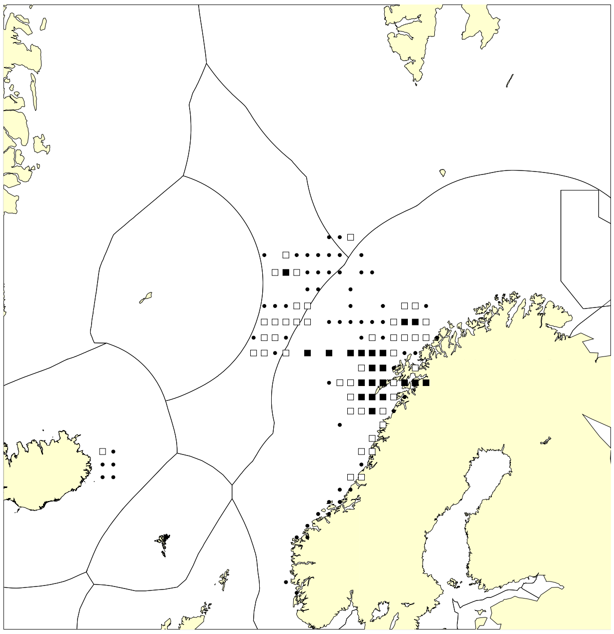
Quarter 1



Quarter 2



Quarter 3



Quarter 4

Figure 3.1.5.2. Total reported catches of Norwegian spring-spawning herring in 2006 by quarter and ICES rectangle. Grading of the symbols: black dots less than 300 t, open squares 300–3000 t, and black squares > 3000 t.

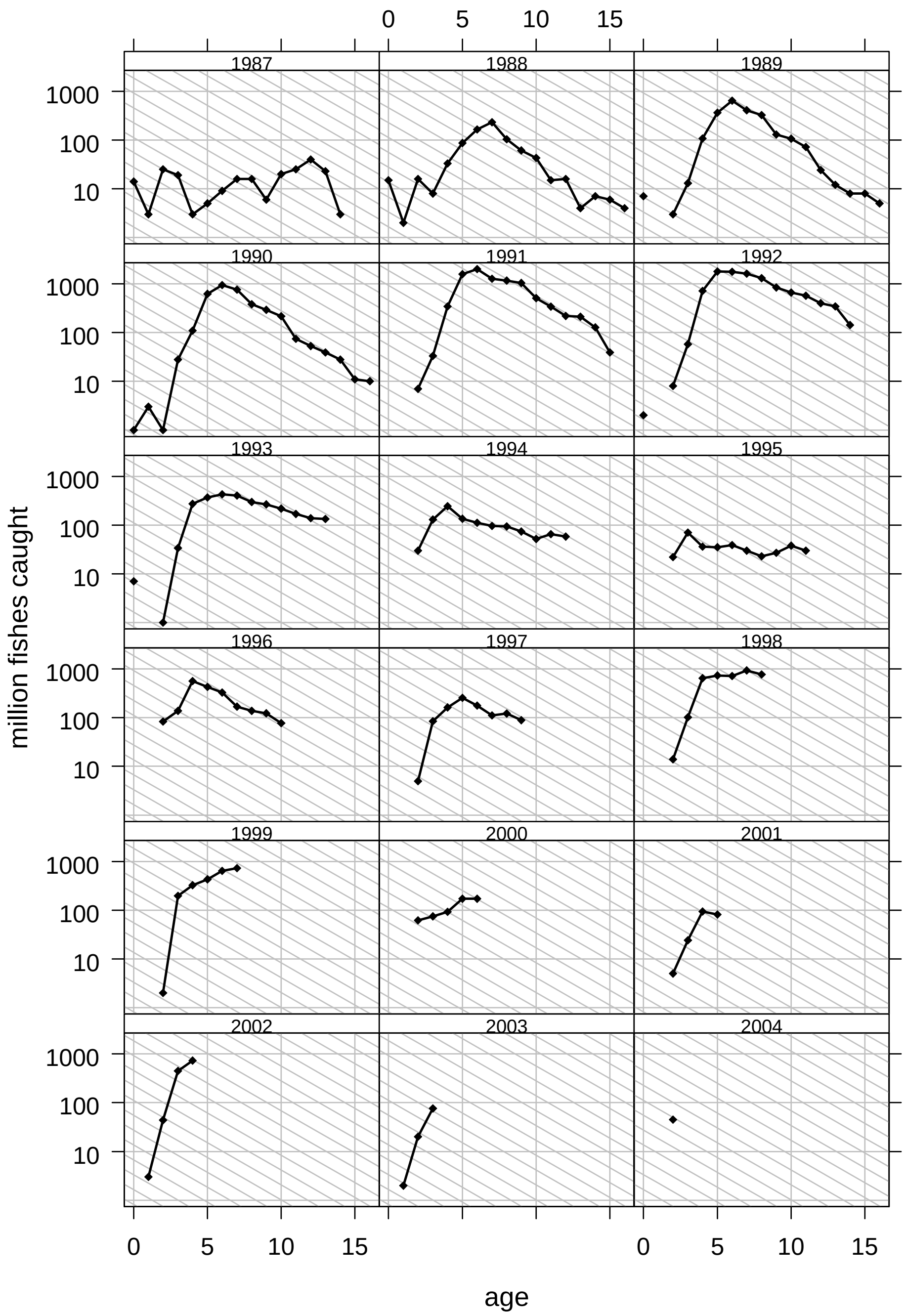


Figure 3.3.2.1. Norwegian spring spawning herring. Age disaggregated catch in numbers plotted on a log scale. The labels above each figure indicate year classes. They grey lines correspond to Z=0.4.

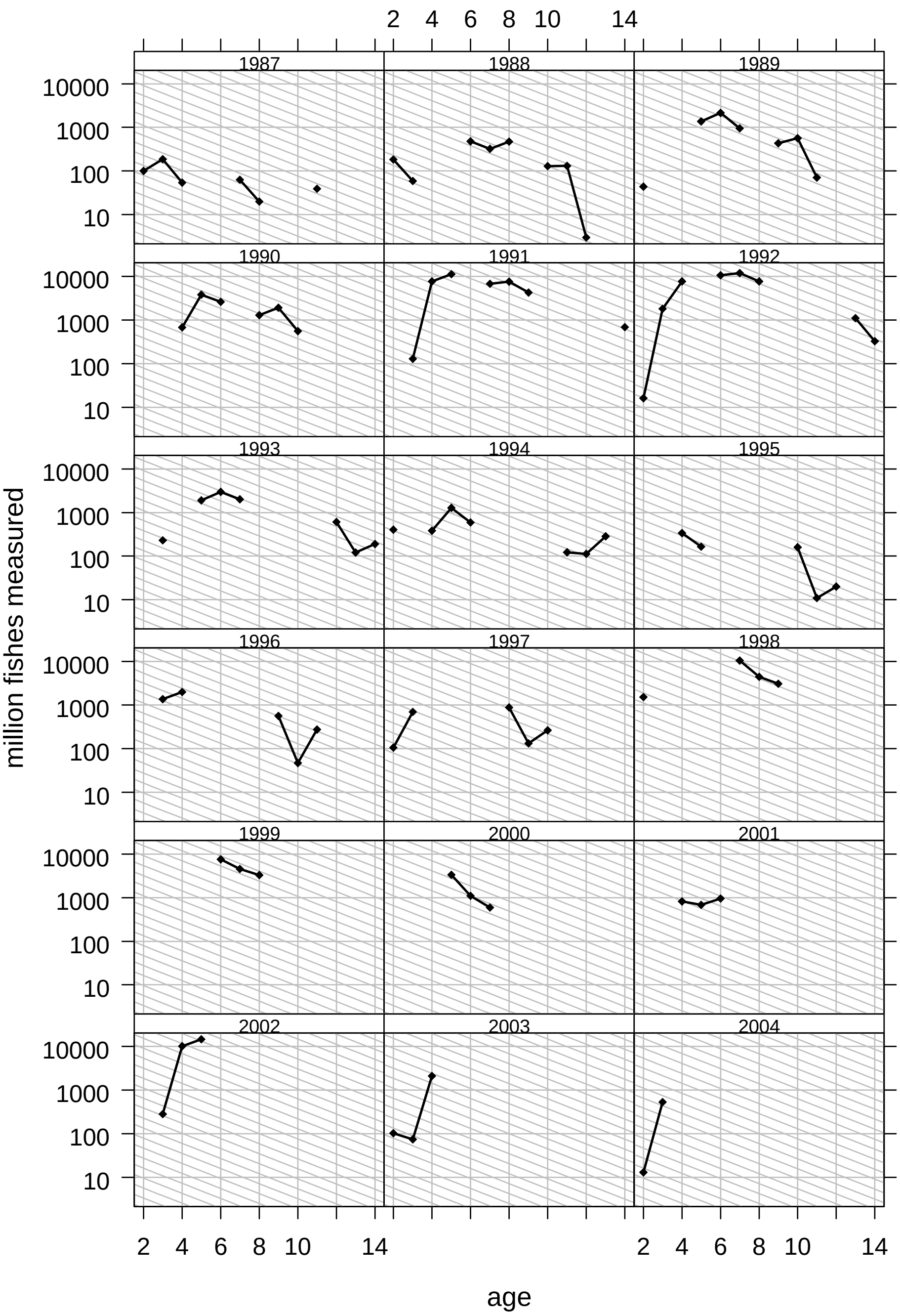


Figure 3.3.2.2. Norwegian spring spawning herring. Age disaggregated abundance indices from the acoustic surveys on the spawning stock in February-March plotted on log scale. The labels above each figure indicate year classes. They grey lines correspond to Z=0.4.

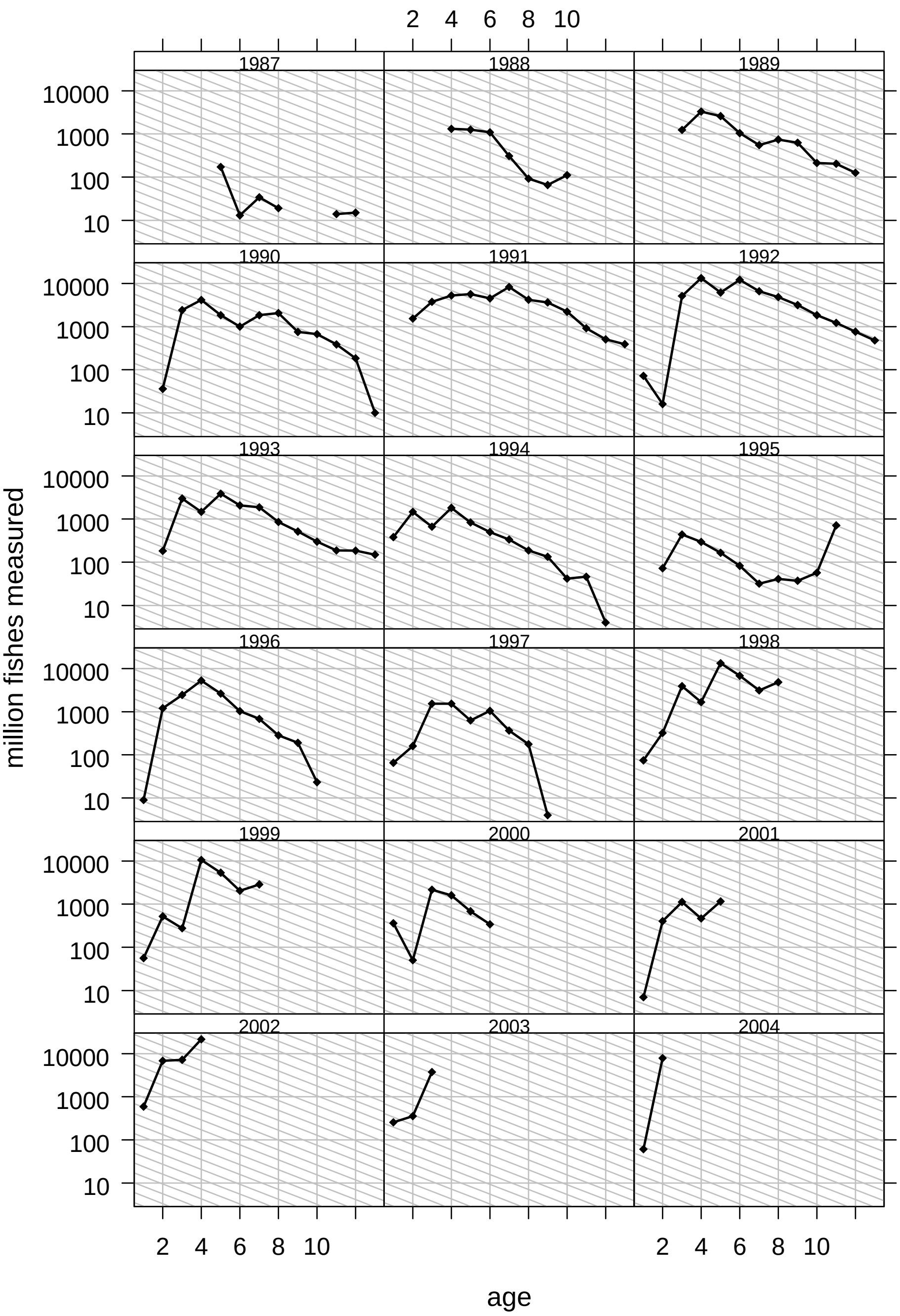


Figure 3.3.2.3. Norwegian spring spawning herring. Age disaggregated abundance indices from the acoustic surveys in the wintering areas in November-December plotted on log scale. The labels above each figure indicate year classes. They grey lines correspond to Z=0.4.

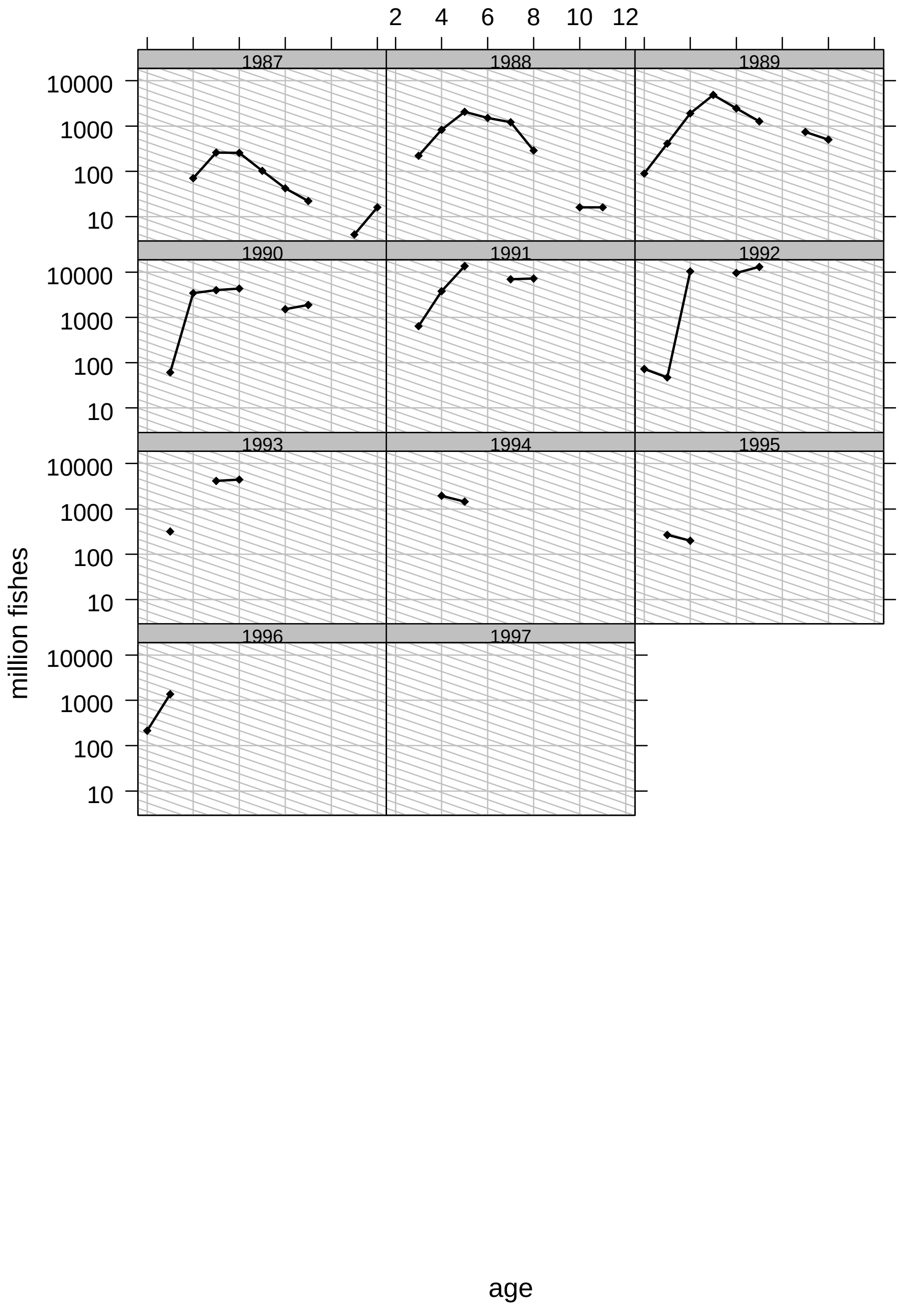


Figure 3.3.2.4. Norwegian spring spawning herring. Age disaggregated abundance indices from the acoustic surveys in the wintering areas in January plotted on log scale. The labels above each figure indicate year classes. They grey lines correspond to Z=0.4.

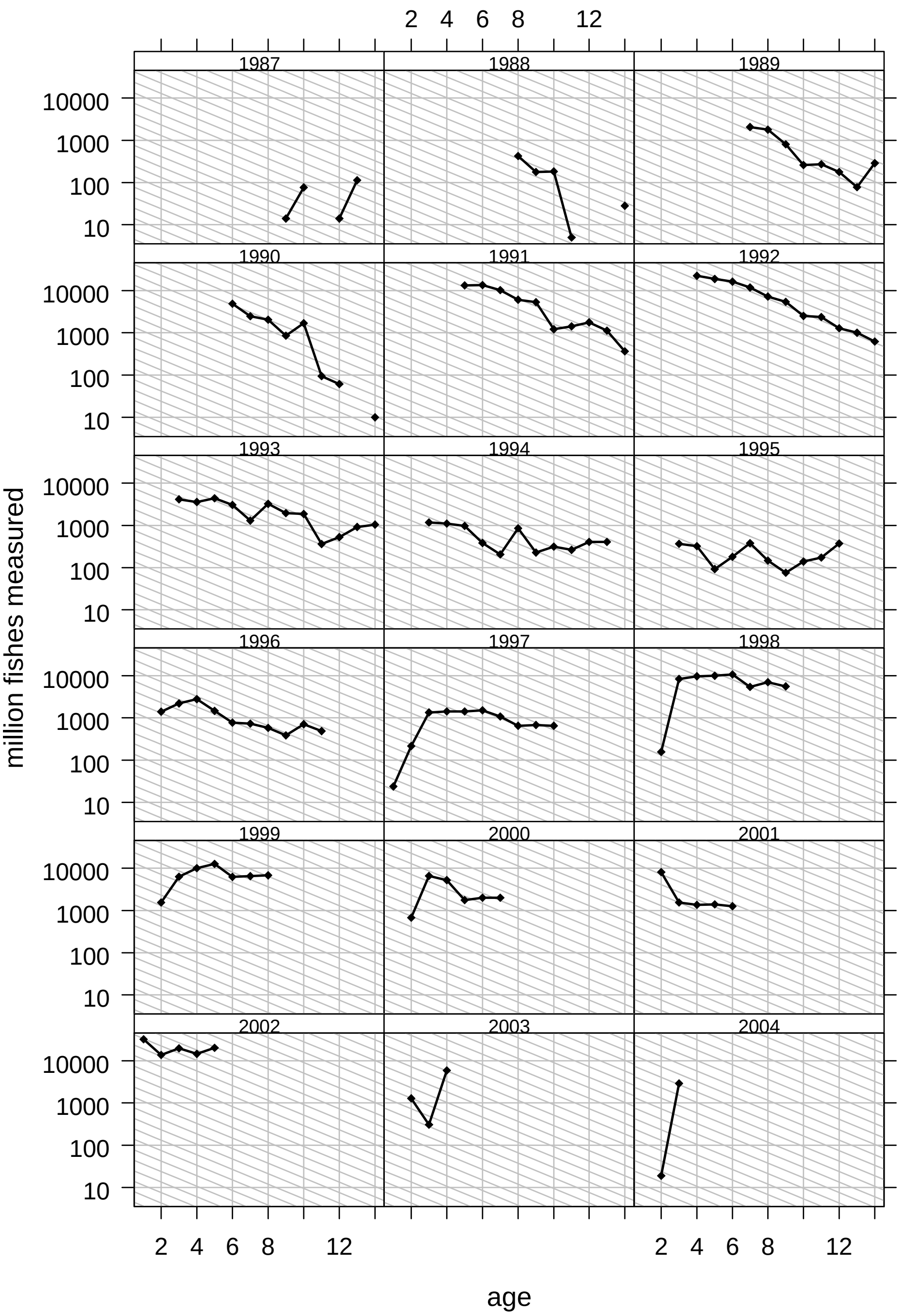


Figure 3.3.2.5. Norwegian spring spawning herring. Age disaggregated abundance indices from the acoustic surveys on the feeding areas in the Norwegian Sea in May plotted on log scale. The labels above each figure indicate year classes. They grey lines correspond to Z=0.4.

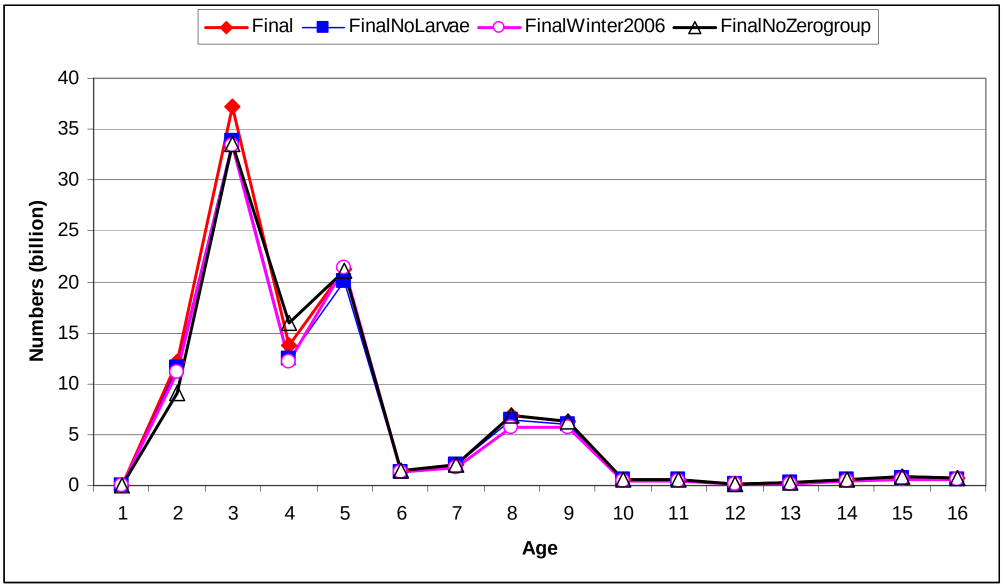
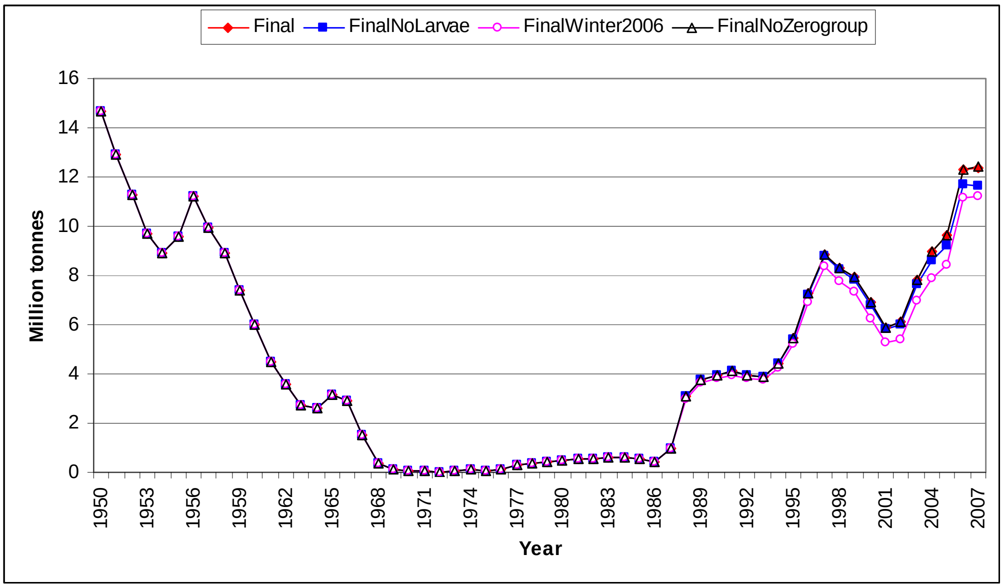


Figure 3.3.3.1. Norwegian spring spawning herring. Number at age in 2007 by SeaStar.



Figur. 3.3.3.2. Norwegian spring spawning herring. Spawning biomass time series for SeaStar exploratory runs.

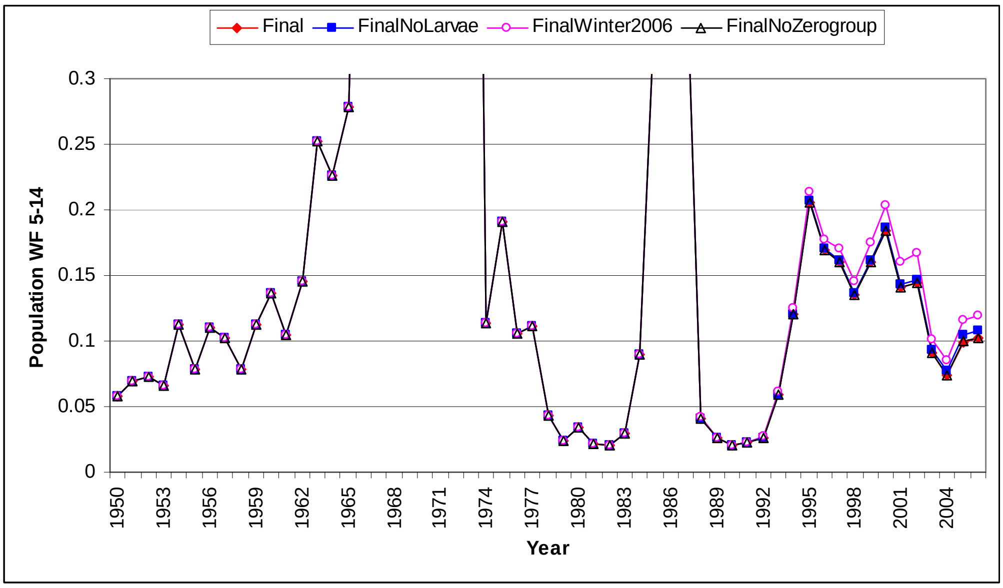


Figure 3.3.3.3. Norwegian spring spawning herring. Mean population weighted F (5–14) for SeaStar exploratory runs.

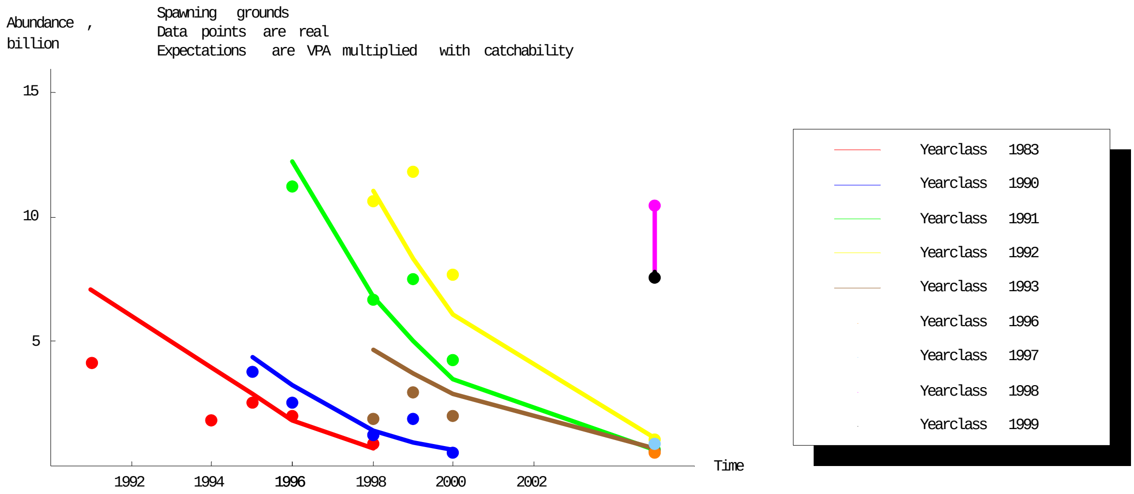


Figure 3.3.3.4. Norwegian spring spawning herring. Expectation values from the VPA (solid lines) and survey observations (dots) for survey 1 (spawning grounds) as estimated by SeaStar.

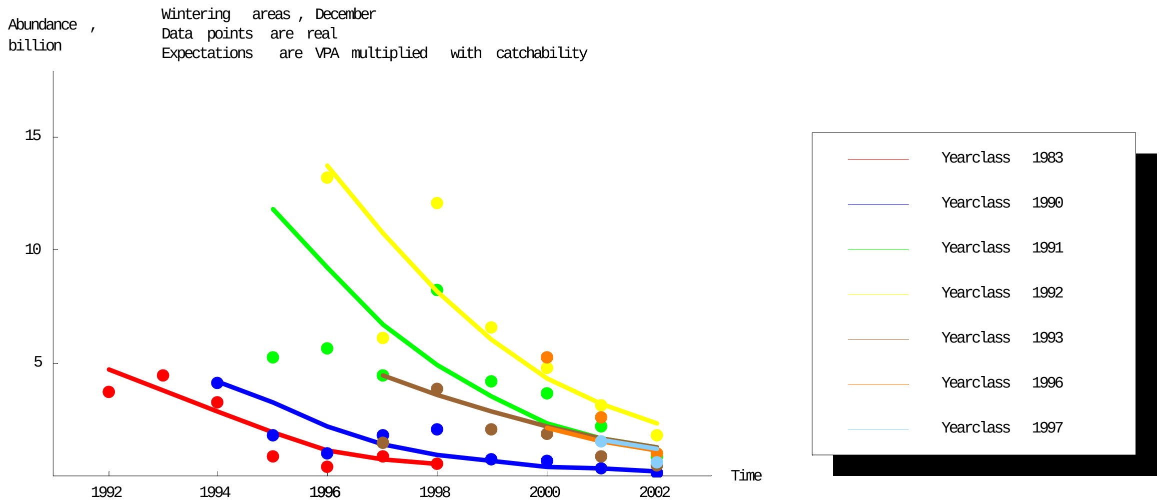


Figure 3.3.3.5. Norwegian spring spawning herring. Expectation values from the VPA (solid lines) and survey observations (dots) for survey 2 (wintering areas in November-December) as estimated by SeaStar.

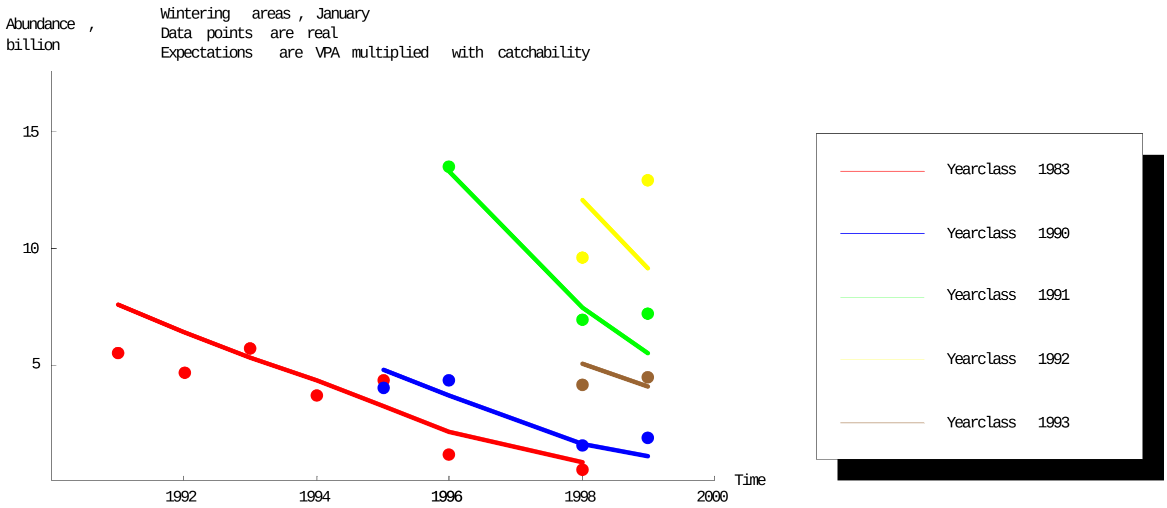


Figure 3.3.3.6. Norwegian spring spawning herring. Expectation values from the VPA (solid lines) and survey observations (dots) for survey 3 (wintering areas in January) as estimated by SeaStar.

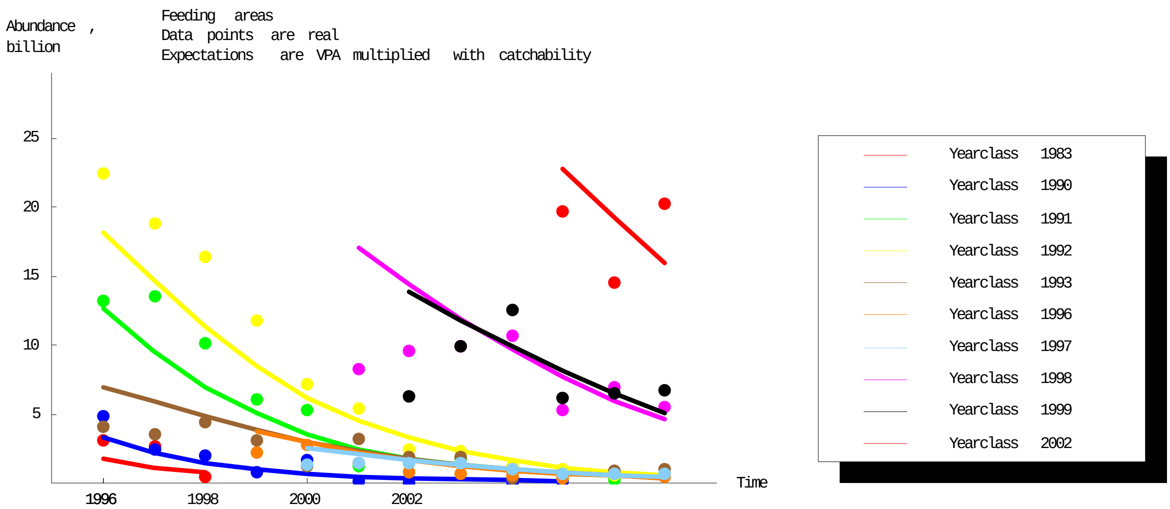


Figure 3.3.3.7. Norwegian spring spawning herring. Expectation values from the VPA (solid lines) and survey observations (dots) for survey 5 (feeding grounds in the Norwegian Sea in May-June) as estimated by SeaStar.

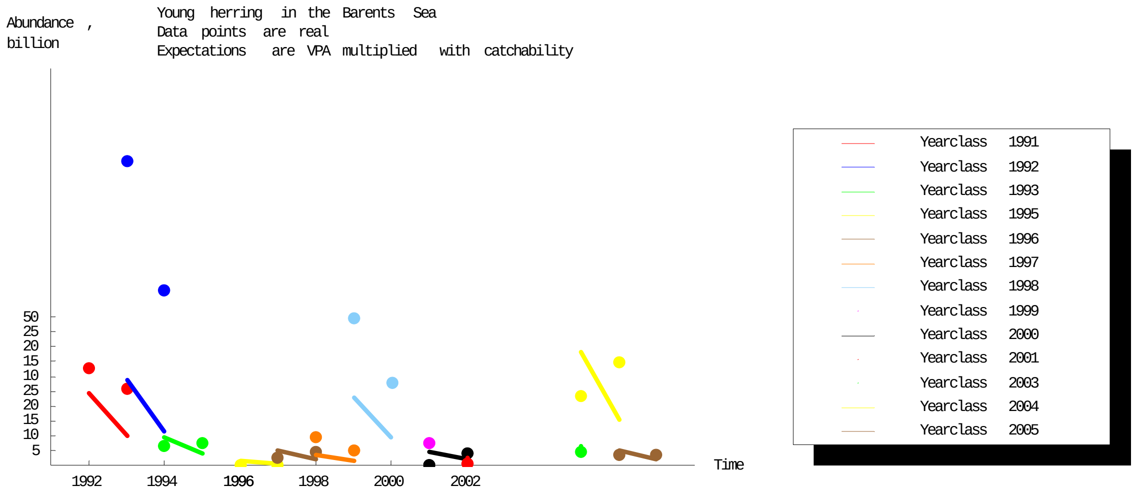


Figure 3.3.3.8. Norwegian spring spawning herring. Expectation values from the VPA (solid lines) and survey observations (dots) for survey 4 (young herring in the Barents Sea in May-June) as estimated by SeaStar.

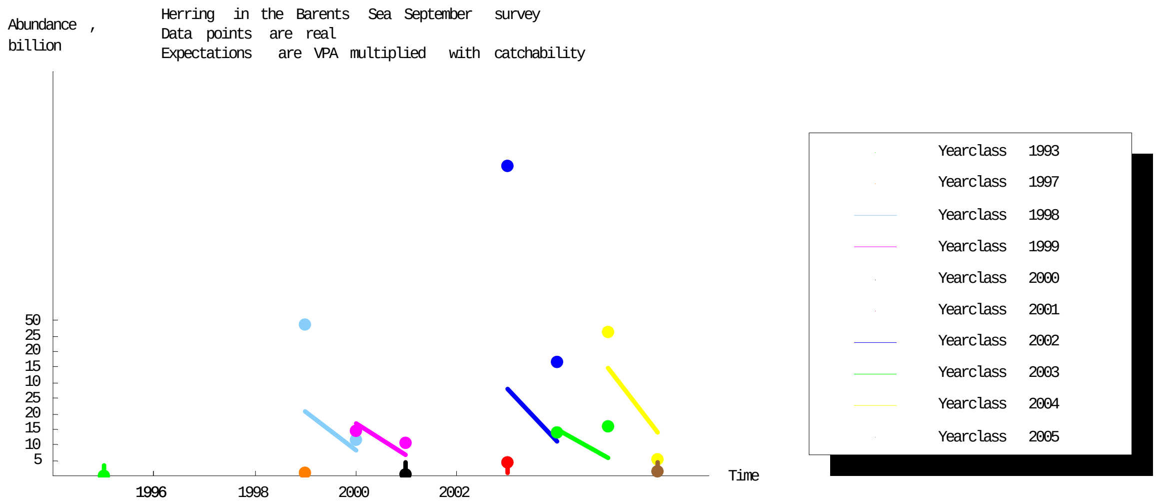


Figure 3.3.3.9. Norwegian spring spawning herring. Expectation values from the VPA (solid lines) and survey observations (dots) for survey 6 (young herring in the Barents Sea in September) as estimated by SeaStar.

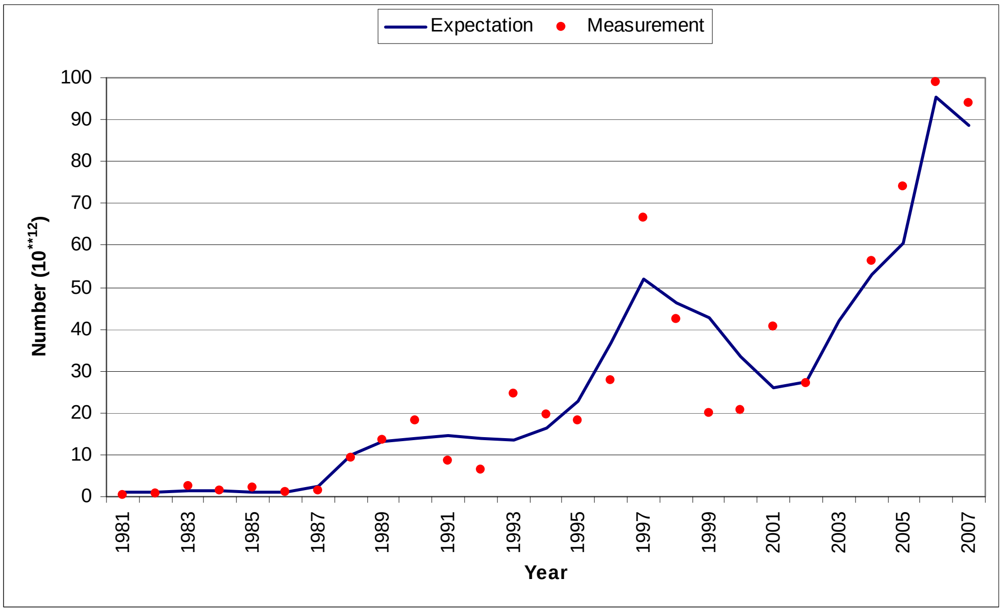


Figure 3.3.3.10. Norwegian spring spawning herring. Expectation values from the VPA (solid line) as estimated by SeaStar and larval observations (dots).

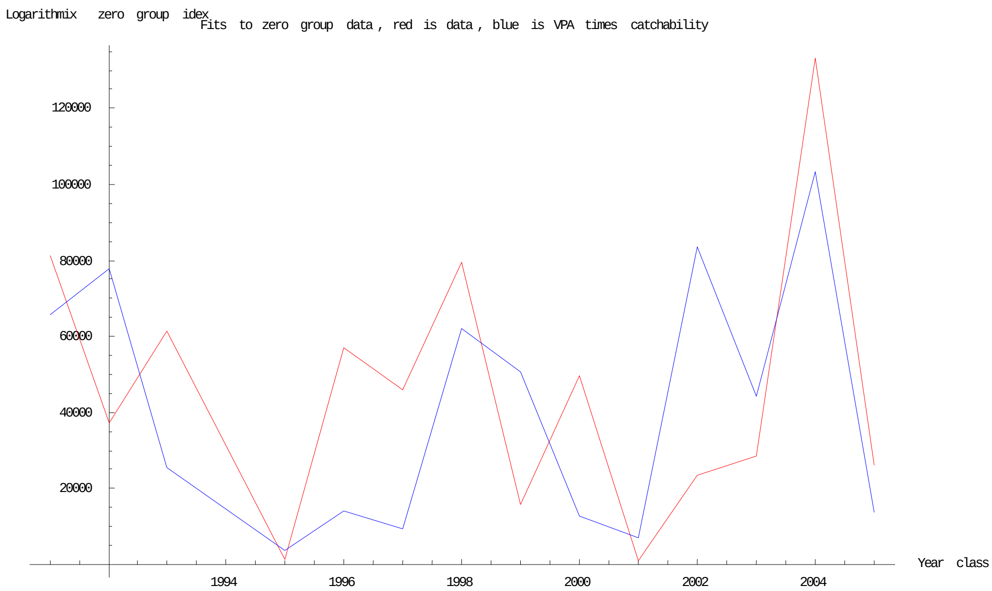


Figure 3.3.3.11. Norwegian spring spawning herring. Expectation values from the VPA (blue line) and zero group observations (red line) as estimated by SeaStar.

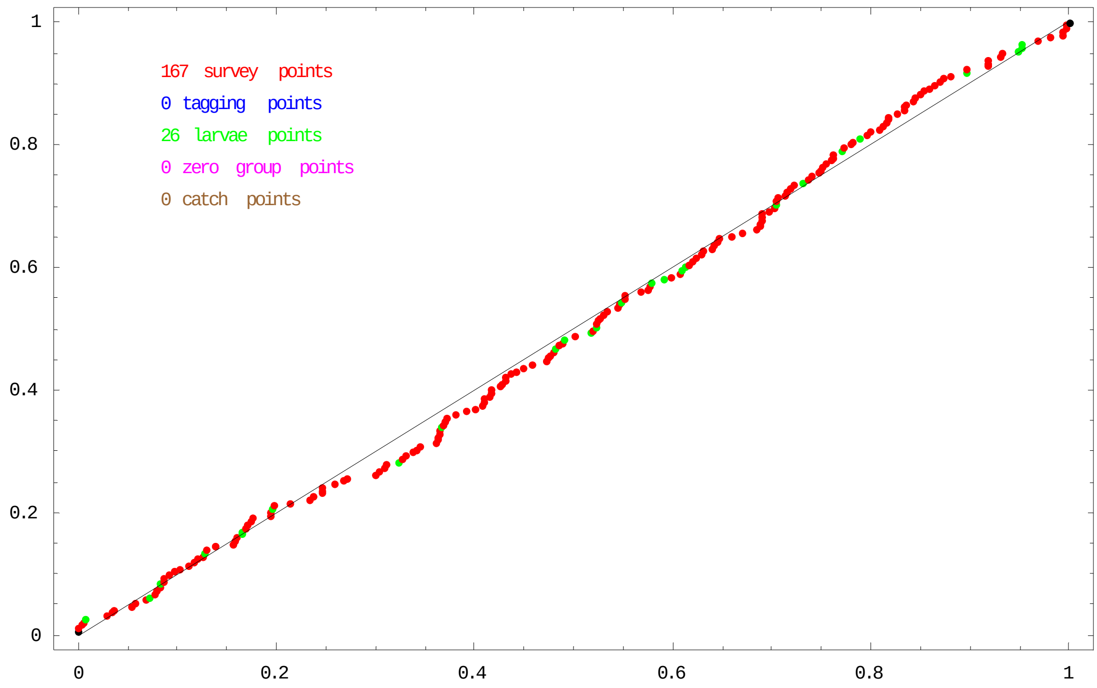


Figure 3.3.3.12. Norwegian spring spawning herring. Quantile-quantile plot for surveys 1, 2, 3 and 5 and the larval survey (stage 1 estimation) from SeaStar.

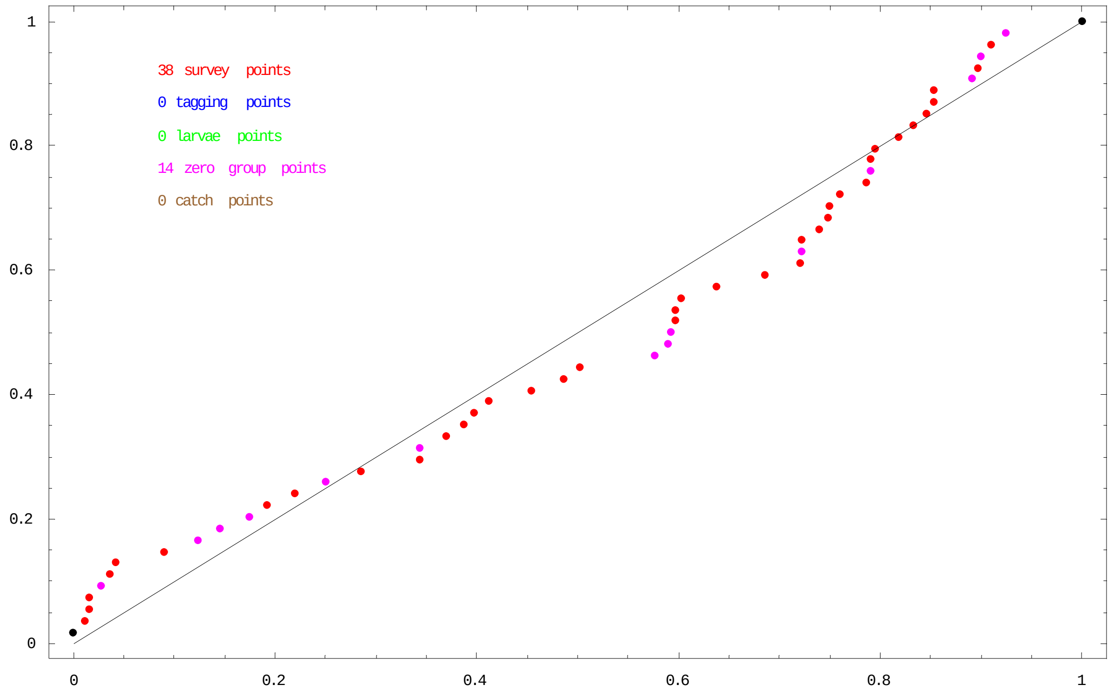
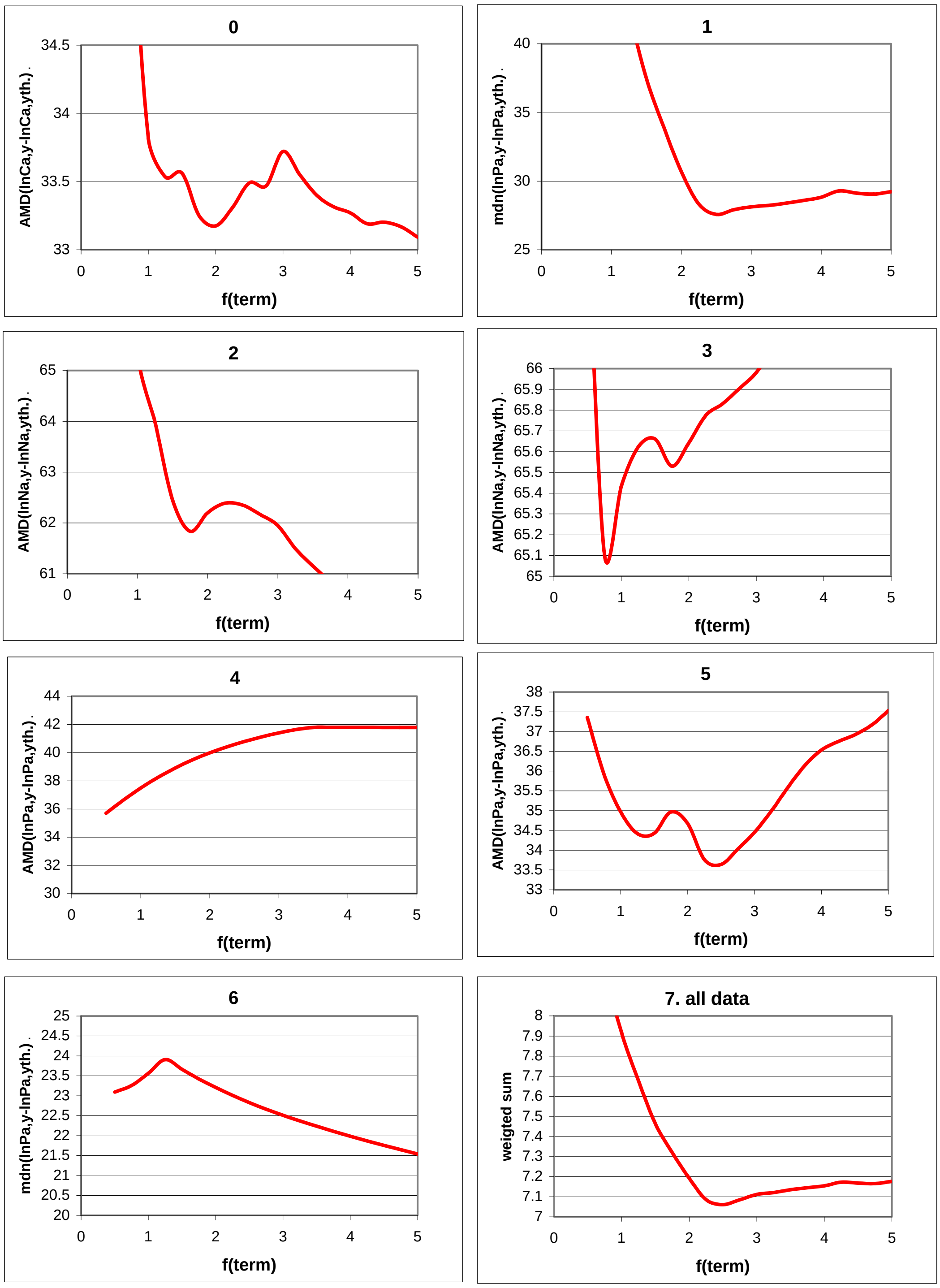


Figure 3.3.3.13. Norwegian spring spawning herring. Quantile-quantile plot for surveys 4 and 6 and the zero group survey (stage 2 estimation) from SeaStar.



0- catch-at-age
1- spawning grounds acoustic in Febr.-March
2-acoust. surv. in wint. area Nov.-December
3- acust. in wintering areas, January
4- Young herring in the Barents Sea (June)
5- Feeding areas, May
6-Young herring in the Barents Sea, September survey
7-All data

Figure 3.3.4.1. Norwegian spring spawning herring. Profiles of components of the TISVPA loss function for its SPALY run.

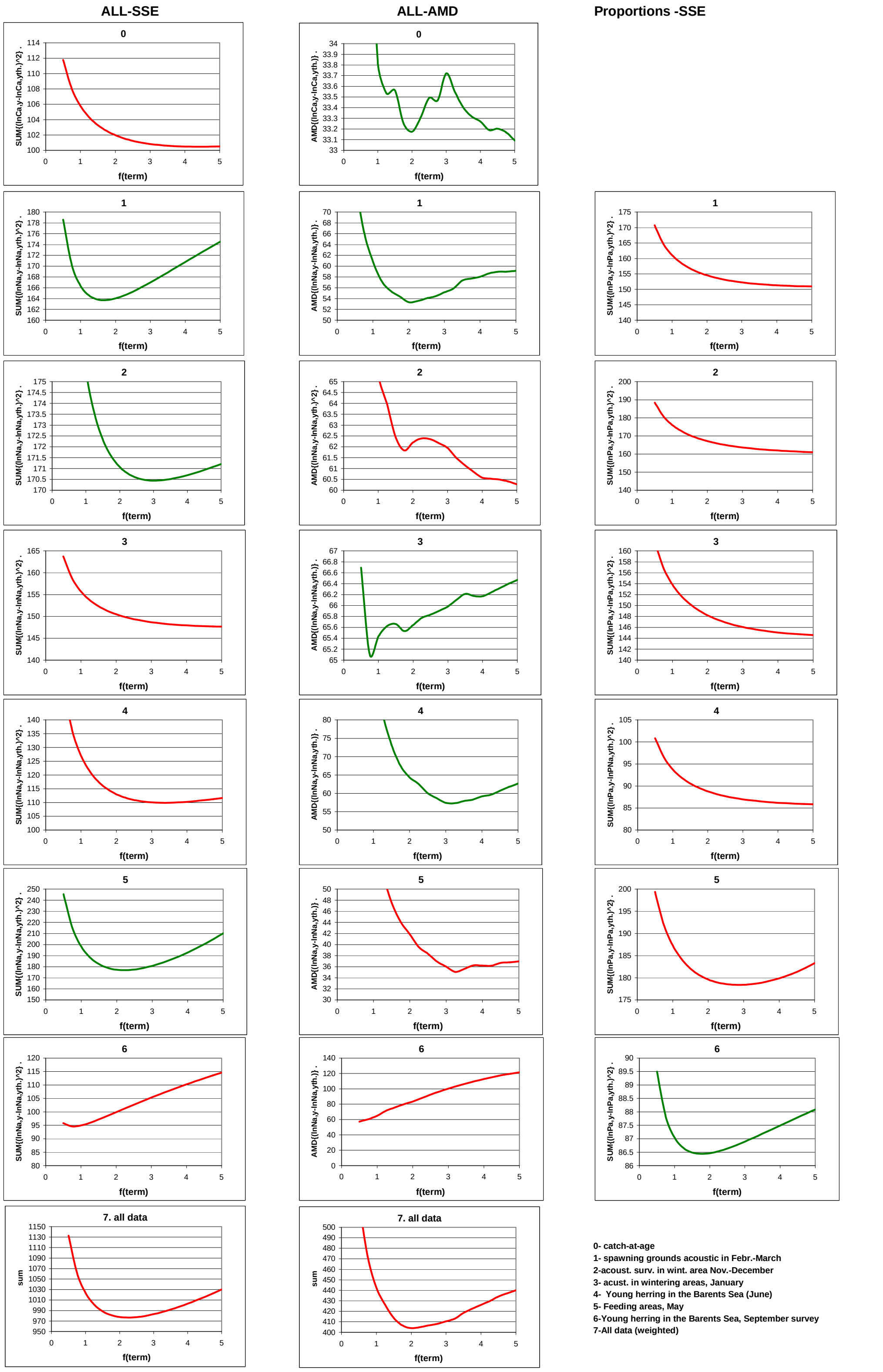
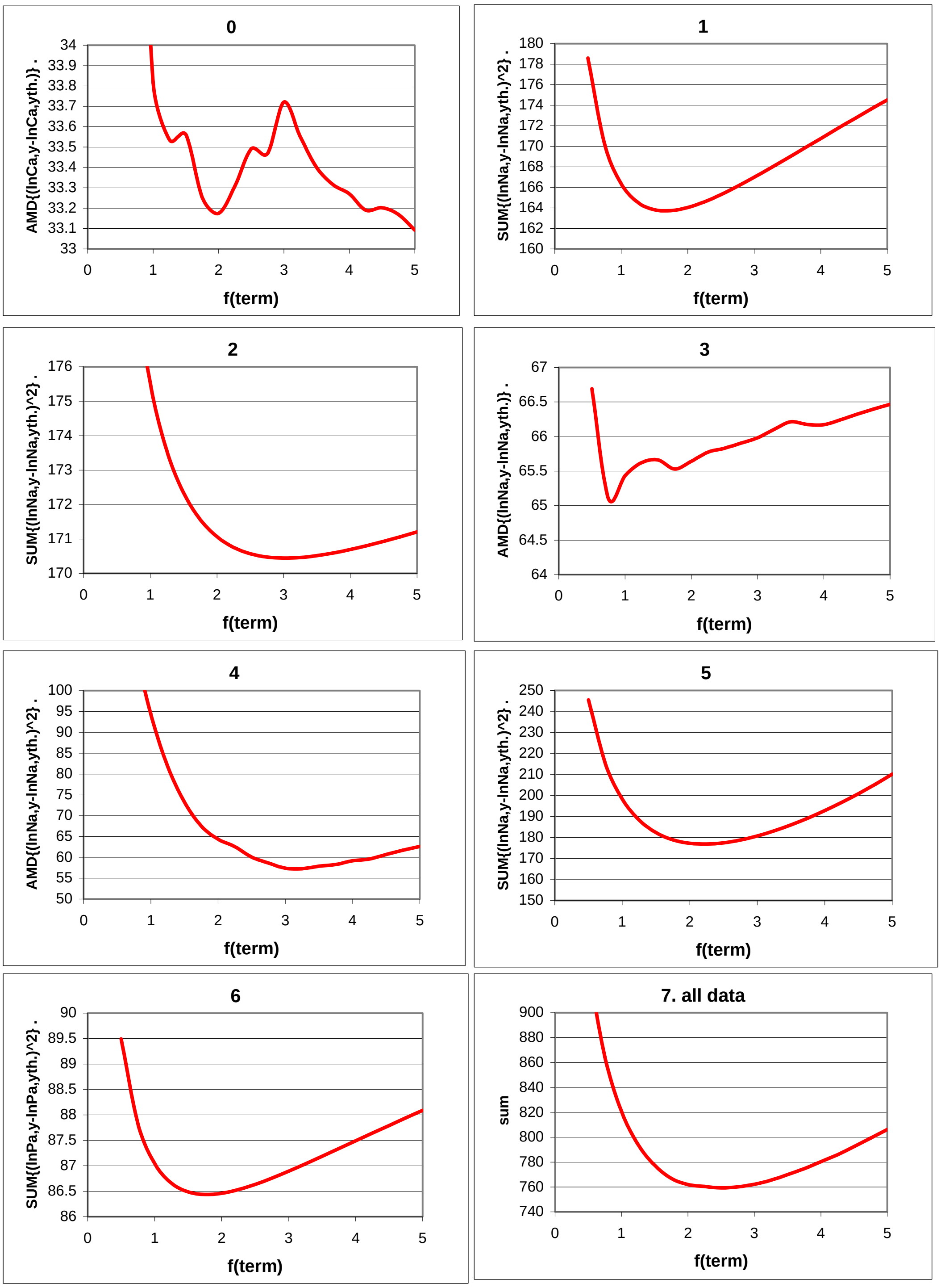


Figure 3.3.4.2. Norwegian spring spawning herring. Profiles of components of the TISVPA loss function for different choice of the measure of closeness of fit.



0- catch-at-age
1- spawning grounds acoustic in Febr.-March
2-acoust. surv. in wint. area Nov.-December
3- acust. in wintering areas, January
4- Young herring in the Barents Sea (June)
5- Feeding areas, May
6-Young herring in the Barents Sea, September survey
7-All data

Figure 3.3.4.3. Norwegian spring spawning herring. Profiles of components of the TISVPA loss function in its final run.

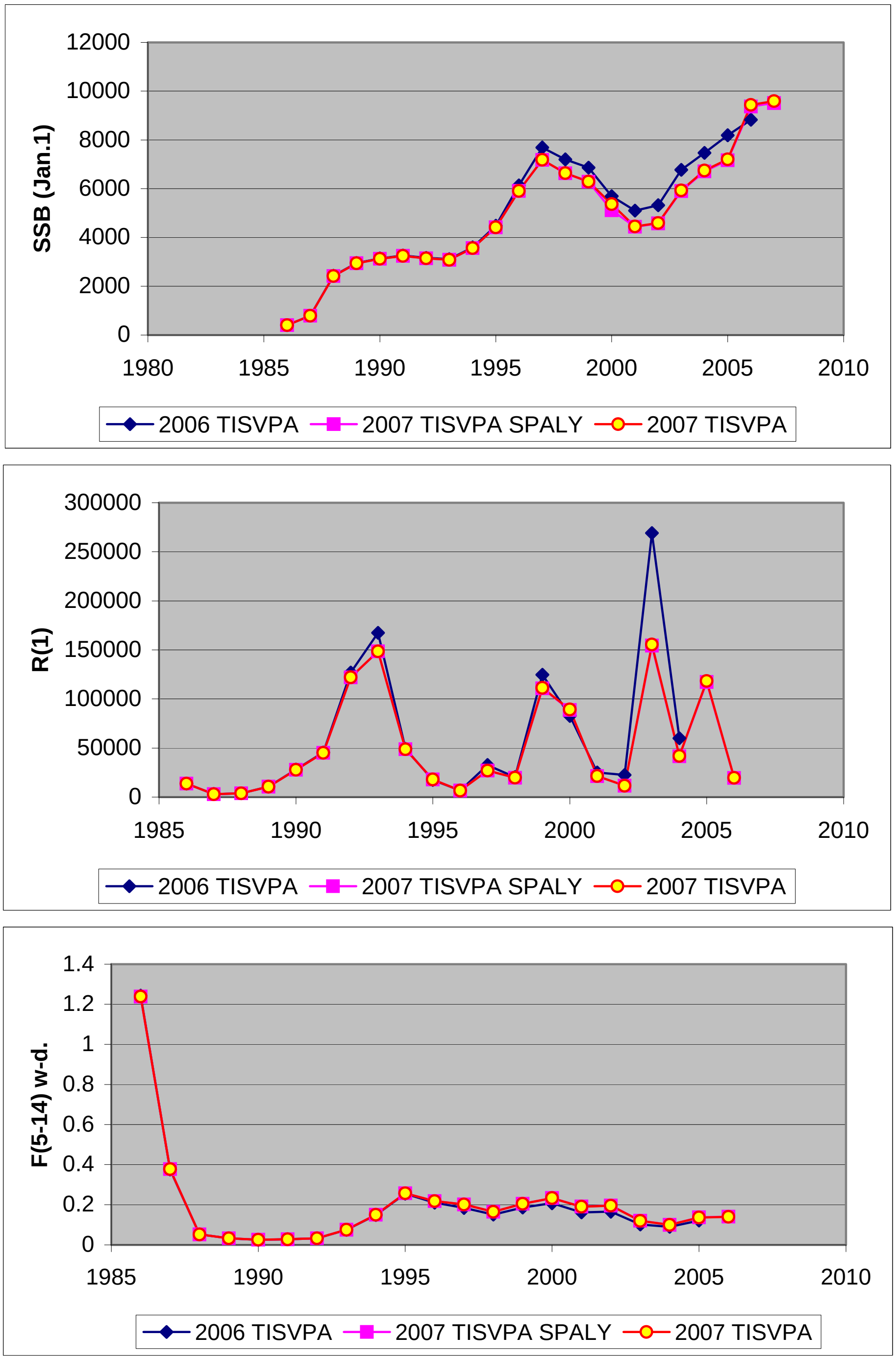


Figure 3.3.4.4. Norwegian spring spawning herring. Comparison of the TISVPA results with the results of previous assessment by means of TISVPA.

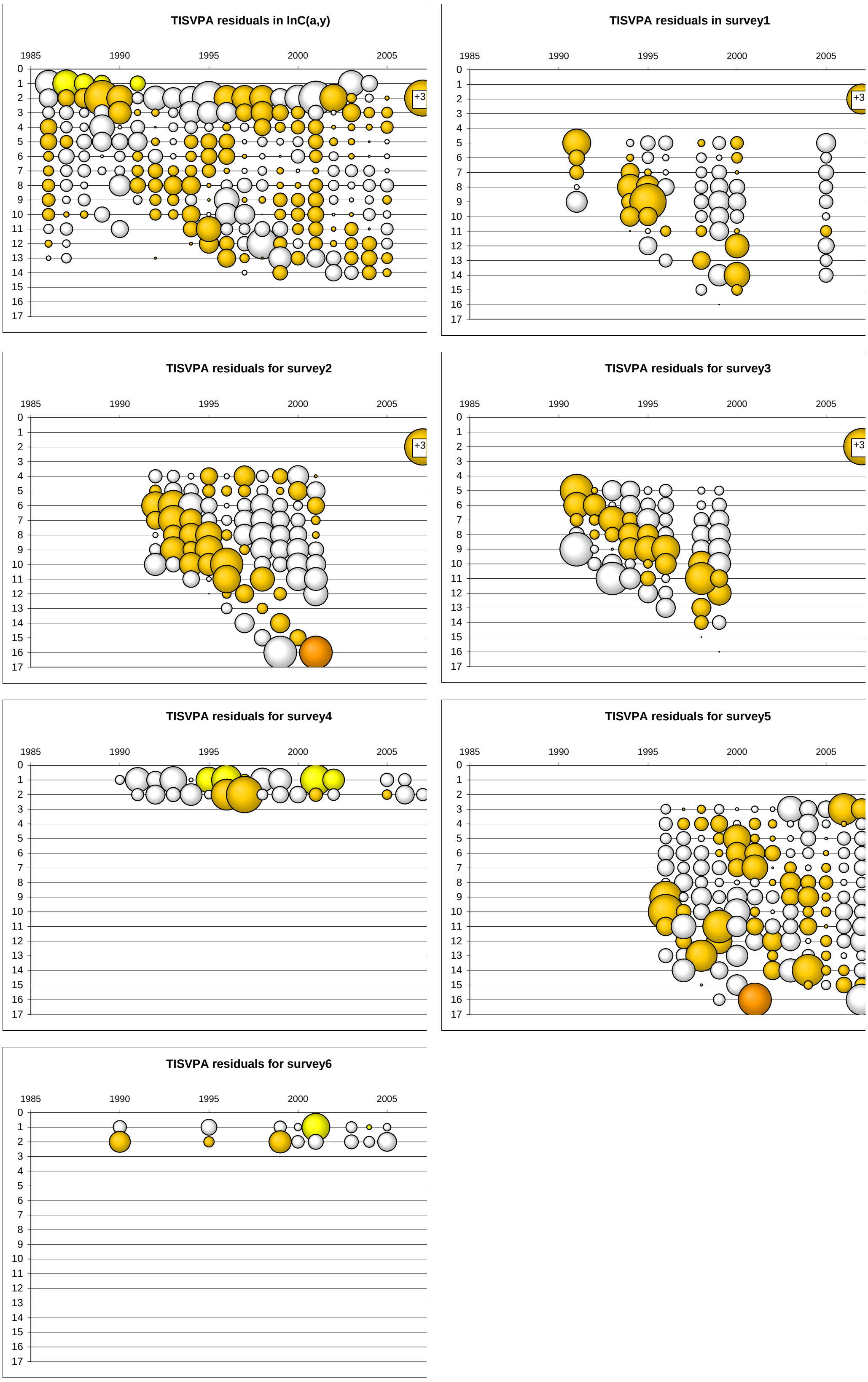


Figure 3.3.4.5. NSSH. Residuals in logarithmic catch-age and surveys by using TISVPA.

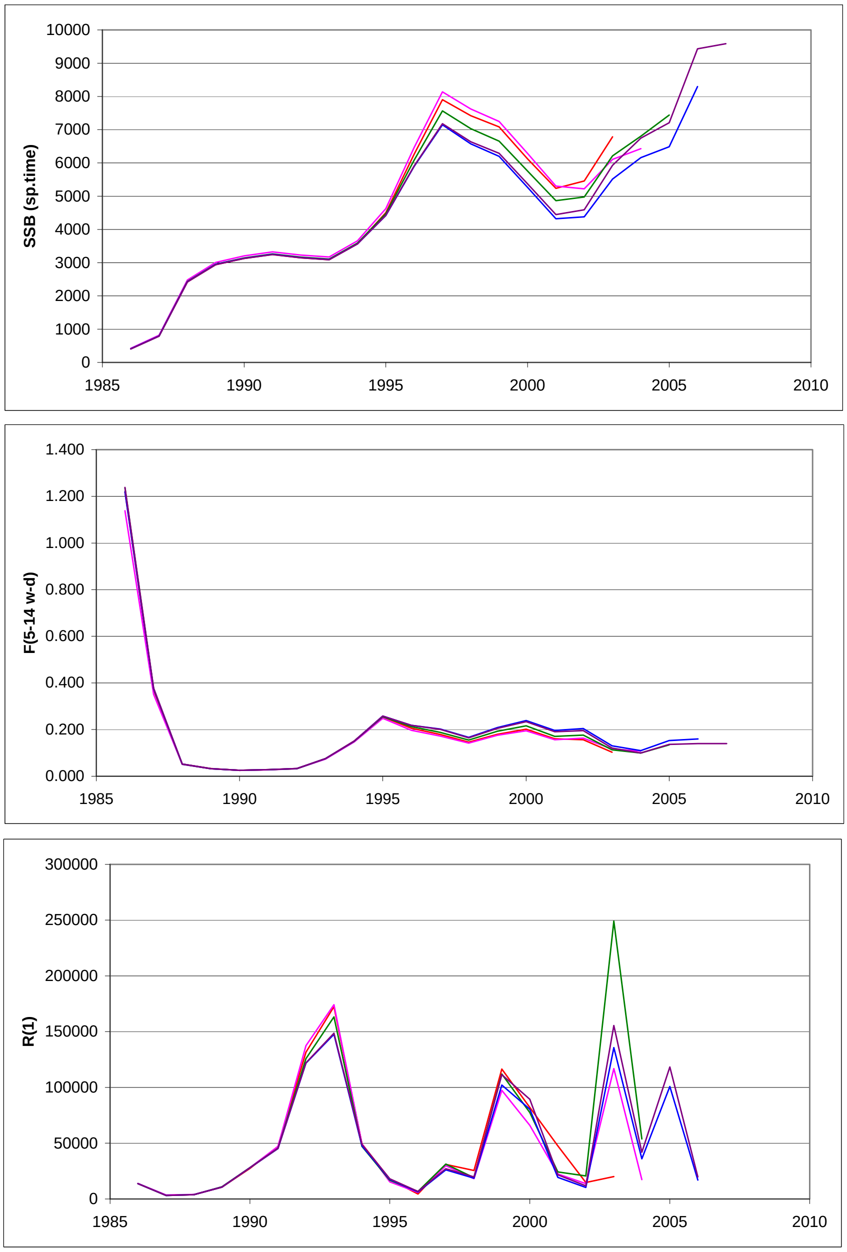


Figure 3.3.4.6. Norwegian spring spawning herring. Retrospective runs by using TISVPA.

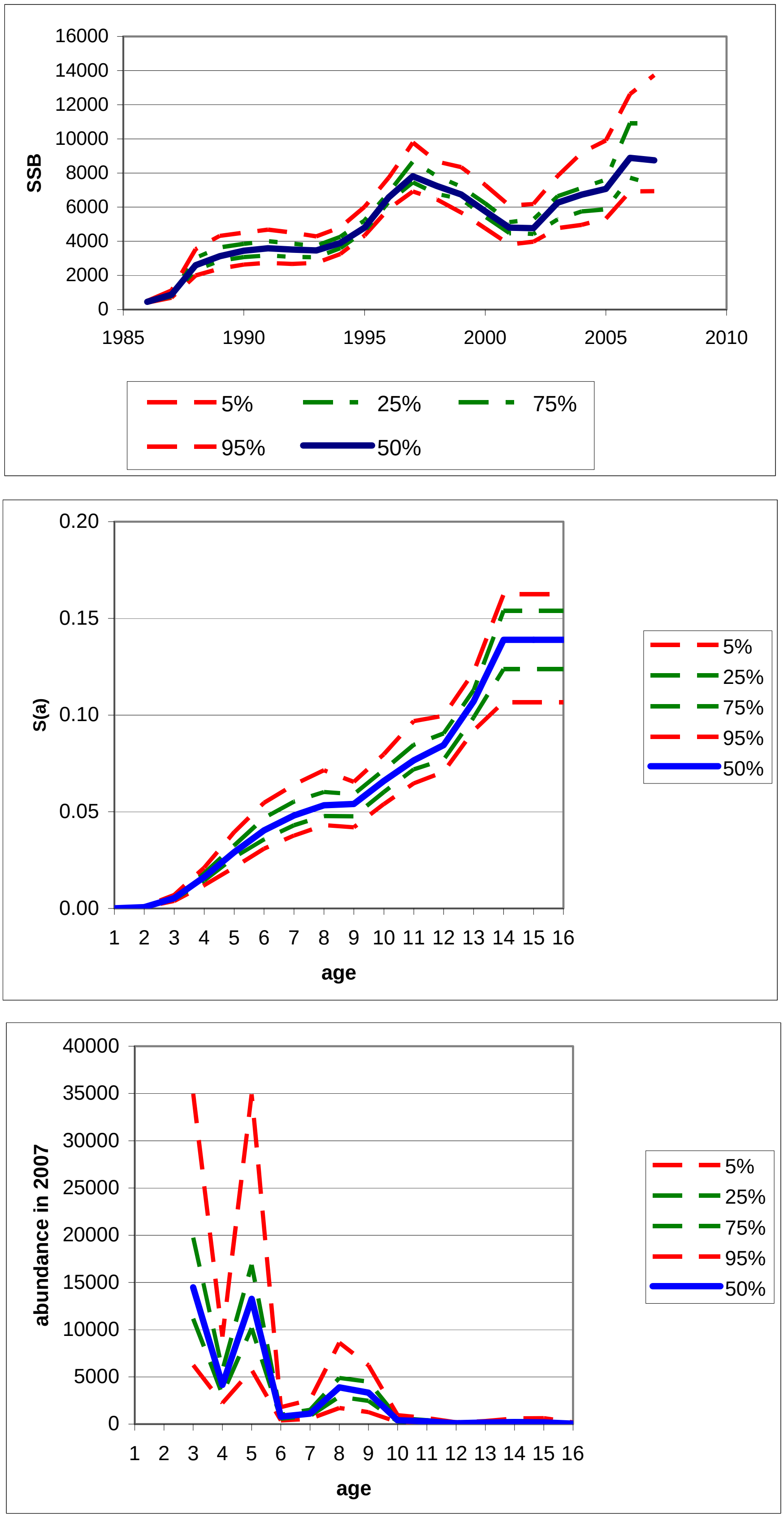


Figure 3.3.4.7. Norwegian spring spawning herring. Bootstrap from TISVPA.

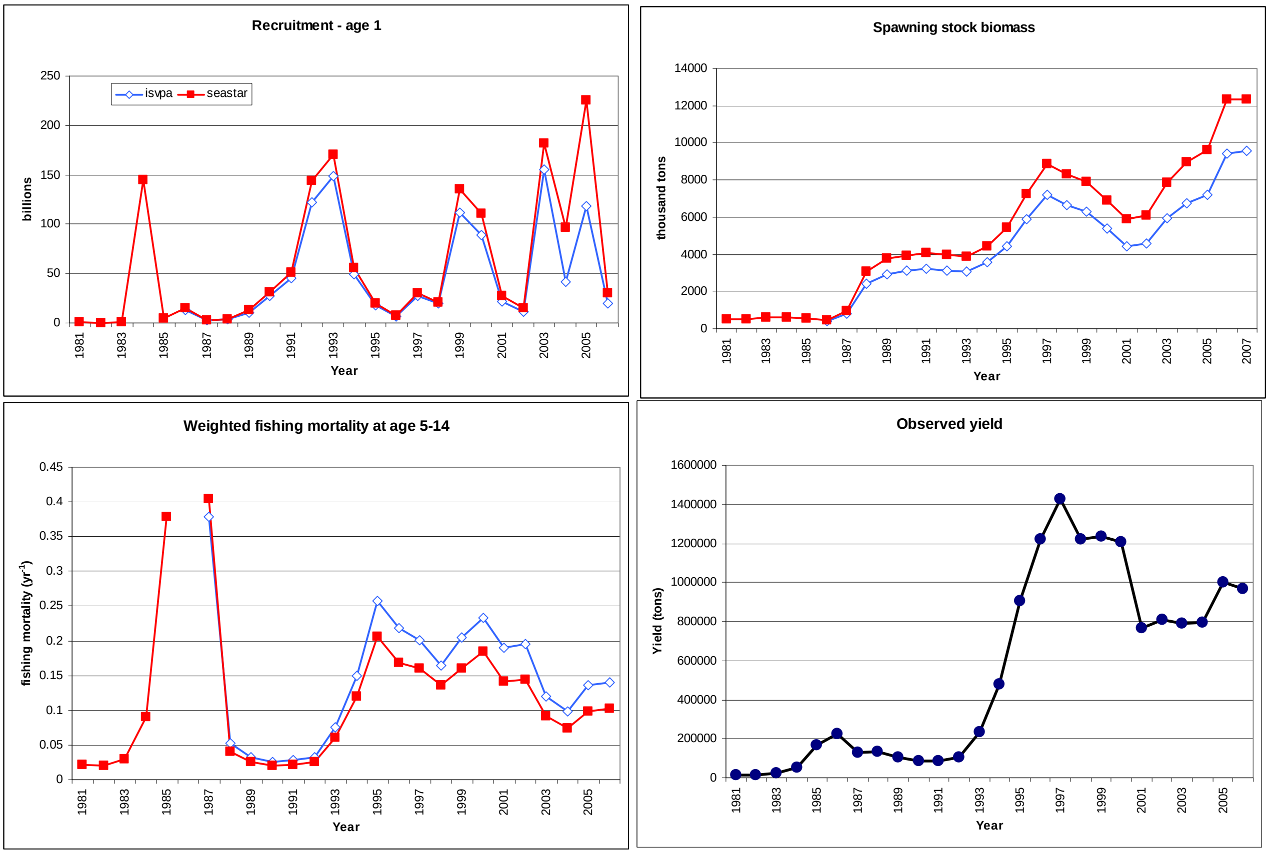


Figure 3.3.5.1. Norwegian spring spawning herring. Comparisons of results from assessments model TISVPA and SeaStar.

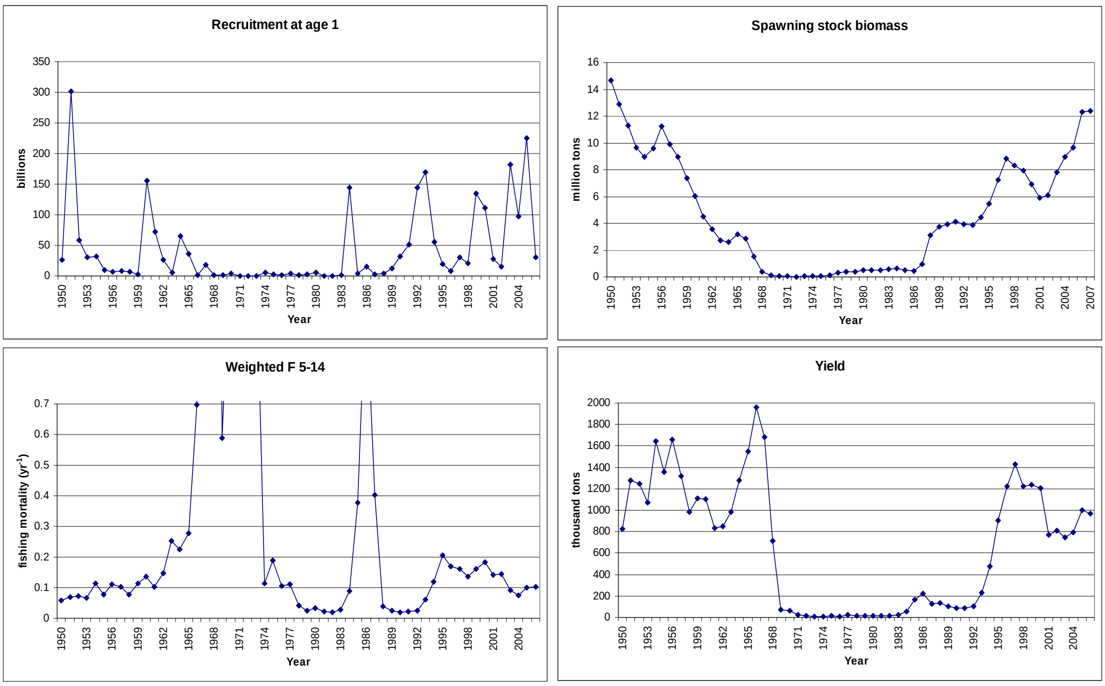


Figure 3.4.1. Norwegian spring spawning herring. Summary of final run.

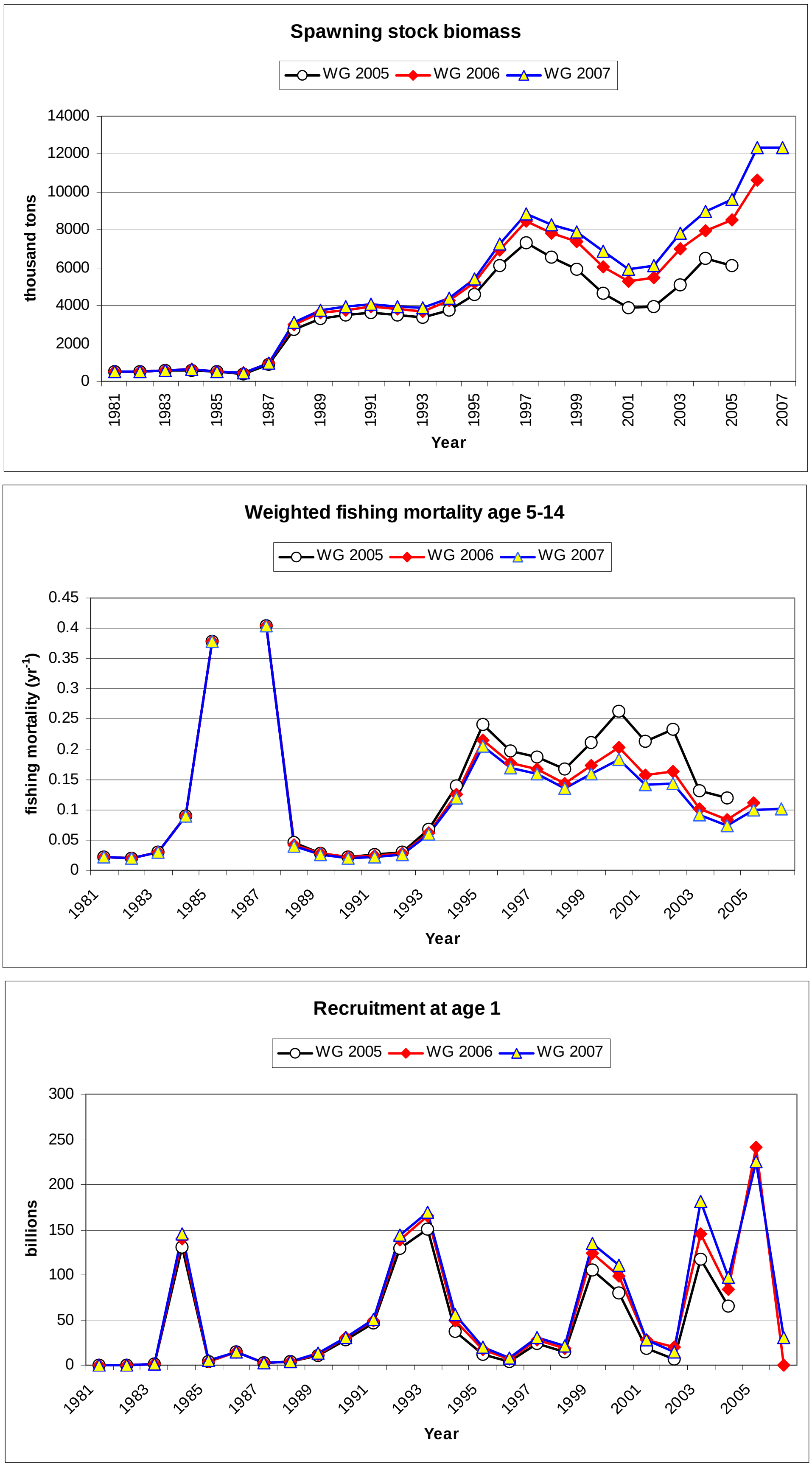


Figure 3.4.1.1. Norwegian spring spawning herring. Comparison of final assessments made in 2005–2007.

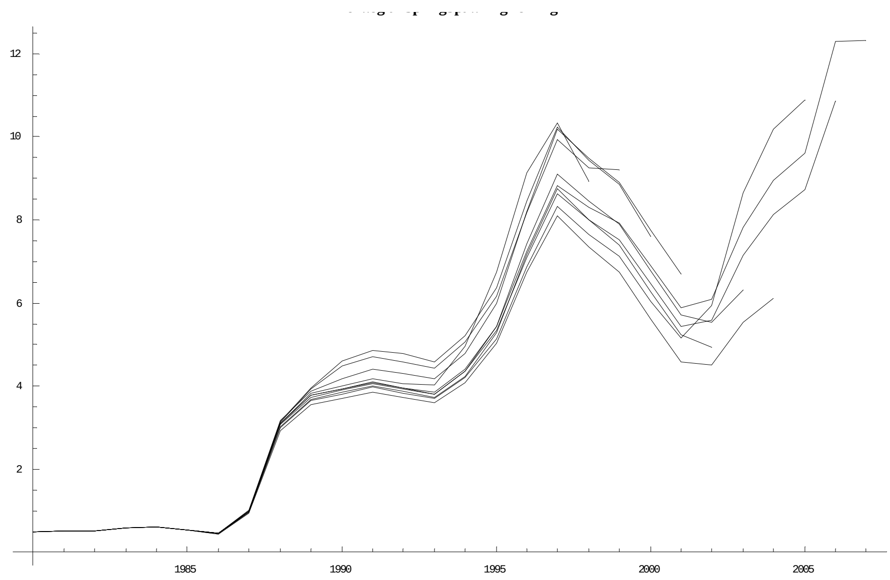


Figure 3.4.2.1. Norwegian spring spawning herring. Retrospective analysis for the SeaStar assessment. The same settings and the same algorithm for selecting year classess to be estimated in stage 1 and 2 are applied for each starting year. See text for details. Years are on x-axis and ssb on y-axis in million tonnes.

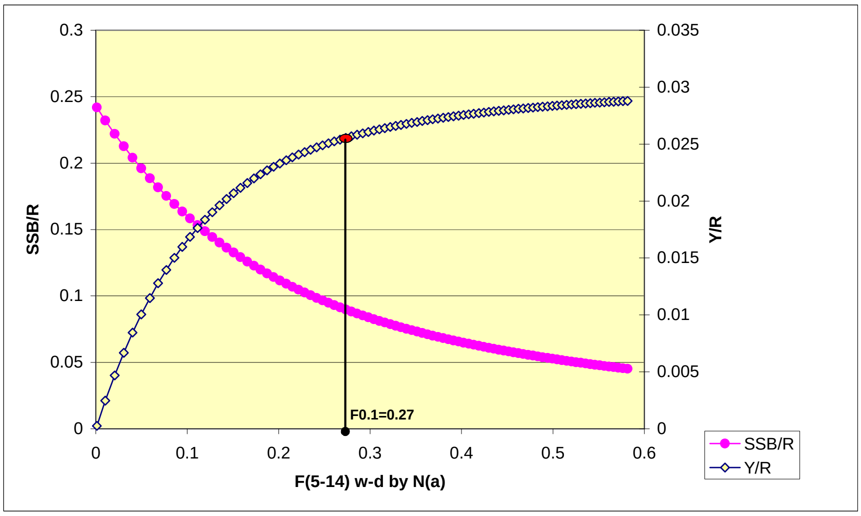


Figure 3.9.1. Norwegian spring spawning herring. Yield per recruit and SSB/R.

4 Blue whiting

The stock of Blue whiting is on the observation list.

4.1 General

4.1.1 Stock description

Blue whiting (*Micromesistius poutassou*) is a pelagic gadoid that is widely distributed in the eastern part of the North Atlantic. The highest concentrations are found along the edge of the continental shelf in areas west of the British Isles and on the Rockall Bank plateau where it occurs in large schools at depths ranging between 300 and 600 meter but is also present in almost all other management areas between the Barents Sea and the Strait of Gibraltar and west to the Irminger Sea. The major spawning takes place in February and March, along the shelf edge and banks west of the British Isles, but in recent years a large fishery has developed between the Rockall-Hatton Plateau. Juveniles are abundant in many areas, with the main nursery area believed to be the Norwegian Sea. Morphological, physiological, and genetic research has suggested that there may be several components of the stock which mix in the spawning area west of the British Isles. Due to the large population size, its considerable migratory capabilities and wide spatial distribution, much remains to be understood regarding the stock composition and dynamics. Accurate estimates of the stock size are difficult to obtain and the management of this species provides therefore a challenge. However, for assessment purposes blue whiting in these areas is treated as a single stock since it has so far not been possible to define an unambiguous border between populations (if separate populations exist).

4.1.2 Ecosystem considerations

An almost threefold increase in the spawning stock of blue whiting stock since mid–1990s has raised a series of questions on the biology of blue whiting and possible effects of the environment on the productive capacity of the stock. In last years report (ICES 2006/ACFM:34) it was shown that the increase in temperature and salinity in a confined study area west of the Porcupine Bank in 1997 and onwards coincides with the increase in recruitment of blue whiting.

The main source water masses that enter the Rockall Trough from the south are the Western North Atlantic Water (WNAW) carried by the North Atlantic Current (NAC) and the Eastern North Atlantic Water (ENAW), which is driven from the ‘intergyre region’ between the Azores and the Bay of Biscay. The ENAW is relatively warm and saline compared to the other water masses in the Rockall region. Hátún *et al.* (2005) studied the hydrographic conditions in the area west of the British Isles and found that after 1996 it was dominated the ENAW, thus giving favourable conditions for spawning over a relatively wide area. However, it remains to be shown whether there is a causal relationship between hydrographic conditions and recruitment of blue whiting, although a tentative hypothesis was suggested by Hátún *et al.* (2007).

4.1.3 ICES Advice

> <u>In 2005</u> ICES stated that fishing within the limits of the existing management plan (F=Fpa) implies catches of less than 1.5 million t in 2006. This will also result in a high probability that the spawning stock biomass in 2007 will be above Bpa. The present fishing level is well above levels defined by the management plan and should be reduced. The Management Plan Point 4 calls for a reduction in the catch of juvenile blue whiting which has not taken place. The primary approach to reducing catch of juveniles is to reduce overall fishing mortality. Catches of juveniles in the last 4 years are much greater than in earlier periods. If an overall reduction of fishing

mortality cannot be achieved then specific measures should be taken to protect juveniles.

In 2006 ICES stated that the maximum catch in 2007 corresponding to a new agreed management plan is 1.9 million tonnes, which is expected to leave the spawning stock biomass at 2.86 million t, i.e. above Bpa in 2008, but will lead to an F above Flim in 2007.

The current fishing mortality, estimated at 0.48, is above the fishing mortalities that are expected to lead to high long-term yields and low risk of depletion of production potential.

Fishing at F_{pa} implies catches of less than 980 thousand t in 2007. This is expected to result in a spawning stock biomass in 2008 well above Bpa.

The newly agreed management plan had been evaluated by ICES and was not considered in accordance with the precautionary approach. ICES concludes that the exploitation boundaries for this stock should be based on the precautionary limits.

4.1.4 Management

4.1.4.1 Coastal States management plan

In October 2006, the coastal states (EU, Norway, Iceland and Faroe Islands) agreed on a sharing arrangement for the blue whiting stock. This arrangement provides for catches in 2007 of 1 700 000 tonnes, allocated as follows: EU 30.5%, Faroe Islands 26.125%, Norway 25.745% and Iceland 17.63%. Russia will be accommodated by transfers from some of the coastal states and additional catches in the NEAFC regulatory area.

1) A Delegation of the Faroe Islands, a Delegation of the European Community, a Delegation of Iceland, and a Delegation of Norway met in Tórshavn on 26 and 27 October 2006 to consult on the management of the blue whiting stock in the North-East Atlantic in 2007.

2) The Delegations recognised that the basis for management measures in 2007 is the Agreed Record of Conclusions of Fisheries Consultations on the Management of Blue Whiting in the Northeast Atlantic concluded in Oslo on 16 December 2005 (the 2005 Agreed Record), including its Annex I and Annex II.

3) In accordance with Annex II, Paragraph 4 of the 2005 Agreed Record, the Delegations agreed to reduce their total allowable catch of blue whiting in 2007 by 300 000 tonnes.

4) In accordance with Paragraphs 5 and 6 of the 2005 Agreed Record, the Delegations agreed to recommend to their respective authorities the arrangement for the regulation of the fisheries of blue whiting in 2007 as contained in Annex I to this Agreed Record.

ANNEX I. ARRANGEMENT FOR THE REGULATION OF THE FISHERIES OF BLUE WHITING IN 2007

1) In accordance with the multi-annual management arrangement for the fisheries of blue whiting set out in Annex II to the 2005 Agreed Record, the Parties agree to restrict their fisheries of blue whiting in 2007 to a maximum catch limit of 1 700 000 tonnes on the basis of the following quotas:

1.1)	European Community	518 500 tonnes
1.2)	Faroe Islands	444 125 tonnes
1.3)	Iceland	299 710 tonnes
1.4)	Norway	437 665 tonnes

2) Each Party may transfer unutilised quantities of up to 10% of the quota allocated to it for 2007 to 2008. Such transfer shall be in addition to the quota allocated to the Party concerned for 2008.

3) In the event of over-fishing of the allocated quotas by any Party in 2007, the quantity shall be deducted from the quota allocated in 2008 for the Party or Parties concerned.

4) The Parties may fish blue whiting within the quotas laid down in Paragraph 1 in their respective zones of fisheries jurisdiction and in international waters.

5) Further arrangements by the Parties, including arrangements for access, quota transfers and other conditions for fishing in the respective zones of fisheries jurisdiction, are regulated by bilateral arrangements.

ANNEX II. ARRANGEMENT FOR THE MULTI-ANNUAL MANAGEMENT OF THE BLUE WHITING STOCK

1) The Parties agree to implement a multi-annual management arrangement for the fisheries on the blue whiting stock which is consistent with the precautionary approach, aiming at constraining harvest within safe biological limits, protecting juveniles, and designed to provide for sustainable fisheries and a greater potential yield, in accordance with advice from ICES.

2) The management targets are to maintain the Spawning Stock Biomass (SSB) of the blue whiting stock at levels above 1.5 million tonnes (Blim) and the fishing mortality rates at levels of no more than 0.32 (Fpa) for appropriate age groups as defined by ICES.

3) For 2006, the Parties agree to limit their fisheries of blue whiting to a total allowable catch of no more than 2 million tonnes.

4) The Parties recognise that a total outtake by the Parties of 2 million tonnes in 2006 will result in a fishing mortality rate above the target level as defined in Paragraph 2. Until the fishing mortality has reached a level of no more than 0.32, the Parties agree to reduce their total allowable catch of blue whiting by at least 100 000 tonnes annually.

5) When the target fishing mortality rate has been reached, the Parties shall limit their allowable catches to levels consistent with a fishing mortality rate of no more than 0.32 for appropriate age groups as defined by ICES.

6) Should the SSB fall below a reference point of 2.25 million tonnes (Bpa), either the fishing mortality rate referred to in Paragraph 5 or the tonnage referred to in Paragraph 4 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of the SSB to a level in excess of 2.25 million tonnes.

7) This multi-annual management arrangement shall be reviewed by the Parties on the basis of ICES advice.

4.1.4.2 North East Atlantic Fisheries Commission regulatory measurements

In addition to the Coastal States management plan, there is a recommendation by the North East Atlantic Fisheries Commission (NEAFC) at its annual meeting in November 2006 to adopt conservation and management measures for blue whiting in the NEAFC area in 2007. This would result in an expected catch of 147 000 tonnes of blue whiting in addition to the Coastal States Agreement of 1.7 million tonnes for 2007.

1) NEAFC takes notes of the Agreed Record of Conclusion of Fisheries Consultations between the Faroe Islands, the European Community, Iceland and Norway on the Management of Blue Whiting in the North-east Atlantic in 2007 signed in Tórshavn, 27 October 2006.

2) NEAFC further notes that by way of the said Agreed Record, the aforementioned Parties agreed to restrict their fishery on the blue whiting stock in 2007 according to a total catch limitation of 1.7 million tonnes.

3) In accordance with Article 5 of the Convention on Future Multilateral Cooperation in North-East Atlantic fisheries, the Contracting Parties recommend the following measure for the blue whiting Stock for 2007.

3.1) In order to ensure consistency and compatibility with the said Agreed Record, the Contracting Parties hereby establish an allowable catch limitation of 268 550 tonnes of blue whiting for 2007 in waters beyond the areas under national fisheries jurisdiction of the Contracting Parties.

3.2) This allowable catch limitation shall be allocated as follows:

3.2.1)	European Community	37 400 tonnes (*)
3.2.2)	Norway	31 450 tonnes (*)
3.2.3)	Denmark in respect of:	
	3.2.3.1. Faroe Islands	31 450 tonnes (*)
3.2.4)	Greenland	10 000 tonnes
3.2.5)	Iceland	21 250 tonnes (*)
3.2.6)	Russian Federation	137 000 tonnes

(*) Catches taken under these allocations shall be deducted from quotas allocated to Parties to the Agreed Record referred to in Paragraph 2.

4) The national quotas referred to in Annex I of the Agreed Record referred to in Paragraph 2 may be fished in the areas defined in Paragraph 3a.

4.1.5 Description and development of the fisheries

4.1.5.1 Denmark

The Danish directed fishery blue whiting is mainly conducted by trawlers using a minimum mesh size of 40 mm. The directed fishery blue whiting in the western and northern areas constituted 82% of the total Danish blue whiting fishery (55 000 t) and this fishery mainly was conducted in March and April. The landings from the North Sea and Skagerrak were approximately 5000 tonnes. All landing were for production of fish meal and oil.

4.1.5.2 Germany

The main fleet targeting pelagic species is based at Bremerhaven and Rostock. The vessels are owned by a Dutch company and operating under the German flag. They consist of three large pelagic freezer-trawlers of lengths between 90 m and 120 m with power ratings between 4200 and 11 000 hp. The crew consists of about 35 to 40 men. The vessels are specially designed for pelagic fisheries. The catch is pumped into large storage tanks filled with cool water to keep the catch fresh until it is processed.

4.1.5.3 Faroe Islands

The Faroese quota for blue whiting was set at about 444 000 tonnes for 2006, of which 312 000 tonnes could be fished by the Faroese fishermen, the remaining amount was traded as part of bilateral negotiations with Russia, EU, and Norway. The Faroese fleet targeting blue whiting consists of nine large vessels and one smaller vessel.

In January the Faroese vessels followed the prespawning blue whiting on their migration southwards in the eastern part of the Faroe zone. Later in January a fishery developed in the spawning area on the Porcupine Bank (VIIc and k). This fishery continued in March, but later in March a large fishery for spawning blue whiting developed west of the Hatton-Rockall Plateau in International waters (VIIc, k and VIb). In April the fishery had moved northwards to the south of the banks on the border between EU and Faroes targeting spawning and postspawning fish (VIb and Vb). In May the postspawning fishery continued in the southern and south-western part of the Faroese EEZ (Vb). This year the postspawning blue whiting migrated northwards past Faroes in the Faroe Bank channel (west of the isles). Later in May and in June the fishery continued north of the Faroes (Vb and IIa) with good catches. There were only scattered catches in the Icelandic, Faroese and International waters during the period from July to October, but the catches started to increase again in late November on the north-eastern continental slope targeting the beginning of the southward migration of blue whiting. In December the fishery gradually moved southwards through the Faroe-Shetland channel targeting prespawning fish.

Only one industrial trawler operating mainly in Norwegian waters (Division IVa) in second quarter, with some catches in Faroese waters.

About 97% of the catches were taken with pelagic trawl the rest with pelagic pair-trawls.

4.1.5.4 Iceland

Iceland and Faroes have a bilateral agreement of mutual fishing rights for blue whiting in each other’s EEZs. Iceland set a total blue whiting catch quota of 352 600 tonnes in 2006 for Icelandic-Faroese and International waters.

The Icelandic directed fishery started in late February in International waters west of the British Isles and continued there through March. In April to June, the fishery was mainly in Faroese waters, but also partly in the Icelandic zone. In July, August and October, the fishery took mainly place on the Dorhnbank, between Iceland and Greenland with a total catch of 21 thousands tonnes. About 15% of the Icelandic catch was taken in the Icelandic zone, 65% in the Faroese zone and the remaining in International waters. Most of the catch was taken in the second quarter of the year (72%). The total Icelandic catch in 2006 was 309 508 tonnes.

A total of 24 trawlers/purse-seiners participated in the Icelandic fishery, as compared to 25 vessels in 2005, using large pelagic trawls with a 40 mm mesh size in the cod-end. The length range of the vessels was 55–105 meters with a mean length of 67 meters. The engine power range of the fleet was 1943–5920 kW (2500–8051 HP) with a mean of 3490 kW (4570 HP). Iceland has set size limitations on landings of blue whiting. If the catch consists of 30% or more of fish smaller than 25 cm, a temporary area closure is imposed.

4.1.5.5 Ireland

The Irish fishery for blue whiting began in late January with the great majority of landings reported from January to March. A total of 21 boats took part and reported landings of 54 900 t. This is a decline from 2005 when the Irish landings peaked at 73 400 t.

The fleet is comprised of 21 pelagic or polyvalent licensed trawlers with RSW tanks and 1 freezer-trawler. In the 2006 fishery, 14 of the largest RSW vessels in the fleet accounted for 90% of the total landings. Blue whiting from the Irish fleet is landed primarily for reduction to fishmeal with smaller but important amounts processed for human consumption. In 2006 landings for human consumption were in the region of 14 000 t with over 9000 t of this coming from the single freezer-trawler in the fleet. The remaining 5000 t were landed from RSW vessels fishing close to the main Irish pelagic port of Killybegs.

In 2007 the freezer-trawler was sold from the Irish fleet after the fishery closed. This is likely to have an impact on the distribution of landings in 2008 for the remaining fleet.

Fishing took place to the west and north of the Porcupine Bank as well as the Rockall trough to the north west of Ireland. Fishing took place on spawning and post spawning aggregations from ICES areas VIa, VIb, VIIb and VIIc. Fishing was concentrated in those rectangles along the shelf-edge and in deeper waters of between 300 and 600 m in depth.

4.1.5.6 Netherlands

The Dutch fleet fishing for pelagic species in European waters consists of 10 freezer trawlers on blue whiting ranging in engine powers from 3500 to 10 000hp. In addition, a number of flag vessels are operating from the Netherlands. In total 41 trips were made. The fishery for blue whiting is carried out with large pelagic trawls and is a directed fishery with almost no bycatch of other species. Catches decreased in 2006 compared to 2005. Most of the catches in 2006 originated from ICES Division VIa and VIIc and were taken in the first half of the year. All catches are landed frozen for human consumption.

4.1.5.7 Norway

After the coastal state agreement in 2005 and quota transfers in other international agreements, the Norwegian TAC for 2006 was set to 637 527 t (of which 472 631 t could be taken in the EU zone and 80 800 t in the Faroese EEZ). The majority (approximately 78%) of the Norwegian catches were taken in a directed pelagic-trawl fishery west of the British Isles and in the Norwegian Sea during the first half of the year. A total of 45 large combined purse-seiners/trawlers took part in this fishery in 2006. The remaining catches (22%) were mainly taken by the industrial trawl fleet (which uses both pelagic and demersal trawls) in the Norwegian deeps and Tampen area (east of 4ºW). This fishery is mainly a directed blue whiting fishery (for the time being with low Norway pout availability) but the bycatch of saithe can be significant (the maximum bycatch proportion of other species is 30% by weight during a trip). 50 industrial trawlers participated in the fishery (defined as landing more than 5 tonnes) in 2006. All the Norwegian TAC was taken in 2006.

Regarding the age and length composition in catches taken by the directed pelagic-trawl fishery west of the British Isles, the proportion of small and young fish seems to have been decreasing since 2004 (Figure 4.1.5.7.1), and the proportion is exceptionally low in 2007. This supports the observation that both the 2005 and 2006 year classes seem weak.

4.1.5.8 Russia

Blue whiting was fished by a few vessels in the eastern part of Faroese fisheries zone in January, but the fishery was interrupted at the beginning of February.

The fishery for blue whiting began on 29 January in the area of 55°00'–55°20'N in the international waters off Porcupine Bank and Rockall to 16°30'W. From 9 February the Russian commercial vessels kept continuously arriving in the area to a total of 29 vessels. The fishery level before the last five days of March was quite often restrained due to the technological constraints on processing catch. In February, aggregations were being formed in the area of 54°00'–56°30'N. In March, when blue whiting was fished by about 45 Russian vessels, the northern boundary of aggregations shifted to 59°N. Main length groups in the catches taken in February were 25–29 cm, followed by 25–27 cm. The spawning took place earlier and was more intensive than in 2005.

In 2004–2006, the fishery ceased approximately at the same time. The total catch in 2006 amounted to 75 thousand tonnes.

Resumption of fishery in the Faroese waters took place up to 4 April. Productivity of that fishery was very high up to 20 May when the main shoals migrated beyond the western border of Faroese zone. The trawlers then shifted to the east of the zone, staying there up to 18 June.

The fishery in the international waters of Norwegian Sea was prosperous after the middle of July. It finished on 20 August. A fishery was attempted in this region in the first half of September, in October and in the first week of December, but with limited success.

Two vessels in October-November and 7–17 vessels in December carrying out blue whiting fishery in the Faroese waters had relatively low productivity, mostly due to weather conditions.

4.1.5.9 Spain

The Spanish blue whiting fishery was carried out mainly by bottom pair trawlers in a directed fishery and by single bottom trawlers in a bycatch fishery. Small quantities were also caught by longliners. These coastal fisheries have trip durations of 1 or 2 days and catches are for human consumption. Thus, coastal landings are driven mainly to market forces, and are rather stable.

This fleet has decreased from 279 vessels in the early 1990s to 135 vessels in 2006 with an average of 28 m length, 444 HP and 141 GRT. 64% of these vessels are operating the whole year as bottom otter trawlers, 28% as pair bottom trawlers and 8% alternate between bottom otter trawls and pair bottom trawls throughout the year.

> Pair Bottom Trawl Fishery: The Pair bottom trawl is a traditional fleet that fish mainly blue whiting (above 80%) and other pelagic species in Div. VIIIc and North IXa. In the middle of 1990s, VHVO gear (with 25 m of vertical opening) gradually replaced the traditional one. From 2001 the cod-end mesh size was increased to 55 mm.
>
> Bottom Trawl Mixed Fishery: This métier operates in Divisions VIIIc and IXa North, using a cod-end mesh size of 65 mm and a vertical opening of 1.2–1.5 m. It targets a wide range of species including horse-mackerel, blue whiting, and mackerel (70% of landings together), and also hake, anglerfish, megrims, and *Nephrops.*

Spanish landings decreased around 14% in 2006 with a landing of 15 173 tones.

4.2 Data available

This Section describes in sub-sections the available data for assessment.

4.2.1 Catch

Catch data from Portugal were revised (a 500 tonnes decrease in total landing weight) after the WG meeting and were not included in this report.

Total catches in 2006 were provided by members of the WG. They were estimated to be about 1.97 million tonnes, 60 thousand tonnes less than in 2005. Time-series with catches by nations and area are given in Tables 4.2.1.1–4.2.1.7.

The spatial and temporal distribution of the catches of blue whiting in 2006 is given by ICES rectangles for the whole year is given in Figure 4.2.1.1 and by quarter in Figure 4.2.1.2. In 2006 the data provided as catch by rectangle represented approximately 98.3% of the total WG catch.

Some details about vessels operated by different nations targeting blue whiting are given in Table 4.2.1.8.

Most of the catches are taken in the directed pelagic trawl fishery in the spawning and post-spawning areas (Divisions Vb, VIa, b, and VIIb, c). Catches are also taken in the directed and mixed fishery in Subarea IV and Division IIIa, and in the pelagic trawl fishery in the Subareas I and II, in Divisions Va, and XIVa,b. These fisheries in the northern areas have taken 340 000–2 300 000 t per year in the last decade, while catches in the southern areas (Subarea VIII, IX, Divisions VIId, e and g–k) have been stable in the range of 20 000–85 000 t. In Division IXa blue whiting is mainly taken as bycatch in mixed trawl fisheries.

The proportion of landings originating from the Norwegian Sea has increased from 5% in the mid–1990 to around 30% in 2003–2004, after which the proportion has decreased again to around 15% (Figure 4.2.1.3). This might have implications for the stock assessment as much larger proportions of juvenile fish occur in catches from the Norwegian Sea, thus probably changing the exploitation pattern of the fishery as whole.

Discard

Discards of blue whiting are thought to be small. Most of the blue whiting is caught in directed fisheries for reduction purposes. However, some discarding occurs in the fisheries for human consumption and as bycatch in fisheries directed to other species. Discarding in 2006 is not included in the assessment.

Reports on discarding from fisheries which catch blue whiting were available from the Netherlands for the years 2002–2006. A discard sampling programme of the pelagic fleet is carried out in the frame work of the EU Data Collection Regulation. On average about 3% (1%–5%) of the Dutch catch (in numbers) of blue whiting is estimated to be discarded. About 2/3 of the discards comes from the directed fishery and mainly originate from cod-end damage or cleaning of the fish tanks. The other 1/3 is bycatch in fisheries targeting other species. Figure 4.2.1.4 gives a length distribution of landings and discards in the period 2002–2005 from the pelagic fleet in the Netherlands.

Also information of discards was available for Spanish fleets. Blue whiting is a bycatch in several bottom trawl fisheries directed to a mixture of species. The estimates of discard in mixed fisheries in 2006 ranged between 23% and 99% (in weight) as most of the catch is discarded and only last day catch may be retained for marketing fresh. The catch rates of blue whiting in these fisheries are however low. In the directed fishery for blue whiting for human consumption with pair trawls, discards were estimate to be 13% (in weight) in 2006.

Discards information from the Portuguese fisheries (WD Godinho *et al*., 2007) showed that for the period 2004–2006 the discarded weight of blue whiting was slightly higher than the landed weight (on average 4000 t per year).

4.2.1.1 Review of catch statistics

The Section addresses the ToR(c): "Review the catch statistics of blue whiting especially from 1978 to 1990 and resolve differences between ACFM landings, EOROSTAT and ICES Fishstat data".

Catch data as recorded in various ICES working group reports (ICES 1985; ICES 1996; ICES 2006) covering the period since 1973 are presented in Table 4.2.1.1.1. These landings are compared with blue whiting, "Area 27", landings from ICES/Fishstat database. In Figure 4.2.1.1.2 it can be seen that blue whiting working groups has adjusted the landings figures slightly over time, but changes are relative small. The working group landings relative to the FishStat landings show a modest deviance for the period since 1978 where landings exceed 100 000 tonnes annually.

In the table below some significant differences among various sources of information are shown. In the late seventies, the main differences are due to the lack of mixed industrial fishery landings in the officially reported landings. The Working Group was aware that individual vessel landings in some industrial fisheries are recorded as landing from one species only. Dependent on the species composition landings from a fishing trip can be recorded as blue whiting or e.g. Norway pout. This quantity goes into the official catch statistic, however it seems that for some years, the mixed industrial landings were not reported at all. In other years samples from the landings were used to quantify the actual species composition and these data are used to derive the WG estimate of the blue whiting landings.

In the early nineties the misreporting could be due to underreporting of blue whiting.

Examples of differences between ICES WG estimate and ICES FishStat database.

		FISHSTAT	ICES WORKING GROUP	ICES-FISHSTAT		
Year	Country	Landings(t)	Directed fishery (t)	Mixed industrial (t)	Total Landings(t)	Difference
1978	Norway	117 954	116 815	**39 989**	156 804	**38 850**
1978	Iceland	26 377	25 293	**9484**	34 777	**8400**
1988	Norway	209 738	208 416	**24 898**	233 314	**23 576**
1988	Denmark	134 642	797	**18 144**	18 941	**-115 701**
1991	Norway	119 201	114 966	**22 644**	137 610	**18 409**
1991	Denmark	50 368	0	**15 538**	15 538	**-34 830**
1991	Sweden	17 980	0	**1000**	1000	**-16 980**

4.2.1.2 Sampling intensity

In total 1715 samples were collected from the fisheries in 2006. 190 533 fish were measured and 27 014 were aged. Sampled fish were not evenly distributed throughout the fisheries (see text table below).

QUARTER	FISHERIES	DIRECTED	MIXED	SOUTHERN	TOTAL
1	No. of samples	498	67	109	674
	WG Catch	1 013 765	5847	5439	1 025 050
2	No. of samples	298	127	113	538
	WG Catch	627 221	42 217	5963	675 401
3	No. of samples	140	46	88	274
	WG Catch	116 312	37 447	4636	158 395
4	No. of samples	95	46	88	229
	WG Catch	83 086	19 729	4479	107 294
Total No. of samples		1031	286	398	1715
Total WG Catch		1 840 384	105 239	20 517	1 966 140

Considering the proportion between catches and sampling, the most intensive sampling took place in the southern fishery of Spain and Portugal. Here one sample was taken for every 52 tonnes, followed by the mixed fishery with one sample for every 368 tonnes, and lastly the directed fishery where there was one sample for every 1785 tonnes caught. In this context it should be noted that implementation of the EU Collection of Fisheries Data, Fisheries Regulation 1639/2001, requires EU Member States to take a minimum of one sample to be taken for every 1000 t landed in their country. Detailed information on the number of samples, number of fish measured, and number of fish aged by country and quarter is given in Tables 4.2.1.2.1 and 4.2.1.2.2 As can be seen, no sampling was carried out by Germany, Sweden and France, all with relatively small landings.

Sampling intensity for age and weight of herring and blue whiting are made in proportion to landings according to CR 1639/2001 and apply to EU member states. For other countries there are no guidelines. Current precision levels of the sampling intensity are unknown and the group recommends reviewing the sampling frequency and intensity on a scientific basis and providing guidelines for sampling intensity.

4.2.2 Length and age compositions

Data on the combined length composition of the 2006 commercial catch by quarter of the year from the directed fisheries in the Norwegian Sea and from the stock’s main spawning area were provided by the Faroes, Iceland, Ireland, Germany, the Netherlands, Norway, Russia and

Scotland. Length composition of blue whiting varied from 12 to 46 cm, with 95% of fish ranging from 21–32 cm in length. The mean length in the fishery was 26.9 cm (Table 4.2.2.1) which is 7 mm larger than the mean length last year. The difference might be due to a decrease in recruitment in the most recent years lowering the proportion of young fish in the population. Length compositions of the blue whiting catch and bycatch from “other fisheries” in the Norwegian Sea and the North Sea and Skagerrak were presented by Norway (Table 4.2.2.2). The catches of blue whiting from the mixed industrial fisheries consisted of fish with lengths of 12–41 cm and a mean of 24 cm. France, Spain and Portugal caught blue whiting in the Southern area. The Spanish and Portuguese data used for length distribution of catches showed a length range from 10–38 cm with a mean length of 23.1 cm (Table 4.2.2.3).

For the directed fisheries in the northern area in 2006, age compositions were provided by Denmark, the Faroe Islands, Iceland, Ireland, Norway, the Netherlands, Russia and Scotland and the sampled catch accounted for 96% of the total catch. Estimates of catch in numbers for unsampled catches were raised according to the knowledge of how, where, and when the catches were taken. The age compositions in the directed fisheries are given in Table 4.2.2.4.

Age compositions for blue whiting bycatches from “other fisheries” in the North Sea and Skagerrak were provided by Norway, Denmark, Faroe Islands and Russia and sampled catch accounted for 96% of catches. These data were used for allocation of the remaining part of the total in that area. The age compositions are given in Table 4.2.2.5.

For the fisheries in the Southern area, age composition representing 81% of the catch were presented by Spain and Portugal. The age compositions in the southern fishery data are given in Table 4.2.2.6.

The combined age composition for the directed fisheries in the Northern area, i.e. the spawning area and the Norwegian Sea, as well as for the bycatch of blue whiting in “other fisheries” and for landings in the Southern area, were assumed to represent the overall age composition of the total landings for the blue whiting stock. The catch numbers-at-age used in the stock assessment are given in Table 4.2.2.7. The SALLOC program (ICES 1998/ACFM:18) was used to calculate the total international catch-at-age, and to document how it was done.

Catch curves made on the basis of the international catch-at-age (Figure 4.2.2.1) indicate a consistent stock-decline and thereby reasonably good quality catch-at-age data, especially for year-classes since 1995.

4.2.3 Weight-at-age

Mean weight-at-age in the catch data were available from Denmark, the Faroes, Iceland, Ireland, the Netherlands, Norway, Portugal, Russia, Scotland and Spain. Mean weight-at-age for other countries was based on the allocations shown in the Annex II (“ALLOC” files) and was estimated by the SALLOC program for the total international catch. Table 4.2.3.1 shows the mean weight-at-age for the total catch during 1983–2006 used in the stock assessment. There is a general trend towards lower weight-at-age (Figure 4.2.3.1). Although the reasons of this fact have not been investigated, the Working Group identified two possible causes:

- Density dependent effect: From 1996 onwards a series of exceptionally large year classes entered the stock leading to a substantial increase in stock size. The increase in population might have reduced the available food per individual fish leading to the observed decrease in mean weight.
- Shift in fishing pattern: During the same period the fishery extended remarkably, reaching new areas. This may have increased the catches of post-spawners and caused the decreased in the observed mean weights.

During the WG meeting it was not possible to draw conclusions on the changes in mean weight. Intersectional work is necessary and the **WG recommends an analysis of the change in mean weight as part of the ToRs for the next WG meeting**.

The weight-at-age for the stock was assumed to be the same as the weight-at-age for the catch.

4.2.4 Maturity and natural mortality

Maturity-at-age used in the assessment was obtained by combining maturity ogives from the southern and northern areas, weighted by catch in numbers-at-age (ICES 1995/Assess:7). These are the same as those used since 1994. Although the values of maturity-at-age probably are too low, sufficient information for estimating new ogives is not available.

The possible need for revising the current estimate of instantaneous natural mortality rate *M* for blue whiting was discussed in detail by the 2002 WG. Although it was admitted that the current estimate M>=0.2 yr^{-1} might be too low, the factual basis for revision was ambiguous. More recent methodological work by WGMG (ICES 2003/D:03) emphasizes that natural mortality rate cannot be estimated reliably with information normally available for stock assessment models. The working group therefore considers that there is no new information that would justify a revision of the current estimate of *M*.

In the table below, blue whiting natural mortality and proportion of maturation-at-age is shown.

AGE	0	1	2	3	4	5	6	7–10+
Proportion mature	0.00	0.11	0.40	0.82	0.86	0.91	0.94	1.00
Natural mortality	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

4.2.5 Catch, effort and research vessel data

4.2.5.1 International Blue Whiting spawning stock survey

Background and status

The International Blue Whiting Spawning Stock Survey (IBWSSS) is carried out on the spawning grounds west of the British Isles in March-April. The survey started in 2004 and is carried out by Norway, Russia and the EU. In 2005 the Faroes joined the survey. This international survey, with broad international participation, allowed for broad spatial coverage of the stock as well as a relatively dense net of trawl and hydrographical stations. The survey is coordinated by PGNAPES (ICES CM 2007/RMC:08).

The International survey directly incorporates both the Norwegian and Russian spawning stock surveys that started in the early 1990s; details of these surveys can be found in previous working group documents (e.g. ICES CM 2006/ACFM:34). The integrity of the Norwegian time-series has been maintained from 1991–2006, and it was used as the major source of survey information in previous assessments. However, in 2007 the Norwegian contribution to the international survey changed, resulting in coverage of a non-standard area, and therefore a break in the time-series. The index from the Norwegian spawning stock survey time-series could therefore not be used this year.

Use of this survey in stock assessment

Both the IBWSSS survey and the Norwegian spawning stock survey were used in the assessment this year.

Quality of the survey

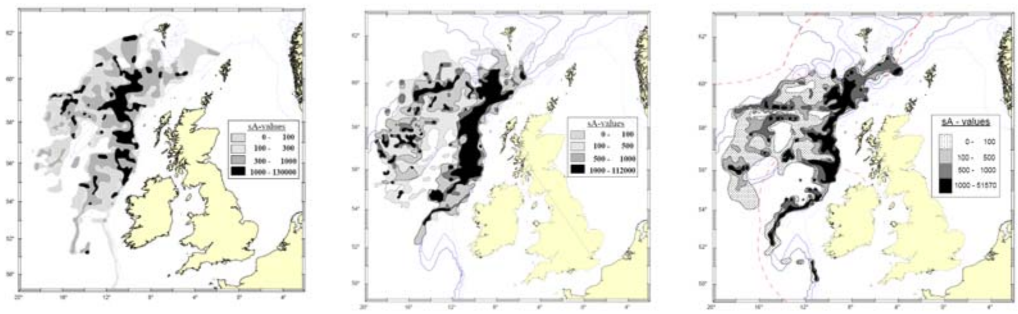
Due to the short time-series from the international survey (2004–2007) there is insufficient data available to fully evaluate its performance. A further problem with the reliability of the joint international survey results is inconsistency between the age readings, due to the increased number of vessels (and readers) participating, (as compared to the Norwegian/Russian time-series). In comparison, the international age readings are probably less consistent than the Norwegian age readings. Between-vessel comparisons have shown significant differences in the past.

For the first time, uncertainty in stock estimates has been assessed. At present, only one source of uncertainty is considered, i.e. spatio-temporal variability in acoustic recordings. Bootstrapping was used to characterize uncertainty in the mean acoustic density. This analysis indicates that confidence limits were stable in 2004–2006 (Figure 4.2.5.1). In 2007, the width of confidence limits was almost doubled because of a few very high acoustic records.

The Norwegian spawning stock survey shows moderate good internal consistency (Figure 4.2.5.2). However, while the international time-series clearly lacks sufficient data points to make a firm conclusion regarding internal consistency, the available data appears inconsistent.

Results

The distribution of acoustic backscattering densities for blue whiting as recorded by the six vessels is shown in Figure 4.2.5.3 (below). The highest concentrations were generally recorded in the area between the Hebrides, Rockall and the banks southwest of the Faroes, but several large concentrations were found just north of Porcupine Bank. The blue whiting spawning stock estimates based on the international survey are given in Table 4.2.5.1.1.



2005 **2006** **2007**

Figure 4.2.5.3. Blue whiting. Schematic map of blue whiting acoustic density (sA, m2/nm2) found during the spawning survey in spring 2005, 2006 and 2007.

Given the uncertainty in the estimate, no change in blue whiting stock abundance in the spawning area could be detected. Point estimates suggest a slight increase in stock biomass and stable stock numbers. In contrast, the estimates in 2006–2007 are significantly higher than the estimate in 2005.

Abundance estimates from this acoustic survey should generally be interpreted as relative indices rather than absolute measures. In particular, acoustic abundance estimates critically depend on the applied target strength. The target strength currently used for blue whiting is based on cod and considered to be too low, possibly as much as by 40% (see Godø *et al.*, 2002, Heino *et al.*, 2003, 2005, Pedersen *et al.*, 2006). This would imply an overestimation of stock biomass by a similar factor. This bias, however, should be roughly constant from year to year, and does not affect the above conclusions about relative change in abundance of stock.

Mean age has increased from last year's 2006 and is now the highest on recorded in the four years since the survey started in 2004. Recruitment to spawning stock seems weak with numbers at ages 1–3 years the lowest in the time-series. On the other hand, numbers of "old" blue whiting (ages 6–8 years) are relatively high. However, age distributions seem noisy. In part, this seems to be caused by variability in recruitment, with some cohorts recruiting to the spawning ground earlier than others. However, between-vessel comparisons of mean age at length also suggest that there could be problems in age reading.

The survey area was reduced by about 20% from 2006. Most of the reduction came from areas with low density in 2006. Nevertheless, the estimates would have been expected to be higher if the same coverage were achieved.

Most of the increase in the stock estimate comes from the southern sub-areas (the Porcupine Bank). This area was covered earlier in season this year than in 2006. With later coverage, the biomass would probably have moved to the Hebrides sub-area. In the Hebrides and the Faroes sub-areas biomass was essentially unchanged, whereas biomass decreased in the Rockall sub-area where coverage was also significantly reduced.

Age and length distributions from the 3 last years are shown in Figure 4.2.5.4.

4.2.5.2 International ecosystem survey in the Nordic Seas

Background and status

The international ecosystem survey in the Nordic Seas (Figure 4.2.5.5 below) is aimed at observing the pelagic ecosystem in the area, with particular focus on herring, blue whiting, mackerel (Norway), zooplankton and hydrography. The observations on herring and blue whiting are done by acoustic observation with main focus on Norwegian spring-spawning herring and blue whiting in the Norwegian Sea. The survey is carried out in May since 1995 by the Faroes, Iceland, Norway, and Russia, and since 1997 (except 2002 and 2003) the EU. The high effort in this survey with such a broad international participation allowed for broad spatial coverage as well as a relatively dense net of trawl and hydrographic stations.

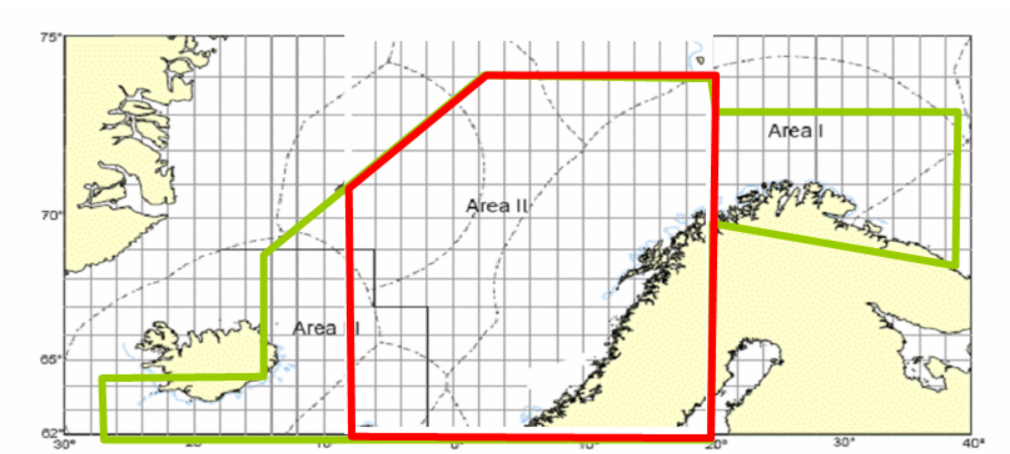


Figure 4.2.5.5. Blue whiting. Areas defined for acoustic estimation of blue whiting and Norwegian spring spawning herring. The dark red box in the middle represents the standard area (8°W–20°E and north of 62°N) of which blue whiting data is used for assessment. The outer green box represents the total survey area.

Estimates in 2000–2007 are available both for the total survey area and for a "standardized" survey area. The latter is more meaningful as the survey coverage has been rather variable in the south where post-spawning blue whiting are entering the Norwegian Sea as well as in the west where large blue whiting occur. As these result in unknown noise that are highly undesirable, the discussion below is therefore based on the estimate for the standard survey area.

Since 2005 this survey has extended into the Barents Sea where the main focus of investigations has been young herring and capelin larvae. The survey is coordinated by PGNAPES (ICES CM 2007/RMC:08).

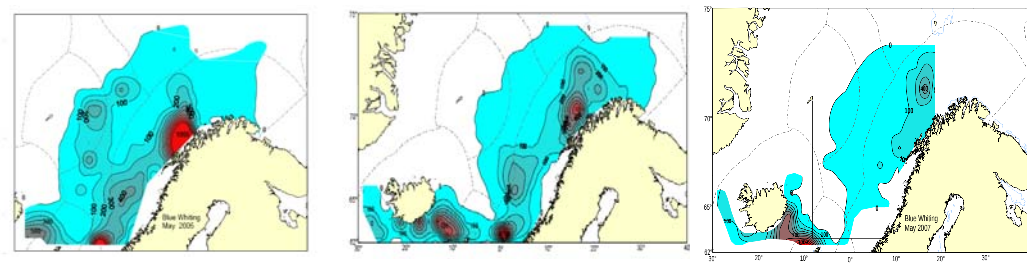
Use of this survey in stock assessment

The survey has been used in the final assessment from 2005 onwards to estimate recruitment of blue whiting. The performance of this survey in predicting recruitment is not yet well known, as the overlap with the assessment estimate is limited and the latter in general is plagued by uncertainties that reflect scarcity of data on the most recent year classes. However, the result is in line with the recruitment index (age 1) from the Barents Sea where the index in 2006 was the lowest one since 1999.

Internal consistency within the survey's age composition shows good correlation for the International time-series (Figure 4.2.5.6); however this correlation is mainly driven by one data point.

Results for blue whiting

The International ecosystem survey in the Nordic Seas shows a strong decline in stock numbers and biomass, and especially a very low index for age 1 and age 2 in both 2006 and 2007. This decline in biomass is far larger than could be explained by acoustic uncertainty. The situation resembles somewhat that in 2000 when what now appear to be too low values were estimated. The reason this is unclear, but could relate to migrations. A well known problem is migration of post-spawning blue whiting from the spawning area to the southern part of the survey area, but this should not affect juvenile blue whiting (for this reason, only indices for ages 1–2 years are used in tuning the assessment). Somewhat higher stock estimate was obtained for similar area in July-August 2007, but even this estimate is considerably (-30%) lower than the estimate in 2006.



2005 **2006** **2007**

Figure 4.2.5.7. Blue whiting. Schematic map of blue whiting acoustic density (sA, m2/nm2) found during the survey in spring 2005, 2006 and 2007.

The decline is particularly dramatic in terms of numbers (-71%), reflecting increasing average size and age of blue whiting in this survey. Mean age of blue whiting fluctuated between 1.3 and 2.1 years in 2000–2005, increased to 2.8 years in 2006, and was estimated to be 3.7 years in 2007 survey. This change reflects strengths of 2005 and 2006 year classes, which are low if not extremely low. Similar signal has been recorded in the Barents Sea February-March, and again in the Norwegian Sea in July-August. There are all reasons to believe that the low numbers of recruits suggested by this survey are real.

The blue whiting stock estimates based on the international survey in both the standard and total survey area are given in Table 4.2.5.1.2.

4.2.5.3 Norwegian Sea summer survey

Background and status:

In 1981–2001 Norway made an acoustic survey in the Norwegian Sea in order to follow the migration of Norwegian spring spawning herring and to measure blue whiting in its feeding areas. This survey used to give the first indication of the incoming year class measured at age 1; in 2004 SGAMHBW recommended using indices from this survey at ages 1–4 years.

This survey was started anew in 2005, but with main focus on mackerel in 2005–2006. From 2007 onwards more focus is/will be put on blue whiting. No estimates have made.

Use of this survey in blue whiting assessment:

As the survey is terminated it provides little information for the latest years in the assessment, and it was decided not to use the survey in the final assessment, but data were used in a SPALY configuration with XSA.

Results:

The stock estimates in numbers at age are given in Table 4.2.5.3.

4.2.5.4 Norwegian bottom trawl survey in the Barents Sea

Background and status

Norway has conducted bottom trawl surveys targeting cod and other demersal fish in the Barents Sea since late 1970s. From 1981 onwards there have been systematically designed surveys carried out during the winter months (usually late January-early March) by at least two Norwegian vessels; in some years the survey has been conducted in co-operation with Russia. Blue whiting is a regular bycatch species in these surveys, and has in some years been among the numerically dominant species (Heino *et al.*, 2007). This survey is presently giving the first reliable indication of year class strength of blue whiting.

Most of the blue whiting catches (or samples thereof) have been measured for body length, but very few age readings are available (from 2004 onwards otoliths are systematically collected). The existing age readings suggest that virtually all blue whiting less than 19 cm in length belong to 1–group and that while some 1–group blue whiting are larger, the resulting underestimation is not significant. An abundance index of all blue whiting and putative 1–group blue whiting from 1981 onwards is given in Table 4.2.5.4 and follows methods described in Heino *et al*., (2007). Somewhat different threshold have been used before (21 cm was used in 2004, 20 cm in 2005, and 18 cm in 2006), the latest change being made to consistently accomodate a change in measurement precision in the middle of the time-series.

Results

Total index has declined substantially from 2006 (-70%), but it is still moderately high in the historic perspective (close to the 3rd quartile of the distribution), and higher than all observations before 1997.

1–group index for 2007 is moderately weak in the historic perspective (being close to the 1st quartile of the distribution). However, it is very weak in comparison to the estimates from this decade, and the lowest one after 1995.

Use of this survey in blue whiting assessment

The survey is not used in the assessments, but it is used for recruitment estimation in the forecasts.

4.2.5.5 Spanish bottom trawl survey

Background and status

Bottom trawl surveys have been conducted off the Galician (NW Spain) coast since 1980, following a stratified random sampling design and covering depths down to 500 m. The survey directed to a mixture of species. Since 1983, the area covered in the Spanish survey was extended to completely cover Spanish waters in Division VIIIc. A new stratification has been established since 1997.

Use of this survey in blue whiting assessment

The survey is not used in the assessments as it is only representative for a small part of the stock area.

Results

Stratified mean catches and standard errors are shown in Table 4.2.5.5. Larger mean catch rates are observed in the 100–500 m depth range. Since 1988 the highest catch rates in the Spanish survey were observed in 1999 (124 kg/haul). The 2006 estimate is 72 kg/haul (Figure 4.2.5.9).

4.2.5.6 Faroes plateau spring bottom trawl survey

Background and status

On the Faroe plateau an annual demersal bottom trawl surveys is carried out during spring (March 1996–2007). The survey is aimed at cod, haddock and saithe, but varying amounts of blue whiting are caught as bycatch each year. An updated time-series of the 0–group and 1–group will be provided for next year's WG.

4.2.5.7 Faroes plateau autumn bottom trawl survey

Background and status

On the Faroe plateau an annual demersal bottom trawl survey is carried out in autumn (August-September 1994–2007). The survey is aimed at cod, haddock and saithe, but varying amounts of blue whiting are caught as bycatch each year. An updated time-series of the 0–group and 1–group will be provided for next years WG.

4.3 Data analysis

4.3.1 Reviews of last year's assessment

The ICES review of the 2006 blue whiting assessment had no serious concerns about the quality of the assessment, but pointed out the need for a statistical analysis of the survey data for their possible inclusion in future assessments. This is initiated in Section 4.2.5.

The review group also pointed out that standard software could be used for sensitivity analysis of the impact of input data for projection on projected biomass and yields. Due to the very uncertain stock size in the terminal year calculated by this year's working group, it was not possible to make meaningful uncertainty estimates and thus employ the standard software (*e.g.* the MLA mid-term forecast).

The review group also noted inconsistency in estimating recruits for forecasts. The choice of method for recruitment estimation will be described and justified in more details in Section 4.6.

4.3.2 Evaluation of data underlying the assessment

Catch data

Catch curves made on the basis of the international catch-at-age (Figure 4.2.2.1) indicate a consistent stock-decline and thereby reasonably good quality catch-at-age data, especially for year classes since 1995. Total estimated mortality is higher for the year classes since 1995, as compared to the year-classes from the previous decade.

Quota uptake of blue whiting in 2007, at least 90% by mid-August, does not indicate a strong decline in the stock size, even though catch rates of a pelagic schooling fish are not a good predictor of its abundance.

Survey data

The WGNPBW has previously concluded that the “Norwegian spawning stock survey” (Section 4.2.5.1) and “International ecosystem survey in the Nordic Seas” (Section 4.2.5.2) can be used in the analytical assessment. However, the spatial coverage of the first was too sparse in 2007 to permit an update of the time-series with 2007 data; the available information from this survey is therefore the same as for last year’s assessment.

The “International Blue Whiting Spawning Stock Survey”, includes the 2007 information and provides a good coverage of the spawning grounds, but has a very short time-series. The estimated (spawning) biomass from this survey is around 10 millions tones. This is far higher than the assessment results. Abundance estimates from this acoustic survey should be interpreted as relative indices rather than absolute measures as the abundance estimates critically depend on the applied target strength, which seems too low (see Section 4.2.5.1 for details). The total SSB estimated from the international survey (Figure 4.2.5.1) in 2007 has a wide confidence interval.

The available survey information is presented in Table 4.3.2.1. The indices at age are quite similar for the International Blue Whiting Spawning Stock Survey and the Norwegian survey (Figures 4.3.2.2 and 4.3.2.3), an expected result as the latter is a subset of the former.

The internal consistency is poor for the International Blue Whiting Spawning Stock Survey, except for age groups 4 to 5. The Norwegian survey performs somewhat better (Figure 4.2.5.2).

The “International ecosystem survey in the Nordic Seas” gives a very clear drop in recruitment for the 2005 and 2006 year class. The internal consistency is reasonably good for this survey (Figure 4.2.5.6).

Comparison of the quality of the Norwegian and International Blue whiting spawning stock surveys.

Due to the short time-series from the International Blue Whiting Spawning Stock Survey there are still too few data to fully evaluate its performance. Compared with the Norwegian Spawning Stock Survey, the internal consistency (Figure 4.2.5.2) of the International survey does not perform well, even though the very short time-series does not allow a direct comparison.

The apparent poor-performance of the International spawning stock survey may be linked to inconsistency between the age readings with several vessels (and readers) participating as compared to the Norwegian/Russian time-series. In comparison to the Norwegian survey the international age readings are probably less consistent than the Norwegian and Russian age readings. Between-vessel comparisons have shown such differences in the past.

The spawning stock spatial coverage of the International survey is much more extensive than of the Norwegian survey; Rockall area often contains a substantial part of the stock and has only been covered by the Norwegian time-series from 1998 onwards, although never extensively. Although the international survey gives a better coverage, the difference in biomass estimate is believed to be not more than 1 to 2 million tonnes over the past years.

Problems in survey progression (the chance of double counting fish) are believed to be stronger within the International survey since inter-vessel coordination proves to be difficult. However, both surveys are having large cruise-breaks within in their survey. Results from 2007 show higher sensitivity to the way fish are distributed than expected. Therefore it is believed that the higher cruise track density of the international survey gives a more precise estimate on the total biomass in the core area.

The correct timing of covering the entire spawning stock is believed to be less accurate in the Norwegian survey in comparison to the international survey.

Based on the above discussion the WG concludes that with the present short time-series, the International survey does not give a more precise measurement of the blue whiting stock abundance compared to the Norwegian survey.

Data exploration with survey combinations

Even though the International Blue Whiting Spawning Stock Survey has a very short time-series, it was decided to investigate including the survey in the assessment, as it is the only survey with a good coverage of the spawning stock in 2007.

Below we investigate different scenarios for the inclusion of the available survey information. A number of exploratory runs using the main assessment methods (SMS, AMCI, ICA, and TISVPA) were made using the following survey combinations:

Three surveys:

- Norwegian spawning stock survey, age 3–8 from 1991–2006
- International Blue Whiting Spawning Stock Survey, age 3–8 from 2004–2007
- International ecosystem survey in the Nordic Seas, age 1–2 from 2000–2007

Two surveys:

- Norwegian spawning stock survey, age 3–8 from 1991–2006
- International ecosystem survey in the Nordic Seas, age 1–2 from 2000–2007

No overlap in time for the spawning surveys:

- Norwegian spawning stock survey, age 3–8 from 1991–2003
- International Blue Whiting Spawning Stock Survey, age 3–8 from 2004–2007
- International ecosystem survey in the Nordic Seas, age 1–2 from 2000–2007

Down-weighted international survey (with no temporal overlap on the spawning surveys):

- Norwegian spawning stock survey, age 3–8 from 1991–2003
- International Blue Whiting Spawning Stock Survey, age 3–8 from 2004–2007, down-weighted
- International ecosystem survey in the Nordic Seas, age 1–2 from 2000–2007

The “two surveys” run can be considered as close to the “same procedure as last year” as was possible, using the same survey configuration as the 2006 working group, with the additional inclusion of 2006 data; however, the absence of a 2007 Norwegian survey meant that it was not possible to fully replicate the previous years methodology, and thus should be thought of as an almost-SPALY (“ASPALY”).

By excluding the 2004–2006 data from the Norwegian spawning stock survey there is “no overlap” in the two spawning stock surveys and the same information is not used twice.

The International Blue Whiting Spawning Stock Survey is very short and the internal consistency is rather poor for most ages. The “down-weighted” configuration explores the effect of giving a lower weight to this survey.

The explorative runs were, carried out with the assessment models (AMCI, ICA, ISVPA/TISVPA, SMS and XSA) employed last year. The models AMCI, ICA, ISVPA and SMS use all the assumption of separability in modeling the fishing mortality, whereas XSA is a VPA-type of assessment model. For the family of separable models AMCI, ISVPA and ICA use a fixed input weight for each survey whereas SMS uses the maximum likelihood method and weights the various surveys according to their estimated variance.

4.3.3 Data exploration in AMCI

The four different runs mentioned above were carried out with the latest version of AMCI, Version 2.4. Apart from tuning fleets, the remaining settings were the same as in the final AMCI run last year. The results from each of the runs are shown in Figure 4.3.3.1. There are only minor differences between the run where all years are used in the tuning data and the run with no overlap between the Norwegian and international spawning stock surveys. Omitting the international spawning stock survey from the tuning leads to higher SSBs and lower Fs in the last years compared to the other three runs. Down-weighting of the International spawning stock survey (50% on all ages and years) gives the highest F and lowest SSB in the last years. All four runs give a steep decline in SSB from 2003 onwards, while the recruitment estimates are quite similar. The estimated SSB in 2007 varies between 3.7 and 5.1 million tonnes, while F in 2006 ranges from 0.37 to 0.46 which is above F_{pa}. The model residuals (only shown for the final run, see below) (Figure 4.3.3.2) do not show any particularly worrisome features. Some year effects are indicated by the survey residuals, especially in the residuals from the Norwegian and international spawning stock surveys. The catch residuals mostly look nice, but the large positive residual of age 1 in 2006 and the row of negative residuals of age 2 the last 5 years show that surveys and catch data provide conflicting information about the abundance of the youngest age groups.

The proposed final AMCI run is the one where the international spawning stock survey is down-weighted. Estimated fishing mortality, stock numbers and stock summary can be found in Tables 4.3.3.1 to 4.3.3.3. Plots of the catch and survey residuals are shown in Figure 4.3.3.2. In Figure 4.3.3.3 the results from this year’s and last year’s final AMCI assessments are compared. Compared to last year, this year’s assessment gives a downward revision of recruitment in 2005, a downward revision of SSB in recent years and an upward revision of F in the recent time period.

4.3.4 Data exploration in ISVPA/TISVPA

As in the previous assessment (2006), the “triple-separable” version of the ISVPA model (TISVPA) was used for exploratory runs. This version allows to taking into account possible cohort-dependent peculiarities in the selection pattern. Such effects can arise from differing interactions of cohorts with the fishing fleet, by possible aging difficulties and errors in a particular cohort or by some other unrevealed reasons.

Bearing in mind that the present situation with the blue whiting stock can be characterized as rather uncertain (it is certain that the stock is declining, but uncertain how rapidly), a wide range of possible settings of the model were used for analysis. In choosing the best settings the guiding ideas were to get non-contradicting signals from all available data (catch-at-age data and 3 surveys: Norwegian acoustic spawning stock survey 1991–2006 (survey 1); International ecosystem survey in the Nordic seas 2000–2007 (survey 2), and International blue whiting spawning stock survey 2004–2007 (survey 3)) in order to retain the meaningful input into the assessment method from all of them.

As a whole, two intrinsically non-controversial possible solutions were found. One of them was in line with the TISVPA result obtained in 2006 (hereafter referred to as the "pessimistic" scenario). Another one showed an almost halved rate of decline in final years-let us name it the "optimistic" scenario.

In the so-called pessimistic run, the model settings were used as follows: "triple-separable" case with the window for estimation of cohort-factors-from age 1 to age 8; the "catch-controlled" version (catch-at-age is assumed as true and all residuals in catch-at-age are attributed to violations of selection pattern stability); the condition of unbiased separable representation of fishing mortalities (more correctly-of exploitation rates); the measure of closeness of fit for catch-at-age; the sum of squared residuals in logarithmic catch-at-age, and the absolute median deviation (AMD) of residuals in logarithmic abundance-at-age for all surveys; catchability-at-age are estimated for all surveys.

The so-called "optimistic" solution came from the TISVPA run with somewhat ideologically different setting: the catch-controlled version was substituted by the "mixed" version (assuming equal possibility for errors in catch-at-age and in assumption of stability of the selection pattern) and the AMD of residuals in logarithmic catch-at-age was used as a measure of closeness of the model fit to catch-at-age data. For Survey 1 the measure of closeness of fit was changed to the median (MDN) of the distribution of squared residuals in logarithmic abundance at age as giving more sharp minimum. For Survey 2, as the data set containing the data only for 2 age groups, it was decided not to estimate catchability coefficients and the measure of closeness was also changed to the median of the distribution of squared residuals in logarithmic abundance-at-age as giving more sharp minima. For Survey 3, bearing in mind that there could be strong year-to-year variations of the stock coverage by the survey (and hence in the effective survey catchability), not logarithmic abundance-at-age values were fitted, but logarithmic age proportions. Moreover, age proportions were weighted by stock abundance (by years) in order to give more weight to the data for years with more abundant stock (as probably being more representative), and the measure of closeness was the median of the distribution of squared residuals in logarithmic weighted (by stock abundance) age proportions as giving a more distinct minimum.

First, let us present the results of these two runs in comparison to the result of the TISVPA assessment in 2006 (Figure 4.3.4.1). As it can be seen, the results of the "pessimistic" run are much more similar to the results of the previous assessment. It is also can be seen that both solutions are equally pessimistic with respect to recruitment in 2005 and 2006 and probably the main difference in solutions is in estimates of the 2002–2004 year-class strength.

Figure 4.3.4.2 proves that both results are rather well supported by signals from all of the available data sources, but these signals were produced using different statistic assumptions and restrictions on the solution, and different degrees of robustness of the measures of closeness of fit used. Generally speaking, all of them are logically and statistically meaningful. However, which of them are more pertinent to the data under consideration is a difficult question requiring deep investigation and is beyond the scope of the WG meeting. Instead we examine some simple tests.

Figure 4.3.4.3 represents the residuals for pessimistic (first column) and optimistic (second column) results for catch-at-age and surveys information. It is difficult to find any apparent difference in the quality of residuals for catch-at-age, as well as for survey 2. For Surveys 1 and 3 residuals in terminal years are somewhat smaller for the optimistic solution, but it is necessary to remember that for Survey 3 in the "optimistic" run we measure residuals in age proportions-not in abundances.

Figure 4.3.4.4 compares the results of bootstrap (conditional parametric with respect to catch-at-age, surveys are noised by lognormal noise with sigma=0.3). It is difficult to draw any firm conclusion from the bootstrap results: confidence intervals for SSB are wide in terminal years for both pessimistic and optimistic cases. However, while for the pessimistic case the bootstrap-median SSB curve in final years generally reflects the shape of SSB curve of the basic run, for the optimistic case the bootstrap-median SSB reveals an unexpected peak in 2005 up to 9 million tones. This may be evidence that the model settings used in the "optimistic" run are less stable with respect to overestimation of the stock. This conclusion is very conditional due to the oversimplified error model used in the bootstrapping exercise.

It appears difficult to choose between the pessimistic and optimistic solution. The results for each scenario are given in Tables 4.3.4.1–4.3.4.6.

4.3.5 Data Exploration in ICA

The ICA (Integrated Catch-at-age Analysis) model was used to explore blue whiting data. In previous years, various ICA settings were investigated. In 2007 it was decided to concentrate on the tuning fleets used in the assessment. The same settings as the final ICA run in 2006 were used for each run in 2007.

The survey combinations used in each run are described in Section 4.3.2. In order to be comparable the same survey options were used for each model.

A downward trend in recruitment can be seen in each of the ICA runs (Figure 4.3.5.1). The International Norwegian ecosystem survey is the main recruitment index used in the assessment. The 2007 index is the lowest in the current time-series. SSB from 2003 shows a declining trend in all runs with the lowest value obtained from the run with no overlap. Mean F values are decreasing and varying between 0.34 and 0.4 depending on the tuning fleet used. The highest F, equal to 0.4 is also produced from the run where there is no overlap between surveys.

The final run chosen has the most recent data from the International survey. The Norwegian spawning stock survey is used only as far as 2003, to avoid "double counting" and overlap with the International survey which runs from 2004–2007. This survey has a short time-series but has increased coverage when compared to the Norwegian survey. The residual patterns from this final run are presented in Figure 4.3.5.3. There is no consistent pattern in the catch residuals. Year effects can be seen in the Norwegian acoustic survey and International survey residuals. The stock summary from this final run is shown in Table 4.3.5.1.

When compared to other models, SMS, AMCI, XSA and TISVPA, ICA produces a similar low value for recruitment. ICA shows a high SSB and the low Mean F in the 2006. A comparison between the final run in 2006 and 2007 is shown in Figure 4.3.5.2. The 2007 runs show a higher mean F, a lower recruitment and SSB.

SETTINGS USED FOR ICA FINAL RUN	2006	2007
Number of age structured tuning series	2	3
International survey included	No	Yes
Number of biomass tuning series	0	0
Number of years for separable constraint	8	8
Reference age for separable constraint	3	3
Constant exploitation pattern	Yes	Yes
S to be fixed on last age	1.5	1.5
Catchability model for tuning fleets	Linear	Linear
Age range for the analysis	1–10	1–10
Survey weights for all fleets	100%	100%
Shrinkage	No	No
Manual down weighting	Yes	Yes
Weighting of age 1 catch numbers	50%	50%

4.3.6 Data Exploration in SMS

Data exploration runs were performed using the Stochastic Multi-species (SMS) model (Lewy and Vinther, 2004) to examine the impact of adding and removing the available surveys (Figure 4.3.6.1), as described above in Section 4.3.2. The temporal overlap between the Norwegian acoustic survey and the International Blue Whiting Spawning Stock Survey (IBWSSS), and the corresponding "double counting" data from the one source, does not appear to create an appreciable discrepancy; the "Three surveys" and "No overlap" runs agree very closely with each other. This result suggests that the information contained in the international survey is similar to that in the Norwegian survey and that there is no contradiction between the surveys in the most recent (overlap) years.

Omitting the IBWSSS survey and simply using the Norwegian acoustic survey (the "two surveys" scenario) caused a large change in the results, both quantitatively (SSB in the terminal year halved) and qualitatively ($F_{3–8}$ increasing in recent years rather than decreasing); the IBWSSS appears to have a very strong influence on the results in the terminal year. All runs showed similar results in recruitment, both in terms of general trends and in estimates of the terminal recruitment. The 2006 assessment agreed closely with the "Three surveys" and "No overlap" runs in terms of mean F, and was midway between the two sets of SSB trajectories.

The SMS uses maximum likelihood to weight the various data sources, giving a higher weight to observations associated with a low uncertainty. Both the results of the described scenarios, and detailed examination of the diagnostic output showed that the model is fitting the IBWSSS with a low standard deviation (0.2) for most ages, and thereby placing a high weight upon it. However, this may be scientifically unwise, due to the very short time-series (four years) and lack of contrast in the data. Reducing the weight given to this survey would thus produce a more robust assessment.

The effect of down-weighting the IBWSS survey was examined by varying the *a priori* weights applied to all survey information in the SMS model (Figure 4.3.6.2). The *a priori* weight on catch observations was kept constant at the default value (i.e. 1.0). If catch and survey observations give the same information of the stock development a different weighing of the data should have no effect. However, for this assessment, decreasing the weight on the survey information, and thereby increasing the relative weight on catch information, reduced the terminal SSB and increased the terminal F estimates. All runs showed similar results in both the trend and magnitude of recruitment. This indicates that the catch data and the survey indices show the same signal for the recruitment in the terminal year, such that down-weighting one of them has a very limited effect.

An alternative and more useful approach to this problem is to down-weight the IBWSSS itself directly, rather than down-weighting all survey information collectively, as was done in Figure 4.3.6.2; while we may question the use of the current, short IBWSSS time-series, we have no *a priori* justification for doing so with the Norwegian acoustic survey or the Norwegian Sea survey, both of which have much longer time-series. By setting a lower level for the uncertainty on the estimates for catchability for this survey, it is possible to define constraints for how closely the method can fit the survey observations, thereby preventing “over-fitting” and excessive weighting of the dataset. Down-weighting the IBWSSS, via this parameter, had the effect of reducing the estimated SSB and increasing the estimated F in the terminal years (Figure 4.3.6.3). Again, the recruitment showed similar results in both the trend and magnitude of recruitment.

The three sets of exploratory runs, viewed together, show that inclusion of the IBWSSS increases the estimate of the SSB and decrease the fishing mortality. The precise reasons for this are unclear, but are clearly related to the most recent value of the survey (*i.e.* the 2007 value). Over-reliance on this survey is scientifically unwise as the performance of this survey is still uncertain and probably not better than the Norwegian survey on the spawning ground (Section 4.3.2). The final SMS run was chosen so that the survey variances of the IBWSSS survey were approximately the same as the Norwegian survey; this was found to correspond to a “minimum CV on cpue observations” parameter of 0.4.

Examination of the catch residuals from the final SMS run (Figure 4.3.6.4) showed no appreciable patterns. The residuals from the survey observations (Figure 4.3.6.5) showed significant year effects in the IBWSS and Norwegian acoustic surveys, a well-known phenomenon with acoustic surveys. The observed indices from the IBWSSS were higher than the predicted model values for all ages in 2007 and in general lower for the preceding three years. No age or cohort effects were apparent.

Examination of the diagnostic output from the final SMS run (Table 4.3.6.1) does not show any major causes for concern, although there is an unusual effect in the values of the survey catchabilities-at-age. The catchability in the Norwegian Spawning Stock Survey increases with age, and reaches at maximum at age 4. This is an unusual result, and tends to contradict the trend seen in the IBWSSS, where the catchability increases monotonically with age, even though these two surveys are quite similar. A similar phenomenon was observed Norwegian Survey in the final SMS run in the 2006 working group. There is no good explanation for the result, but could simply be due to a lower (trawl) catchability of the oldest fish on the Norwegian survey.

The final SMS run (Figure 4.3.6.6, Tables 4.3.6.2–4.3.6.4) shows a small decrease in fishing mortality in the terminal years. SSB is rapidly decreasing associated with a strong decreasing recruitment from 2001 onwards. The 2006 recruitment level is at historic low levels.

The trends in SSB and recruitment estimated by the current assessment using the SMS method extend those estimated during the 2006 working group (Figure 4.3.6.7). The fishing mortality estimated in the terminal years has decreased slightly and SSB increased slightly over the 2006 assessment. The ASPALY run (using the same two fleets used last year, but no update of the Norwegian spawning ground survey) shows now a marked increase in F and a much lower SSB compared to the 2006 assessment.

Comparison of the observed and fitted catches from the SMS run (Figure 4.3.6.8) did not provide strong evidence that the separability assumption has been violated; there is close agreement between the two time-series.

The stock-recruitment relationship derived from the SMS run (Figure 4.3.6.9) clearly shows the stock as having had two distinct regimes since the early 1980s; the first corresponding to seemingly random moderate-low recruitment and biomass levels, followed by a large circular trajectory corresponding the recent boom-bust cycle. The role of recruitment in driving the dynamics of this stock is clearly apparent from this figure.

The uncertainties on SSB and mean F are large (Figure 4.3.6.10). The CV of SSB increases from 5% in 2001 to 15% in 2006. CV on F increases from 8% to 20% in the same period. Uncertainties on stock numbers (1. January 2006) varies between 17% and 47%; largest on the youngest and oldest ages. All the estimated uncertainties are clearly higher than the values estimated last year.

4.3.7 Data exploration in XSA

The SPALY run was carried out using following fleets:

- Norwegian spawning ground survey (NSSS) 1981–2006, ages 2–8
- Russian spawning stock survey 1982–1996, ages 3–8
- Norwegian Sea ecosystem survey 1989–2001, ages 1–7

These data did not provide sufficient basis for the assessment of young fish abundance. Therefore this year a new set of data sources was applied:

- Norwegian spawning ground survey 1996–2006, ages 2–8
- Norwegian Sea summer survey 1989–2001, ages 1–7
- International ecosystem survey in the Nordic Seas, 2000–2006, ages 1–2

The last of the surveys contains indices in 1st and 2nd age groups. As result, the estimation of recruits in the terminal was determined from surveys and the number of years with year-effect in log-catch residuals decreased. Investigating the different tuning configurations, the following combination was found to give the best fit to the data:

- q plateau set at age 6
- catchability depends on stock size for ages less than 3
- SE at survey estimates set as 0.3
- Regression type P

The results are presented in the Figures 4.3.7.1 and 4.3.7.2. Retrospective analysis suggests that the assessment is not liable to bias. According to those outcomes, F seems to be excessive and a drop in recruitment level is evident. Nevertheless, a significant decrease in SSB is not yet visible.

4.3.8 Comparison of results of different assessments

The effect on F and SSB of including the “International blue whiting spawning stock survey” in the assessment was not consistent for the various methods. Compared to the “Two surveys” configuration used in last year’s assessment, AMCI gave a higher F, ICA almost an identical F and SMS a much lower F.

Compared to last year, all the final exploratory runs estimated an increase in $F_{2005.}$ The models show mainly a small drop in F from 2005 to 2006.

Comparing the results of the assessment methods with each other (Figure 4.3.8.1) shows some differences in the terminal year with ISVPA-pessimistic as the most extreme with a steep increase in F and a very clear drop in SSB. The other final explorative runs estimate an F_{2006} in the narrow range 0.40–0.46 (and XSA F at 0.53). The recruitment in 2006 (age 1) is estimated very low by all models, whit the highest estimate from XSA. Compared to the 2006 assessment the 2004 year class is now estimated lower, and the 2002 and 2003 year classes higher.

There are several important points on which all assessment methods agree. All methods predicted a severe decreasing trend in recruitment since 2001, with the 2006 recruitment being at a historic low. All methods agree that fishing pressure is well above F_{PA}, and the TISVPA "pessimistic" estimate F is above F_{lim}. SSB clearly shows a decrease from the peak in 2003, with the steepest decrease from ISVPA "pessimistic"/ bringing SSB below B_{PA}.

4.4 Final assessment

4.4.1 Choice of final assessment

The explorative runs showed that surveys indicate a rather stable SSB in the most recent years. Catch data and the assumption of a separable F model indicate however an increase in F, which in combination with a decrease in recruitment produces a rapid decline in estimated SSB. The relative weightings given to each of these information sources varies between the assessment methods and most likely accounts for the diverging estimates in both SSB magnitude and the fishing mortality trends.

The WG decided to bring the SMS assessments into the forecast. SMS has been used for the last two years as the final assessment method and SMS in its final configuration gave results similar to the AMCI, ICA and TISVPA/optimistic methods.

4.4.2 Final assessment

Input data are catch-at-age numbers (Table 4.2.2.7), mean weight-at-age in the sea and in the catch (Table 4.2.3.1.) and natural mortality and proportion mature in Section 4.2.4. Survey data are presented in Table 4.3.2.1.

The key settings and data for the final blue whiting assessment in 2006 and 2007 are shown in the table below.

SETTINGS/OPTIONS FOR THE FINAL ASSESSMENT	2006	2007
Software	SMS	SMS
Age range for the analysis	1–10+	1–10+
Last age a plus-group?	Yes	Yes
Recruitment in the terminal year	Estimated	Estimated
Catch data		
Constant selection pattern for the catch fleet?	2 periods: 1981–1992,1993–2005	2 periods: 1981–1992,1993–2006
First age with age independent catchability	8	8
Age groups with the same variance	1, 2, 3–6, 7–10	1, 2, 3–6, 7–10
Age-structured tuning time-series		
Norwegian spawning ground survey, ages 3–8,	1993–2006	1993–2003
First age with age independent catchability	7	5
Age groups with the same variance	3–4, 5–6, 7–8	3–4, 5–6, 7–8
International ecosystem survey in the Nordic Seas, ages 1–2	2000–2006	2000–2007
First age with age independent catchability	2	2
ages 1–2	2000–2006	2000–2007
Age groups with the same variance	1, 2	1, 2
International blue whiting spawning stock ground survey , ages 3–8	Not used	2004–2007
First age with age independent catchability		5
Age groups with the same variance		3–8, min std 0.4

Due to the short time-series for the "International blue whiting spawning stock ground survey" is was not possible to present a meaningful retrospective analysis of the assessments.

The model was run until 2006. The SSB January 1st in 2007 is estimated from survivors without taking the contribution from recruits into account. With the (expected) low recruitment this omission has practically no implications. The key results are presented in Tables 4.3.6.2–4.3.6.4 and summarized in Figure 4.3.6.6. Residuals of the model fit are shown in Figure 4.3.6.4 and Figure 4.3.6.5 and discussed in Section 4.3.6.

4.5 Historic Stock Trends

The assessment results are presented in Figure 4.3.6.6.

Recruitment (age 1) has been at a lower level around 10 billion in the period 1981–1995 after which it increased to a higher level of around 35 billion in period 1996–2004. The highest recruitment at around 60 billions was reached in 2001 after which it declines almost linearly to a historic low level in 2006. Preliminary estimates for the 1–group in 2007 indicate also a very weak recruitment.

SSB was rather stable around B_{pa} in the period 1981–1995 after which it steadily increased to the highest observed level in 2003 at 7 million tonnes. SSB declined afterwards to around 4 million tonnes in 2007.

Fishing mortality increased from around 0.25 in the start of the 1980s to around B_{lim} five years later. This was followed by historical low F level in start of the 1990s after which F steadily increased to a level of around $\mathbf{F}_{lim}$ since 2000.

4.6 Recruitment estimates

4.6.1 Recruitment estimates

Average recruitment at age 1, 1981–2005 is estimated by SMS as 20.8 billions (arithmetic mean) or 14.8 billions (geometric mean). For the most recent period, 1996–2005, with high recruitment the values are 37.8 (AM) or 35.6 (GM) billions.

Last year the potential recruitment signals in different survey time-series were explored, and recruitment (age 1 in the assessment year) was predicted based on three of these. The same prediction models that were used last year are this year fitted to new recruitment estimates from the final assessment.

These models are as follows:

1) Linear regression on log-log scale with the Norwegian bottom trawl survey in the Barents Sea winter survey index (Section 4.2.5.4.)

2) Regression on natural scale forced through the origin with the International ecosystem survey in the Nordic Seas (Section 4.2.5.2), standard area.

3) Regression on natural scale forced through the origin with the International ecosystem survey in the Nordic Seas, full coverage.

All three regressions are illustrated in Figure 4.6.1. The Barents Sea index is catch per nautical mile of blue whiting smaller than 19 cm and the time-series is shown in Table 4.2.5.4. The two time-series estimates of (acoustic) age 1 from the International ecosystem survey in the Nordic Seas are shown in Table 4.2.5.1.2. The full coverage includes areas outside the standard area (which is shown in Figure 4.2.5.5), and these areas may be important nursery areas for blue whiting. The time-series from the surveys with full coverage are therefore believed to give the best recruitment signal of the two.

The text table below shows estimated recruitment in 2006 and 2007 based on the three prediction models mentioned above. The variation between the different estimates is high for both years, but the general picture is that both the 2005 and 2006 year classes are weak. Information from commercial catches in 2006 (catch-at-age 1) and 2007 (age and length distributions in Figure 4.1.5.7.1.) support this impression.

Data Source	Time period (used in the regressions)	Year class 2005 (Recruitment 2006 at age 1 in billions)	Year class 2006 (Recruitment 2007 at age 1in billions)
WG07 assessment (SMS)		2.90	n.a.
Barents sea winter survey	1981–2006	17.83	8.38
International ecosystem survey in the Nordic Seas, standard area	2000–2006	0.435	0.016
International ecosystem survey in the Nordic Seas, full coverage	2001–2006	5.50	1.29

4.7 Short-term forecasts

Short term forecasts were conducted with MFDP (Multi Fleet Deterministic Projection) Version 1a.

Input

A deterministic short term projection is presented based on final assessments, catch weights, stock weights and exploitation pattern are averaged over the previous three years (2004–2006). Population numbers and fishing mortalities were taken from the assessment outputs. Catches in 2007 is assumed at 1.8 million tonnes, which is the agreed rounded TAC (Section 4.1.4).

Recruitment at age 1 in 2006 was assumed at 11.67 billion. Recruitment at age 1 in 2007 was assumed at 4.84 billion. Both of these estimates are obtained by taking the mean of two survey-based estimates: one from the International ecosystem survey in the Nordic Seas with full coverage and one from the Barents Sea winter survey. The reason for not using the final assessment estimate of recruitment at age 1 in 2006 is that this is unrealistically low and appears as an extreme outlier (Figure 4.6.1, upper panel). Both estimates are still quite low. Geometric mean recruitment for the period 1981–2005 (14.8 billion) was used for recruitment in 2008.

Table 4.7.1.1 gives an overview of the input data.

Output

The predicted catch and SSB from the forecasts are presented in Table 4.7.1.2.

Fishing at $F_{pa} = 0.32$, is associated with expected landings of 845 thousand tonnes in 2008 and an SSB of 2.60 million tonnes in 2009, slightly above the precautionary limit, $B_{pa} = 2.25$ million tonnes.

4.8 Medium-term forecasts

No medium forecast was done this year.

Last year ICES made a review of the present blue whiting management plan (Section 4.1.4). ICES considered that given the high recruitment level observed for the period 1996–2005, the management plan is robust to uncertainties in both assessment and implementation. For low recruitment scenarios, the management plan is not robust to these uncertainties, unless there are unrealistically low levels of noise and bias in both stock assessment estimates and implementation of the TAC. ICES concludes that the management plan is not precautionary as the lower recruitment scenario is plausible (given that it was the case in the past) and, under this scenario for range of realistic assessment and implementation bias, there is higher than 5% probability that the spawning stock biomass will fall below $B_{lim.}$

The assessment this year highlights that the blue whiting assessment is very uncertain and that the 2005 and probably also the 2006 year-classes are low and definitely outside the range of recruitment referred to by the ICES review as high recruitment. This emphasis that the present management plan with a reduction of landing of (minimum) 100 000 tonnes per year until F_{pa} is reached is far from sufficient to maintain the stock within safe biological limits.

4.9 Biological reference points

The present precautionary reference points have been introduced in the advice of ACFM in 1998. The values and their technical basis are:

REFERENCE POINT	B_{IM}	B_{PA}	F_{LIM}	F_{PA}
Value	1.5 mill t	2.25 mill. t	0.51 yr^{-1}	0.32 yr^{-1}
Basis	B_{loss}	B_{lim}* exp(1.645* σ), with σ= 0.25.	F_{loss}	F_{med}

Although problems have been identified with these reference points they have remained unchanged since then. A major problem is that fishing at $\mathbf{F}_{pa}$ implies a high probability of bringing the stock below $\mathbf{B}_{pa}$, in other words the present combination of $\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$ is inconsistent.

The Workshop on Limit and Target Reference Points (WKREF) considered the biological reference points for Blue Whiting at a meeting in Gdynia, Poland in January this year (ICES CM 2007/ACFM:05). The original reference points for this stock were set in 1998, before the era of high productivity became apparent. The group examined the consequences of these new observations on the reference points by first splitting the time-series into two productivity regimes (low productivity from 1981–1994, and high productivity from 1995–2005). Standard methods (i.e. using the guidelines from the Study Group on Precautionary Reference points, SGPRP (ICES CM 2003/ACFM:15)) were then used to re-estimate the reference points, which were found to be comparable to the current values. A new probabilistic approach for estimating B_{lim} was also employed, but again, the result was found to be comparable with the current values. The group concluded that there was no basis for revising the current reference points. WKREF also noted that there may be no need for different Blim values in different productivity regimes.

4.10 Quality of the assessment

The assessments presented this year should be considered as very uncertain. As may be seen in Figure 4.3.8.1 the estimated spawning stock and fishing mortality vary considerably between the different models that were run. All the models should be using the same data so this difference between models lies mostly in different weighting of data. A statistical approach (SMS), where the data sources are weighted according to their uncertainty and methods (AMCI, ICA) based on fixed weighting of the data sources gave a stable F in the most recent years and moderate decline in SSB. TISVPA can produce both a stable F and a steep increase in F alternative with likely configurations. The problem for all types of models seems to be conflicting information from the catch and survey data in combination with a relatively high uncertainty of the acoustic estimates of the stock size.

The difference in the model results is only compared from the mean values of the SSB, F and recruitment. The confidence intervals of those are however very large. Figure 4.3.4.4 presents uncertainties of SSB and stock numbers estimates from the two alternative TISVPA runs. The 90% confidence interval of SSB ranges from around 2 to 10 million tonnes for the "pessimistic" alternative. The uncertainty of the output from the final assessment (Figure

4.3.6.10) is high and has increased compared to the assessment done last year, even though the methods used are the same. Such uncertainties are usually an underestimate of the “real uncertainty” as uncertainties in the structural model are not included.

The assessment is consistent with the results presented last year. In 2006 ICES stated that the maximum catch in 2007 corresponding to the existing management plan is 1.9 million tonnes, is expected to leave the spawning stock biomass at 2.86 million tonnes in 2008. The short term projection made this year estimates an SSB of 3.01 million tonnes for 2008, with an assumed landing of 1.8 million tonnes in 2007.

While there is substantial uncertainty about the precise value of both F and SSB in the most recent year, the recruitment estimates for the terminal year are more consistent between methods. However, the 2005 year class derived from the surveys alone is estimated 4 times higher than the estimate from the analytical assessments using both survey and catches. Both estimates of the 2005 year class are in the low end of the historical time-series. The estimate of the 2006 year class is mainly coming from surveys and the estimated low level has not fully been confirmed by the fishery as catch data from 2007 on the immature stock component are not yet available.

4.11 Status of the Stock

Based on the most recent estimates of fishing mortality and SSB, ICES classifies the stock as having full reproductive capacity, but being harvested unsustainably.

The 2005 and probably also the 2006 year classes are in the low end of the historical time-series. It is impossible to say if this is a shift towards the low recruitment regime, as observed in the period before the mid 1990s, or just an anomaly. SSB has declined since its historical peak in 2003 at around 7 million tonnes to 4.3 million tonnes in the beginning of 2007. Landings of just below 2 million tonnes in 2007 in combination with the small 2005 year class will reduce SSB further.

4.12 Management Considerations

Blue whiting fisheries have entered a new era as agreement on a management plan was reached in the end of year 2005. This will guard against excessively high catches, but is no guarantee on sustainability if productivity of the stock declines. The ICES review of the plan pointed out that that the management plan is not precautionary in a situation with a (continued) low recruitment, as observed before 1995, when a realistic level of assessment uncertainty is taken into account.

The current estimate of the size of the blue whiting stock is uncertain because commercial catch data and data from scientific surveys give conflicting signals. However, all models estimate a considerable decline in SSB since 2003 and a fishing mortality which currently is above the precautionary level. Fishing at F_{pa} in 2008 is predicted to give a TAC at 845 thousand tonnes and a SSB at 2600 thousand tonnes, which is just above B_{pa}.

Understanding of the factors which drive blue whiting recruitment is poor. In the past decade, recruitment of blue whiting has been high compared to the period before. Presently there are however strong indications that the 2005 year class is weak. The available information indicates that the 2006 year class is weak as well. These two year classes might be an order of magnitude lower than the preceding 10 year classes. The consequence of this is that the biomass of blue whiting will continue to decrease rapidly in the near future. We will therefore be facing a collapse in the blue whiting stock if the present fishing pressure is not substantially reduced.

4.13 Recommendations

Sampling intensity for age and weight of herring and blue whiting are made in proportion to landings according to CR 1639/2001 and apply to EU member states. For other countries there are no guidelines. Current precision levels of the sampling intensity are unknown. The group recommends, as part of the ToRs for the next WG meeting **a review of the sampling scheme on a scientific basis and provide guidelines for sampling intensity**.

WG recommends an analysis of the change in mean weight as part of the ToRs for the next WG meeting.

Table 4.2.1.1 Blue whiting. Landings (tonnes) from the directed fisheries (Sub-areas I and II, Division Va, XIVa and XIVb) 1988–2006, as estimated by the Working Group.

Country	1988	1989 3)	1990	1991	1992	1993	1994 2)	1995 3)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Denmark	-	-	-	-	-	-	-	-	-	-	-	15	7,721	5,723	13,608	38,226	23,437	365	338
Estonia	-	-	-	-	-	-	-	-	377	161	904	-	-	-	-	-			
Faroes	-	1,047	-	-	-	-	-	-	345	-	44,594	11,507	17,980	64,496	82,977	115,755	109,380	64,639	70,650
France																			2,315
Germany	3	1,341	-	-	-	-	2	3	32	-	78	-	-	3117	1,072	813	488	569	1,772
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Iceland	-	4,977	-	-	-	-	-	369	302	10,464	68,681 4)	96,295	155,024	245,814	195,483	312,334	279,811	145,640	152,155
Latvia	-	-	-	-	-	-	422	-	-	-	-	-	-	-	-				
Netherlands	-	-	-	-	-	-	-	72	25	-	63	435	-	5180	906	592	1,365		1,279
Norway 5)	-	-	-	-	-	-	-	-	-	-	-	-	-	64,581	100,922	215,075	302,166	9,778	10,442
Norway 6)	-	-	566	100	912	240	-	-	58	1,386	12,132	5,455	-	28,812	-	-	22167	6,793	6,041
Poland	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Scotland																	64		
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	850	57,206	15,794	785	
USSR/ Russia 1)	55,816	35,250	1,540	78,603	61,400	43,000	22,250	23,289	22,308	50,559	51,042	65,932	103,941	173,860	145,649	191,507	166,677	177,008	159,370
Total	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570	177,494	179,639	284,666	591,583	541,467	931,508	921,349	405,577	404,362

1) From 1992 only Russia

2) Includes Vb for Russia.

3) Icelandic mixed fishery in Va.

4) include mixed in Va and directed in

5) Directed fishery

6) By-catches of blue whiting in other fisheries.

Table 4.2.1.2 Blue whitings. Landings (tonnes) from directed fisheries (Division Vb,VIa,b, VIIa,b,c and Sub-area XII) 1988–2006, as estimated by the Working Group.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998 [1]	1999	2000	2001	2002	2003	2004	2005	2006
Denmark	797	25	-	-	3,167	-	770	-	269	-	5051	19,625	11,856	18,110	2,141	17,813	44,992	24,731	52,009
Estonia	-	-	-	-	6,156	1,033	4,342	7754	10,605	5,517	5,416	-	-	-	-	-	[4]		
Faroes	79,339	70,711	43,405	10,208	12,731	14,984	22,548	26,009	18,258	22,480	26,328	93,234	129,969	188,464	115,127	208,427	206,078	197,134	244,387
France	-	2,190	-	-	-	1,195	-	720	6,442	12,446	7,984	6,662	13,481	13,480	14,688	13,365	-	8,046	14,264
Germany	5,263	4,073	1,699	349	1,307	91	-	6,310	6,844	4,724	17,891	3,170	12,655	15,862	15,378	21,866	13,813	22,089	33,756
Iceland	-	-	-	-	-	-	-	-	-	-	-	64,135	105,833	119,287	91,853	189,159	99,832	119,569	157,353
Ireland	4,646	2,014	-	-	781	-	3	222	1,709	25,785	45635	35,240	25,200	29,854	17,723	22,484	62,730	73,174	54910
Japan	-	-	-	-	918	1,742	2,574	-	-	-	-	-	-	-	-	-	-		
Latvia	-	-	-	-	10,742	10,626	2,160	-	-	-	-	-	-	-	-	-	-		
Lithuania	-	-	-	-	-	2,046	-	-	-	-	-	-	-	-	-	-	-		2,314
Netherlands[2])	800	2,078	7,280	17,359	11,034	18,436	21,076	26,703	17,644	23,676	27,884	35,408	46,128	68,415	33,365	45,239	82,520	143,470	101,349
Norway	208,416	258,386	281,036	114,866	148,733	198,916	226,235	261,272	337,434	318,531	519,622	475,004	460,274	399,932	385,495	502,320	486,843	622,981	527,172
UK (Scotland)	5,071	8,020	6,006	3,541	6,849	2,032	4,465	10,583	14,325	33,398	92,383	98,853	42,478	50,147	26,403	27,136	56,326	104,526	72,030
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-		
USSR/ Russia [3])	121,705	127,682	124,069	72,623	115,600	96,000	94,531	83,931	64,547	68,097	79,000	112,247	141,257	141,549	144,419	163,812	179,400	150,014	168,664
Total	426,037	475,179	463,495	218,946	318,018	347,101	378,704	423,504	478,077	514,654	827,194	943,578	989,131	1,045,100	846,602	1,211,621	1,232,534	1,465,735	1,428,208

[1]) Including some directed fishery also in Division IVa.

[2]) Revised for the years 1987, 1988, 1989, 1992,

[3]) From 1992 only Russia

[4]) Reported to the EU but not to the ICES WGNPBW. (Landings of 19,467 tonnes)

Table 4.2.1.3 Blue whiting. Landings (tonnes) from directed fisheries and by-catches caught in other fisheries (Divisions IIIa, IV) 1988–2006, as estimated by the Working Group.

Country	1988	1989	1990	1991	1992	1993 3)	1994	1995	1996	1997	1998 2)	1999	2000	2001	2002	2003	2004	2005	2006
Denmark 4)	18,144	3,632	10,972	5,961	4,438	25,003	5,108	4,848	29,137	9,552	40,143	36,492	30,360	21,995					
Denmark 5)		22,973	16,080	9,577	26,751	16,050	14,578	7,591	22,695	16,718	16,329	8,521	7,749	7,505	35,530	26,896	21,071	16,354	2,316
Faroes 4) 6)	492	3,325	5,281	355	705	1,522	1,794	-	6,068	6,066	-	-	-	60	7,317	5,712	6,864	1,437	1,969
Faroes 5) 6)											296	265	42	6,741				3,589	391
Germany 1)	280	3	-	-	25	9	-	-	-	-			-	81	-	36	19	17	909
Iceland																		307	
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		4	9	
Lithuania																			2,321
Netherlands	-	-	20	-	2	46	-	-	-	793			-	-	50	0	0	0	83
Norway 4)	24,898	42,956	29,336	22,644	31,977	12,333	3,408	78,565	57,458	27,394	28,814	48,338	73,006	21,804	85,062	117,145	107,311	98,938	96,007
Norway 5)														58,182					
Russia	-	-	-	-	-	-	-	-	-	-	-	-	-	69	-	-		5,204	1,066
Scotland																	35	3	76
Sweden	1,229	3,062	1,503	1,000	2,058	2,867	3,675	13,000	4,000	4,568	9,299	12,993	3,319	2,086	17,689	8,326	3,289	2,175	101
UK	100	7	-	335	18	252	-	-	1	-	-	-	-	-	-	65			
Total	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091	94,881	106,609	114,476	118,523	145,652	158,180	138,593	128,033	105,239

1) Including directed fishery also in Division IVa.

2) Including mixed industrial fishery in the Norwegian Sea

3) Imprecise estimates for Sweden: reported catch of 34265 t in 1993 is replaced by the mean of 1992 and 1994, i.e. 2,867 t, and used in the assessment.

4) Directed fishery

5) By-catches of blue whiting in other fisheries.

6) For the periode 1987-2000 landings figures also include landings from mixed fisheries in Division Vb.

7) Some corrections done in the total amount.

Table 4.2.1.4 Blue whiting. Landings (tonnes) from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e) 1988–2006, as estimated by the Working Group.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Faroes																			3,616
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600 2)	88 2)	973	148	
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98 2)	96 2)	12,659	305	
Netherlands	-	-	450	10	-	-	-	-	-	-	10 1)	-	-	-	3208 2)	2471,8 2)	11,426	4,313	
Norway	-	-	-	-	-	-	-	-	-	-			-	-	-	-	39,197		2,789
Portugal	5,979	3,557	2,864	2,813	4,928	1,236	1,350	2,285	3,561	2,439	1,900	2,625	2,032	1,746	1,659	2,651	3,937	5,190	5,323
Russia																	685		
Scotland																	603	10	
Spain	24,847	30,108	29,490	29,180	23,794	31,020	28,118	25,379	21,538	27,683	27,490	23,777	22,622	23,218	17,506	13,825	15,612	17,643	15,173
UK	12	29	13	-	-	-	5	-	-	-	-	-	-	-	-	181			
France	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	784			1,430
Total	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122	29,400	26,402	24,654	24,964	23,071	20,097	85,093	27,608	28,331

1) Directed fisheries in VIIIa

2) Landings reported as Directed fisheries and included in the Catch-at-Age calculations of that fisheries

Table 4.2.1.5 Blue whiting. Total landings by country and area for 2006 in tonnes.

Area	**Denmark**	**Faroe Islands**	**France**	**Germany**	**Iceland**	**Lithuania**	**Ireland**	**Norway**	**Portugal**	**Russia**	**Scotland**	**Spain**	**Sweden**	**Netherlands**	**Grand Total**
IIa	338	64,062	2,315	1,741	125,612			16,483		145,704				1,279	357,534
IIb				31						13,666					13,697
IIIa	982			17				203					23		1,225
IVa	1,204	2,360		680		2,321		95,780		1,066	76		30	83	103,600
IVb	130			212				24					48		414
Va		6,337			5,125										11,462
Vb	4,132	79,151	1,623	545	80,470			2,214		84,522	2,564			3,052	258,273
VIa	26,990	30,191	6,334	18,572	13,976	2,314	9,677	83,526		1,882	57,927			51,787	303,176
VIb	9,021	86,683			59,785		6,984	125,345		58,477	996			2,581	349,872
VIIb	1,645		1,133	3,313			3,099								9,190
VIIc	10,221	40,324	5,174	11,326			35,150	310,533		417	10,543			43,929	467,617
VIIg								2,789							2,789
VIIIabd			21												21
VIIIcIXa									5,323			15,173			20,496
VIIj			1,289												1,289
VIIk		3,616	120												3,736
XII		8,038			3,122			5,554		23,366					40,080
XIVb		251			21,418										21,669
Grand Total	54,663	321,013	18,009	36,437	309,508	4,635	54,910	642,451	5,323	329,100	72,106	15,173	101	102,711	1,966,140

Table 4.2.1.6 Blue whiting. Landings (tonnes) from the main fisheries, 1988–2006, as estimated by the Working Group.

Area	Norwegian Sea fishery (Sub-areas 1+2 and Divisions Va, XIVa-b)	Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb-c)	Directed- and mixed fisheries (Divisions IIIa and IV)	**Total northern areas**	Total southern areas (Subareas VIII and IX and Divisions VIId, e, g-k)	**Grand total**
1988	55,829	426,037	45,143	**527,009**	30,838	**557,847**
1989	42,615	475,179	75,958	**593,752**	33,695	**627,447**
1990	2,106	463,495	63,192	**528,793**	32,817	**561,610**
1991	78,703	218,946	39,872	**337,521**	32,003	**369,524**
1992	62,312	318,081	65,974	**446,367**	28,722	**475,089**
1993	43,240	347,101	58,082	**448,423**	32,256	**480,679**
1994	22,674	378,704	28,563	**429,941**	29,473	**459,414**
1995	23,733	423,504	104,004	**551,241**	27,664	**578,905**
1996	23,447	478,077	119,359	**620,883**	25,099	**645,982**
1997	62,570	514,654	65,091	**642,315**	30,122	**672,437**
1998	177,494	827,194	94,881	**1,099,569**	29,400	**1,128,969**
1999	179,639	943,578	106,609	**1,229,826**	26,402	**1,256,228**
2000	284,666	989,131	114,477	**1,388,274**	24,654	**1,412,928**
2001	591,583	1,045,100	118,523	**1,755,206**	24,964	**1,780,170**
2002	541,467	846,602	145,652	**1,533,721**	23,071	**1,556,792**
2003	931,508	1,211,621	158,180	**2,301,309**	20,097	**2,321,406**
2004	921,349	1,232,534	138,593	**2,292,476**	85,093	**2,377,569**
2005	405,577	1,465,735	128,033	**1,999,345**	27,608	**2,026,953**
2006	404,362	1,428,208	105,239	**1,937,809**	28,331	**1,966,140**

Table 4.2.1.7 Blue whiting. Total landings of by quarter and area for 2006 in tonnes. Landing figures provided by Working Group members.

Area	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Grand Total
I			-	-	-
IIa	9,367	236,467	85,236	26,464	357,534
IIb			2,160	11,537	13,697
IIIa	27	211	968	19	1,225
IVa	5,795	41,990	36,404	19,412	103,600
IVb	25	16	75	298	414
Va		1,324	9,910	228	11,462
Vb	16,196	202,672	241	39,164	258,273
VIa	137,304	164,551	696	625	303,176
VIb	330,566	18,881	425		349,872
VIIb	8,498	539	91	62	9,190
VIIc	464,669	2,249	417	282	467,617
VIIg	2,789				2,789
VIIIabd	11	7	2	1	21
VIIIcIXa	5,428	5,956	4,634	4,478	20,496
VIIj	672	443	104	70	1,289
VIIk	3,678	41	10	7	3,736
XII	40,026	54			40,080
XIVb			17,022	4,647	21,669
Total	1,025,050	675,401	158,395	107,294	1,966,140

Table 4.2.1.8. Blue whiting. Some details about the number, length and capacity of vessels prosecuting blue whiting fishery by country.

Country	Vessel length range (m)	Engine power (HP)	Gear	Storage	Discard estimates	Number of vessels
Germany	95-125 m	4200-11000 hp	Single Midwater	Freezer	Yes (some)	3
France						
Iceland	50-59 m	3000-5027 HP (av.=3692)	Single midw. trawl		Yes	5
	60-69 m	3000-6690 HP (av.=4476)	Single midw. trawl		Yes	10
	70-79 m	4080-11257 HP (av.=7131	Single midw. trawl		Yes	8
	>80 m	8050 HP	Single midw. trawl		Yes	1
Ireland	145.6 m	14400/19303	SMWT	RSW	No	1
	64.6 m	2710/3638	SMWT	RSW	No	1
	71.2 m	2984/4000	SMWT	RSW	No	1
	64.6 m	2710/3638	SMWT	RSW	No	1
	64.4 m	1319/1770	SMWT	RSW	No	1
	57.8 m	2100/2853	SMWT	RSW	No	1
	60 m	5520/7500	SMWT	RSW	No	1
	31.6 m	3300/4425	SMWT	RSW	No	1
	59.2 m	3460/4701	SMWT	RSW	No	1
	53.06 m	917/1231	SMWT	RSW	No	1
	53.06 m	1007/1352	SMWT	RSW	No	1
	48.6 m	1070/1436	SMWT	RSW	No	1
	51 m	1544/2072	SMWT	RSW	No	1
	48.6 m	1103/1479	SMWT	RSW	No	1
	40.4 m	708/950	SMWT	RSW	No	1
	40.4 m	634/851	SMWT	RSW	No	1
	45 m	1082/1452	SMWT	RSW	No	1
	37.3 m	1119/1596	SMWT	RSW	No	1
	37.3 m	1118/1500	SMWT	RSW	No	1
	45 m	700/940	SMWT	RSW	No	1
	34.72 m	708/949	SMWT	RSW	No	1
Netherlands	55 m	2890 hp	Pair midwater	Freezer	Yes	2
	88-140 m	4400-10455hp	Single Midwater	Freezer	Yes (some)	14
Norway	14-62	236-5400	Industrial trawl			50
	60-94	2640-9000	Directed pelagic trawl			45
Spain	27.6 m	477	Pair bottom trawl fishery			38
	26.5 m	404	Bottom trawl mixed fishery			86
			alterning bottom trawl and pair bottom trawl			11

Table 4.2.1.1.1. Blue whiting landings data as recorded by ICES FishStat database and various ICES working group reports covering the period since 1973.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Denmark	0	0	0	0	34816	78302	81679	69219	46353	58100	82783
Estonia	0	0	0	0	0	0	0	0	0	0	0
Faeroe Islands	4869	4137	482	14080	29689	43478	38031	39383	37110	54671	72634
Finland	0	0	0	0	0	0	0	0	0	0	0
France	0	0	0	0	0	0	0	0	0	4696	6739
Germany	0	0	0	0	0	0	0	0	0	0	0
Germany, Fed. Rep. of	3	2657	35	118	10113	16281	4473	9933	18320	1719	830
Germany,New Lõnder	0	0	0	5061	3125	10003	22723	14475	22169	10813	8837
Greenland	0	0	0	0	0	0	0	0	0	0	0
Guernsey	0	0	0	0	0	0	0	0	0	0	0
Iceland	379	119	3	569	9968	26377	19096	9934	15021	1689	7077
Ireland	0	0	0	160	0	0	1	1877	2744	0	0
Latvia	0	0	0	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	1182	185	368	855	9202	14138
Norway	2445	3420	8341	25859	40109	117954	221377	134973	166701	170086	190229
Poland	0	341	4704	11475	6539	8206	8989	11307	4942	996	0
Portugal	0	0	0	0	1744	114	307	3237	5873	3271	4328
Russian Federation	0	0	0	0	0	0	0	0	0	0	0
Spain	18837	17683	22212	18199	17883	16913	1488	22389	29759	26066	24850
Sweden	0	0	0	0	7030	6908	1253	3916	1955	1241	3850
UK - Eng+Wales+N.Irl.	0	0	0	0	0	0	0	0	0	0	0
UK - England & Wales	0	0	455	401	1643	5298	2937	3879	6000	4689	0
UK - Scotland	0	0	279	1573	3000	1599	1500	6956	2451	0	0
Un. Sov. Soc. Rep.	8169	2187	18090	26730	71027	210857	688984	766906	522951	176941	109831
Sum	34702	30544	54601	104225	236686	543472	1093023	1098752	883204	524180	526126
ICES.1985	103016	107513	112045	163977	268736	608710	1118598	1122564	909557	575890	569845
ICES.1995											
ACFM.2006											

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Denmark	95121	84783	69830	72732	134642	84289	60175	50368	43965	69378	22834
Estonia	0	0	0	0	0	0	0	7630	6156	1077	4342
Faeroe Islands	62264	76005	86307	86902	77591	73833	46165	6645	12731	14984	24404
Finland	0	0	0	0	0	0	0	0	0	0	0
France	3882	0	0	0	0	2191	0	0	0	0	0
Germany	0	0	0	0	0	0	0	401	1320	100	5920
Germany, Fed. Rep. of	1595	753	0	262	1012	975	1689	0	0	0	0
Germany,New Lõnder	9364	8528	6291	4647	4666	4566	230	0	0	0	0
Greenland	0	0	10	0	0	0	0	0	3	0	0
Guernsey	0	0	0	0	0	0	0	0	0	0	0
Iceland	105	0	0	0	0	2655	0	0	0	0	0
Ireland	0	668	16440	3706	4646	2014	2	0	781	0	3
Latvia	0	0	0	0	0	0	0	14019	10742	10626	2582
Lithuania	0	0	0	0	0	0	0	0	13809	2418	0
Netherlands	16178	1931	10002	9261	800	2022	6523	8291	11036	18482	21076
Norway	212625	233038	280098	193483	209738	265900	284339	119201	154556	199981	226235
Poland	0	0	0	0	10	0	0	0	0	0	0
Portugal	4200	5906	8116	9151	6151	3574	2864	2984	2164	1222	1987
Russian Federation	0	0	0	0	0	0	0	0	159365	137796	123258
Spain	16070	19959	29397	28984	33838	33664	29814	38234	31965	34256	30506
Sweden	5401	3616	8532	2013	1226	3092	1503	17980	2058	37265	3705
UK - Eng+Wales+N.Irl.	0	0	0	0	0	1209	13	107	373	11	1423
UK - England & Wales	33	5	18	31	15	0	0	0	0	0	0
UK - Scotland	0	0	4972	3310	5186	11512	8239	4015	7099	2283	3047
Un. Sov. Soc. Rep.	171120	215303	284017	278183	179330	162932	125609	168251	0	0	0
Sum	597958	650495	804030	692665	658851	654428	567165	438126	458123	529879	471322
ICES.1985											
ICES.1995	641776	695596	826986	664434	553413	625433	561610	369524	475495	514779	
ACFM.2006				664837	557847	627447	561610	369524	475089	480679	459414

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Denmark	46182	52700	33486	69305	79809	62075	65057	51040	87966	89523	39109
Estonia	13715	10982	5678	6320	0	0	0	0	0	0	0
Faeroe Islands	25936	20094	28773	71217	105106	152687	258333	204525	326592	316867	267447
Finland	0	0	0	0	0	0	0	0	81	0	0
France	6	6442	12446	7992	6343	16042	19054	14771	16121	19476	7162
Germany	6314	6867	4722	17971	3171	12655	19060	17052	26988	15294	22824
Germany, Fed. Rep. of	0	0	0	0	0	0	0	0	0	0	0
Germany,New Lõnder	0	0	0	0	0	0	0	0	0	0	0
Greenland	0	0	0	0	0	0	0	0	0	0	0
Guernsey	0	0	1	1	1	0	0	0	0	0	0
Iceland	369	513	10480	68514	160425	259158	365101	286381	501494	422078	265889
Ireland	222	1710	25987	45538	35880	26067	29910	17825	22586	58427	69650
Latvia	0	0	0	0	0	0	0	0	0	0	0
Lithuania	400	651	0	0	1231	0	0	0	0	0	0
Netherlands	22685	16407	24132	27693	32889	43145	63627	35628	57257	77183	128368
Norway	261361	356054	348268	570665	534570	553480	573687	557684	851396	958768	738599
Poland	0	0	0	0	0	0	0	38	297	345	0
Portugal	2346	3565	2449	1900	2676	2169	1762	1698	3526	5749	7675
Russian Federation	93824	87310	118656	130042	182637	241905	315586	298367	354789	346762	332240
Spain	33397	30262	37900	30549	30926	28000	28822	25522	23824	29023	50096
Sweden	13000	4038	4568	6034	15511	3362	2058	18483	65533	19958	4385
UK - Eng+Wales+N.Irl.	17	1169	304	6493	7637	2570	1742	2277	643	1488	7357
UK - England & Wales	0	0	0	0	0	0	0	0	0	0	0
UK - Scotland	5478	13157	33397	92443	98854	42478	50147	26402	28742	58355	118773
Un. Sov. Soc. Rep.	0	0	0	0	0	0	0	0	0	0	0
Sum	525252	611921	691247	1152677	1297666	1445793	1793946	1557693	2367835	2419296	2059574
ICES.1985											
ICES.1995											
ACFM.2006	578905	645982	672437	1128969	1256228	1412928	1780170	1556792	2321406	2377569	2026953

Table 4.2.1.2.1. Blue whiting. Total landings and sampling statistic.

Country	Quarter	Landings (t)	No. Samples	No. Fish measured	No. Fish aged
Denmark	1	47323	18	1741	1740
	2	5929	3	103	103
	3	1230	4	104	104
	4	181	1	35	35
	Total	54663	26	1983	1982
Faroe Islands	1	138812	12	2333	1200
	2	147335	7	1589	700
	3	13303	7	1610	700
	4	21563	5	808	500
	Total	321013	31	6340	3100
France	1	9389	0	0	0
	2	6185	0	0	0
	3	1452	0	0	0
	4	983	0	0	0
	Total	18009	0	0	0
Germany	1	21548	0	0	0
	2	13717	0	0	0
	3	828	0	0	0
	4	344	0	0	0
	Total	36437	0	0	0
Iceland	1	58280	16	1439	800
	2	221441	85	7577	4216
	3	24327	13	736	579
	4	5460	0	0	0
	Total	309508	114	9752	5595
Ireland	1	54910	20	4043	1787
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0
	Total	54910	20	4043	1787
Lithuania	1	2417	0	0	0
	2	1592	0	0	0
	3	373	0	0	0
	4	253	0	0	0
	Total	4635	0	0	0
Norway	1	481271	409	23208	3079
	2	103741	313	15820	2158
	3	38796	126	5022	590
	4	18643	126	5022	590
	Total	642451	974	49072	6417
Portugal	1	821	75	8447	532
	2	949	77	8725	238
	3	1858	53	5654	369
	4	1695	62	6270	436
	Total	5323	267	29096	1575
Russia	1	90263	15	20066	554
	2	110617	13	21062	503
	3	73438	36	27708	1648
	4	54782	9	5937	282
	Total	329100	73	74773	2987
Scotland	1	60896	6	634	224
	2	11204	2	273	83
	3	6	0	0	0
	4	0	0	0	0
	Total	72106	8	907	307
Sweden	1	53	0	0	0
	2	34	0	0	0
	3	8	0	0	0
	4	6	0	0	0
	Total	101	0	0	0
Spain	1	4607	34	3455	219
	2	5007	36	3355	424
	3	2776	35	3297	391
	4	2783	26	2685	455
	Total	15173	131	12792	1489
The Netherlands	1	54460	69	1725	1725
	2	47650	2	50	50
	3	0	0	0	0
	4	601	0	0	0
	Total	102711	71	1775	1775
Grand Total		1966140	1715	190533	27014

Table 4.2.1.2.2 Blue Whiting. Sampling levels in 2006 per area.

Area	Landings	Nos samples	Nos fish aged	Nos fish measured
I	0	8	347	2027
IIa	357534	496	5438	46956
IIb	13697	13	628	7502
IIIa	1225	69	258	2749
IVa	103600	217	1130	9189
IVb	414	0	0	0
Va	11462	4	294	609
Vb	258273	58	2923	18189
VIa	303176	69	3058	8189
VIb	349872	104	3568	28826
VIIb	9190	2	110	161
VIIc	467617	138	4041	10083
VIIg	2789	59	534	3131
VIIIabd	21	0	0	0
VIIIcIXa	20496	398	3064	41888
VIIj	1289	0	0	0
VIIk	3736	1	100	184
XII	40080	68	985	10068
XIVb	21669	11	536	782
Total general	1966140	1715	27014	190533

Table 4.2.2.1 Blue whiting. Landings in numbers ('000) by length group (cm) and quarter for the Northern area in 2006.

Length (cm)	Q1	Q2	Q3	Q4	All year
5					
6					
7					
8					
9					
10					
11					
12	50	114	7		171
13	37	86	7		130
14	50	124	7		181
15	50	114	7		171
16	1 401	7 398	57	8	8 863
17	813	31 237	68	10	32 127
18	2 128	27 571	139	18	29 856
19	4 986	28 450	834	50	34 320
20	22 178	34 875	3 296	576	60 925
21	34 012	32 764	5 408	2 598	74 783
22	83 077	34 214	9 806	10 762	137 859
23	240 278	99 678	27 251	33 492	400 700
24	674 239	280 375	64 606	70 286	1089 505
25	1131 998	546 685	135 609	87 423	1901 715
26	1323 447	757 780	172 784	78 650	2332 660
27	1103 233	754 735	155 505	69 726	2083 198
28	824 610	573 173	93 129	46 868	1537 780
29	543 674	402 263	53 291	30 646	1029 875
30	386 049	278 681	34 095	19 730	718 554
31	271 415	181 290	25 073	18 302	496 079
32	168 099	117 542	22 240	13 320	321 201
33	106 549	73 966	15 086	8 746	204 348
34	57 695	34 168	10 266	6 211	108 339
35	36 358	13 098	6 079	3 383	58 918
36	23 855	8 516	3 143	2 296	37 810
37	10 313	4 653	1 500	1 368	17 835
38	7 505	3 300	299	555	11 658
39	3 289	1 291	156	514	5 250
40	1 532	1 388	7	473	3 399
41	821	754	156	514	2 245
42	1 012	390		5	1 407
43		10		5	15
44	414	11	7		432
45	686	11			697
46		10			10
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
TOTAL numbers	7065 850	4330 715	839 917	506 533	12743 015

Table 4.2.2.2 Blue whiting. Landings in numbers ('000) by length group (cm) and quarter for the North Sea and Skagerrak in 2006.

Length (cm)	Q1	Q2	Q3	Q4	All year
5					
6					
7					
8					
9					
10					
11					
12	75	795			870
13	56	597			653
14	75	795			870
15	75	795			870
16	364	3 778	1 283	633	6 058
17	1 212	12 924	1 539	759	16 434
18	2 015	21 475	1 796	886	26 172
19	3 506	37 382	3 847	1 898	46 633
20	4 215	44 937	14 363	7 084	70 599
21	3 973	42 353	33 343	16 446	96 115
22	3 264	34 797	43 090	21 253	102 404
23	4 215	44 937	49 245	24 290	122 687
24	5 932	63 231	67 968	33 525	170 656
25	6 285	67 008	72 328	35 675	181 296
26	4 980	53 090	66 942	33 019	158 031
27	2 928	31 218	33 856	16 699	84 701
28	2 052	21 873	20 006	9 868	53 799
29	914	9 743	7 695	3 795	22 147
30	933	9 943	5 386	2 657	18 919
31	522	5 567	2 309	1 138	9 536
32	410	4 374	1 539	759	7 082
33	149	1 591	770	380	2 890
34	205	2 187	1 539	759	4 690
35	112	1 193	513	253	2 071
36	56	597			653
37	56	597			653
38	18	398			416
39	19	199			218
40	19	199			218
41	19	199			218
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
TOTAL numbers	48 654	518 772	429 357	211 776	1208 559

Table 4.2.2.3 Blue whiting. Landings in numbers ('000) by length group (cm) and quarter for the Southern area in 2006.

Length (cm)	Q1	Q2	Q3	Q4	All year
5					
6					
7					
8					
9					
10			42		42
11			229		229
12			687		687
13	2		346	3	352
14	53		193	24	270
15	39		29	127	195
16	90		93	331	515
17	810	109	65	215	1 200
18	5 156	997	78	96	6 326
19	9 524	2 412	248	142	12 326
20	7 430	5 028	854	874	14 185
21	3 718	9 579	4 013	1 730	19 039
22	4 013	11 182	8 161	3 201	26 557
23	6 672	10 023	9 030	3 970	29 695
24	7 890	8 604	5 159	4 532	26 184
25	5 729	8 175	3 602	4 668	22 174
26	4 265	4 830	1 682	3 459	14 236
27	3 260	3 487	1 454	2 846	11 046
28	1 954	1 627	1 307	1 778	6 666
29	1 221	787	689	818	3 515
30	744	232	522	534	2 033
31	233	43	303	258	837
32	156	8	115	55	334
33	27	8	31	22	89
34	23	3	29	8	62
35	4	1	21	2	28
36	5		8	13	27
37	1	1	1	1	4
38					1
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
TOTAL numbers	63 021	67 135	38 989	29 709	198 853

Table 4.2.2.4 BLUE WHITING. Catch in number (millions) by age group in the directed fisheries (Sub-areas I and II, Divisions Va, and XIVa+b, Vb, VIa+b, VIIbc and VIIg-k) in 1993-2006.

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
0	0	0	1	4	167	15	61	41	119	16	58	6	24	3
1	37	44	99	497	1352	984	544	912	3459	1111	2464	1132	856	114
2	130	31	143	327	1079	3535	1180	752	3924	2439	3626	3481	996	616
3	335	190	338	451	751	3211	5257	3119	2728	2939	7964	6220	4614	3670
4	1348	362	416	425	526	929	3235	4834	3644	2114	4726	6524	5655	5692
5	376	1242	566	248	268	346	362	1517	2474	1804	2006	2972	4304	3615
6	196	294	769	430	238	311	186	500	555	1602	1090	1252	1391	1621
7	108	201	246	619	270	298	143	210	160	336	398	633	506	475
8	60	103	154	214	391	257	146	144	91	165	119	246	244	167
9	38	88	58	88	101	209	66	57	69	100	18	74	97	64
10+	14	32	40	70	164	85	138	139	55	142	27	36	54	35
Total	2,641	2,588	2,829	3,373	5,307	10,180	11,318	12,225	17,281	12,768	22,495	22,575	18742	16,072

Table 4.2.2.5 BLUE WHITING. Catch in number (million) by age group in the directed fishery and by-catches from mixed fisheries (Divisions IIIa and IV) for 1993-2006.

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
0	132	95	3303	812	29	11	60	56	9	190	222	52	46	4
1	167	33	101	1334	621	576	188	822	770	621	1191	925	496	258
2	39	21	88	71	269	524	286	317	416	685	369	784	389	272
3	91	18	29	58	50	259	434	253	174	274	368	405	408	346
4	97	37	11	71	14	47	168	143	149	105	73	116	196	195
5	15	6	6	39	14	6	16	22	109	17	18	46	138	63
6	7	3	11	45	5	4	5	3	29	45	23	12	26	23
7	8	1	2	33	4	3	5	0	9	8	1	11	11	11
8	0	1	2	14	6	4	6	7	6	3	1	1	5	8
9	-	0	1	9	1	4	1	1	8	2	1	1	3	1
10+	-	-	1	11	2	12	3	1	11	1	1	1	1	1
Total	556	214	3,555	2,499	1,015	1,450	1,172	1,627	1,689	1,951	2,269	2,355	1,720	1,181

Table 4.2.2.6 BLUE WHITING. Catch in number (millions) by age group in the Southern area, 1993-2006.

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
0	25	13	3	9	11	18	18	32	33	17	7	4	16	4
1	41	12	96	43	118	97	57	80	134	88	88	84	85	39
2	146	56	123	131	143	122	82	123	146	108	79	130	141	39
3	181	149	55	117	86	71	130	93	60	79	47	50	70	55
4	62	72	38	36	26	69	57	35	14	24	26	10	26	37
5	12	27	44	33	8	32	35	9	10	4	12	5	12	15
6	7	9	20	17	4	7	15	10	1	1	4	3	3	8
7	2	5	6	5	3	2	3	3	0	0	1	1	1	2
8+	1	4	5	3	3	4	2	0	0	0	1	0	1	1
Total	477	347	390	394	402	422	399	384	398	321	264	286	355	200

Table 4.2.2.7. Blue Whiting: Catch in numbers (thousands) of the total stock in 1982-2006.

Age	1983	1984	1985	1986	1987	1988	1989	1990
0								
1	2,283,000	2,291,000	1,305,000	650,000	838,000	425,000	865,000	1,611,000
2	567,000	2,331,000	2,044,000	816,000	578,000	721,000	718,000	703,000
3	270,000	455,000	1,933,000	1,862,000	728,000	614,000	1,340,000	672,000
4	286,000	260,000	303,000	1,717,000	1,897,000	683,000	791,000	753,000
5	299,000	285,000	188,000	393,000	726,000	1,303,000	837,000	520,000
6	304,000	445,000	321,000	187,000	137,000	618,000	708,000	577,000
7	287,000	262,000	257,000	201,000	105,000	84,000	139,000	299,000
8	286,000	193,000	174,000	198,000	123,000	53,000	50,000	78,000
9	225,000	154,000	93,000	174,000	103,000	33,000	25,000	27,000
10+	334,000	255,000	259,000	398,000	195,000	50,000	38,000	95,000

Age	1991	1992	1993	1994	1995	1996	1997	1998
0			157,000	108,000	3,307,000	825,000	207,000	44,000
1	266,686	407,730	263,184	306,951	296,100	1,893,453	2,131,494	1,656,926
2	1,024,468	653,838	305,180	107,935	353,949	534,221	1,519,327	4,181,175
3	513,959	1,641,714	621,085	367,962	421,560	632,361	904,074	3,541,231
4	301,627	569,094	1,571,236	389,264	465,358	537,280	577,676	1,044,897
5	363,204	217,386	411,367	1,221,919	615,994	323,324	295,671	383,658
6	258,038	154,044	191,241	281,120	800,201	497,458	251,642	322,777
7	159,153	109,580	107,005	174,256	253,818	663,133	282,056	303,058
8	49,431	79,663	64,769	90,429	159,797	232,420	406,910	264,105
9	5,060	31,987	38,118	79,014	59,670	98,415	104,320	212,452
10+	9,570	11,706	17,476	30,614	41,811	82,521	169,235	85,513

Age	1999	2000	2001	2002	2003	2004	2005	2006
0	139,000	129,000	161,000	223,000	287,000	62,606	85,329	18,510
1	788,200	1,814,851	4,363,690	1,821,053	3,742,841	2,156,261	1,427,277	412,961
2	1,549,100	1,192,657	4,486,315	3,232,244	4,073,497	4,426,323	1,518,938	939,865
3	5,820,800	3,465,739	2,962,163	3,291,844	8,378,955	6,723,748	5,083,550	4,206,005
4	3,460,600	5,014,862	3,806,520	2,242,722	4,824,590	6,697,923	5,871,414	6,150,696
5	412,800	1,550,063	2,592,933	1,824,047	2,035,096	3,044,943	4,450,171	3,833,536
6	207,200	513,663	585,666	1,647,122	1,117,179	1,276,412	1,419,089	1,718,775
7	151,200	213,057	170,020	344,403	400,022	649,885	518,304	506,198
8	153,100	151,429	97,032	168,848	121,280	249,097	249,443	181,181
9	68,800	58,277	76,624	102,576	19,701	75,415	100,374	67,573
10+	140,500	139,791	66,410	142,743	27,493	36,805	55,226	36,688

Table 4.2.3.1. Blue Whiting: Mean weights-at-age in the total catch and stock in 1983-2006.

Age	1983	1984	1985	1986	1987	1988	1989	1990
0	0.020	0.026	0.016	0.030	0.023	0.031	0.014	0.034
1	0.046	0.035	0.038	0.040	0.048	0.053	0.059	0.045
2	0.074	0.078	0.074	0.073	0.086	0.076	0.079	0.070
3	0.118	0.089	0.097	0.108	0.106	0.097	0.103	0.106
4	0.140	0.132	0.114	0.130	0.124	0.128	0.126	0.123
5	0.153	0.153	0.157	0.165	0.147	0.142	0.148	0.147
6	0.176	0.161	0.177	0.199	0.177	0.157	0.158	0.168
7	0.195	0.175	0.199	0.209	0.208	0.179	0.171	0.175
8	0.200	0.189	0.208	0.243	0.221	0.199	0.203	0.214
9	0.204	0.186	0.218	0.246	0.222	0.222	0.224	0.217
10+	0.228	0.206	0.237	0.257	0.254	0.260	0.253	0.256

Age	1991	1992	1993	1994	1995	1996	1997	1998
0	0.036	0.024	0.028	0.033	0.022	0.018	0.031	0.033
1	0.055	0.057	0.066	0.061	0.064	0.041	0.047	0.048
2	0.091	0.083	0.082	0.087	0.091	0.080	0.072	0.072
3	0.107	0.119	0.109	0.108	0.118	0.102	0.102	0.094
4	0.136	0.140	0.137	0.137	0.143	0.116	0.121	0.125
5	0.174	0.167	0.163	0.164	0.154	0.147	0.140	0.149
6	0.190	0.193	0.177	0.189	0.167	0.170	0.166	0.178
7	0.206	0.226	0.200	0.207	0.203	0.214	0.177	0.183
8	0.230	0.235	0.217	0.217	0.206	0.230	0.183	0.188
9	0.232	0.284	0.225	0.247	0.236	0.238	0.203	0.221
10+	0.266	0.294	0.281	0.254	0.256	0.279	0.232	0.248

Age	1999	2000	2001	2002	2003	2004	2005	2006
0	0.035	0.031	0.038	0.021	0.019	0.026	0.032	0.037
1	0.063	0.057	0.050	0.054	0.049	0.042	0.039	0.049
2	0.078	0.075	0.078	0.074	0.075	0.066	0.068	0.072
3	0.088	0.086	0.094	0.093	0.098	0.089	0.084	0.089
4	0.109	0.104	0.108	0.115	0.108	0.102	0.099	0.105
5	0.142	0.133	0.129	0.132	0.131	0.123	0.113	0.122
6	0.170	0.156	0.163	0.155	0.148	0.146	0.137	0.138
7	0.199	0.179	0.186	0.173	0.168	0.160	0.156	0.163
8	0.193	0.187	0.193	0.233	0.193	0.173	0.166	0.190
9	0.192	0.232	0.231	0.224	0.232	0.209	0.195	0.212
10	0.245	0.241	0.243	0.262	0.258	0.347	0.217	0.328

Table 4.2.5.1.1. Blue whiting: Estimated stock numbers (millions) at age and total biomass (million tonnes) for blue whiting in the in the international survey 2004–2007.

YEAR		AGE										
	BIOMASS	1	2	3	4	5	6	7	8	9	10	11
2004	10.9	4886	17603	34350	44397	16775	5521	3111	1962	1131	127	
2005	7.6	3631	4320	18774	25579	26660	8298	2016	728	323	2	4
2006	10.3	3162	5540	32201	38942	16608	7972	2459	791	293	7	
2007	11.1	1732	2654	16343	32851	24794	13952	7282	2509	951	420	235

Table 4.2.5.1.2. Blue whiting. Estimates of stock numbers of blue whiting from the International ecosystem survey in Nordic Seas, May-June, 2000–2007. The upper panel present numbers (millions) in the standard survey area, and the lower panel presents age 1 abundance for total survey coverage.

Standard survey area

YEAR	AGE										
	1	2	3	4	5	6	7	8	9	10	11
2000	48927	3133	3580	1668	201	5					
2001	85772	25110	7533	3020	2066						
2002	15251	46656	14672	4357	513	445		15		6	
2003	35688	21487	35372	4354	639	201	43	3			
2004	49254	22086	13292	8290	1495	533	83	39			
2005	54660	19904	13828	4714	1886	326	103	43	8	3	11
2006	570	18300	15324	6550	1566	384	246	80	47	2	8
2007	21	552	5846	3639	1674	531	178	49	19		

Total survey area

YEAR	AGE
	1
2000	n.a.
2001	80823
2002	17321
2003	57300
2004	55155
2005	61791
2006	7788
2007	1834

Table 4.2.5.3. Blue whiting. Age stratified acoustic survey estimates of blue whiting in the Norwegian Sea in July-August. Numbers in millions.

Year\Age	1	2	3	4	5	6	7	8	9	Total
1981	182	728	4542	3874	2678	2834	2964	2756	2054	22612
1982	184	460	1242	4715	3611	3128	2323	1679	874	18216
1983	22356	396	468	756	1404	576	468	432	324	27180
1984	30380	13916	833	392	539	539	343	49	49	47040
1985	5969	23876	12502	658	423	188	235	141	376	44368
1986	2324	2380	7224	6944	1876	952	336	308	140	22484
1987	8204	4032	5180	5572	1204	224	168	56	84	24724
1988	4992	2880	2640	3480	912	120	96	24	48	15192
1989	1172	1125	812	379	410	212	22	32		4164
1990	no survey									
1991	no survey									
1992	792	1134	6939	766	247	172	90	11	18	10169
1993	830	125	1070	6392	1222	489	248	58	88	10522
1994	no survey									
1995	6974	2811	1999	1209	1622	775	173	61		15624
1996	23464	1057	899	649	436	505	755	69	41	27875
1997	30227	25638	1524	779	300	407	260	137	123	59395
1998	24244	47815	16282	556	212	100	64	10	255	89538
1999	14367	9750	23701	9754	1733	466	79	48	91	59989
2000	25813	3298	2721	3078	23	46	6			34985
2001	61470	22051	7883	3225	1824	156	12		68	96689
2002	no survey									

Table 4.2.5.4. Blue whiting 1-group indices from the Norwegian bottom trawl survey in the Barents Sea. (Blue whiting <19 cm in total body length which most likely belong to 1-group.)

YEAR		**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
CATCH RATE (IND./NM)	**ALL**	**0.10**	**0.24**	**5.20**	**7.45**	**38.8**	**24.1**	**11.8**	**6.25**	**1.85**	**18.4**
	<19CM	**0.00**	**0.01**	**0.56**	**2.49**	**1.02**	**1.14**	**0.02**	**0.43**	**0.20**	**17.0**

Year		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Catch rate (ind./nm)	All	56.1	34.3	8.09	3.73	1.95	11.5	185.7	11.6	6.9	108.1
	<19cm	2.47	0.07	0.01	0.00	0.12	6.65	171.4	0.30	0.75	97.2

Year		2001	2002	2003	2004	2005	2006	2007
Catch rate (ind./nm)	All	362.7	117.7	64.2	140.8	211.2	286.8	87.8
	<19cm	256.5	11.5	25.8	41.1	91.3	3.76	0.13

Table 4.2.5.5. Blue whiting. Stratified mean catch (Kg/haul and Number/haul) and standard error of BLUE WHITING in bottom trawl surveys in Spanish waters (Divisions VIIIc and IXa north). All surveys in September-October.

Kg/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	9.50	5.87	119.75	45.99	68.18	13.79	92.83	28.24
1986	9.74	7.13	45.41	12.37	29.54	8.70	36.93	7.95
1987	-	-	-	-	-	-	-	-
1988	2.90	2.59	154.12	38.69	183.07	141.94	143.30	45.84
1989	14.17	12.03	76.92	17.08	18.79	6.23	59.00	11.68
1990	6.25	3.29	52.54	9.00	18.80	4.99	43.60	6.60
1991	64.59	34.65	126.41	26.06	46.07	18.99	97.10	17.16
1992	6.37	2.59	44.12	6.64	29.50	6.16	34.60	4.23
1993	1.06	0.63	14.07	3.73	51.08	22.02	22.59	6.44
1994	8.04	5.28	37.18	8.45	25.42	5.27	29.70	5.19
1995	19.97	13.87	36.43	4.82	15.97	4.10	28.52	3.66
1996	7.27	3.95	49.23	7.19	92.54	17.76	54.52	6.36
Kg/haul	70-120 m		121-200 m		201-500 m		TOTAL 70-500 m	
Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1997	17.87	7.35	44.68	10.52	57.14	16.60	42.62	7.29
1998	14.13	4.17	42.78	8.13	78.88	22.01	47.14	7.58
1999	93.01	14.60	112.39	19.92	169.21	50.26	124.66	17.85
2000	62.39	12.00	91.99	14.75	58.72	24.94	76.19	10.61
2001	8.35	3.31	50.18	10.09	52.41	16.71	42.02	7.02
2002	31.40	5.02	69.00	13.41	36.75	12.07	51.80	7.64
2003	42.52	12.22	71.40	11.01	46.43	11.42	58.13	6.92
2004	2.80	2.11	14.05	7.79	59.51	21.41	24.76	7.31
2005	50.63	16.15	95.17	19.28	40.06	8.88	69.94	10.57
2006	14.28	7.01	70.79	12.60	115.08	39.88	71.64	13.18

Number/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	267	181.71	3669	1578.86	1377	262.98	2644	963.20
1986	368	237.56	2486	1006.67	752	238.87	1763	616.40
1987	-	-	-	-	-	-	-	-
1988	83	71.74	6112	1847.36	7276	6339.88	5694	2086.00
1989	629	537.29	3197	876.75	566	213.11	2412	599.00
1990	220	115.48	2219	426.46	578	185.43	1722	276.00
1991	2922	1645.73	5563	1184.69	1789	847.33	4214	780.88
1992	124	50.81	1412	233.99	845	199.12	1069	146.87
1993	14	8.61	257	69.61	894	427.77	401	124.53
1994	346	234.12	2002	456.50	997	245.91	1487	689.00
1995	1291	864.97	2004	341.48	485	137.81	1493	240.37
1996	147	82.71	1167	167.20	2097	385.23	1263	142.30
Kg/haul	70-120 m		121-200 m		201-500 m		TOTAL 30-500 m	
Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1997	552	235.60	1443	361.89	1183	323.14	1180	209.94
1998	351	105.96	1463	320.26	2012	590.04	1387	234.82
1999	2508	427.20	4388	849.80	6119	2026.40	4490	727.90
2000	2267	414.97	3930	604.11	2009	859.71	3027	400.87
2001	171	77.34	1310	263.84	1232	381.49	1048	172.74
2002	771	90.34	2526	499.30	1075	331.09	1739	268.70
2003	1320	384.25	2791	554.16	1513	454.02	2114	317.68
2004	31	22.77	336	154.33	1472	736.78	599	225.74
2005	1141	504.13	3874	944.57	1102	292.20	2564	492.91
2006	508	253.18	4546	942.59	6485	2848.15	4254	947.65

Figure 4.3.2.1. Blue Whiting. Survey indices used in the assessment.

```
#  Survey indices at age, BLUE WHITING-COMBINED, 2007 WG, 3 fleets
#######################################################################

# Norwegian spawning ground survey, 1991 2006
# Effort and catch numbers age 3 - 8
 1      6340      8497      7407      4558      2019       545  #1991
 1     26123      4719      1574      1386       810       616  #1992
 1      3321     26771      2643      1270       557       426  #1993
 1      2950      4476     11354      1742      1687       908  #1994
 1      9874      7906      6861      9467      1795      1083  #1995
 1      7433      8371      2399      4455      4111      1202  #1996
 1        -1        -1        -1        -1        -1        -1  #1997
 1     34991      4697      1674       279       407       381  #1998
 1     60309     26103      1481       316        72       153  #1999
 1     31011     41382      6843       898       427       228  #2000
 1     12843     13805      8292       718       175        51  #2001
 1     54740     12757      5266      8404      1450       305  #2002
 1     70303     28756      5735      2430      1708       260  #2003
 1     40669     50137     15649      4454      2218      1313  #2004
 1     19968     30459     31708      7455      1993       747  #2005
 1     19446     36617     15998      8167      1592       466  #2006
#######################################################################

# International ecosystem survey in the Nordic Seas, 2000-2007
# Effort and catch numbers age 1-2
  1     48927      3133  #2000
  1     85772     25110  #2001
  1     15251     46656  #2002
  1     35688     21487  #2003
  1     49254     22086  #2004
  1     54660     19904  #2005
  1       570     18300  #2006
  1        21      552   #2007
#######################################################################

# International blue whiting spawning stock ground survey  2004-2007
# Effort and catch numbers age 3-8
  1     34350     44397     16775      5521      3111   1962  #2004
  1     18774     25579     26660      8298      2016    728  #2005
  1     32201     38942     16608      7972      2459    791  #2006
  1     16343     32851     24794     13952      7282   2509  #2007
```

Table 4.3.3.1 Blue whiting AMCI final run. Annual fishing mortality.

Age	1981	1982	1983	1984	1985	1986	1987	1988
1	0.073	0.048	0.155	0.175	0.158	0.148	0.121	0.083
2	0.097	0.077	0.103	0.158	0.177	0.229	0.198	0.169
3	0.186	0.139	0.163	0.215	0.261	0.349	0.302	0.254
4	0.228	0.175	0.202	0.259	0.283	0.421	0.396	0.337
5	0.274	0.202	0.231	0.296	0.322	0.454	0.427	0.400
6	0.428	0.314	0.363	0.469	0.521	0.694	0.608	0.574
7	0.428	0.314	0.363	0.469	0.521	0.694	0.608	0.574
8	0.428	0.314	0.363	0.469	0.521	0.694	0.608	0.574
9	0.428	0.314	0.363	0.469	0.521	0.694	0.608	0.574
10	0.428	0.314	0.363	0.469	0.521	0.694	0.608	0.574
Fref	0.309	0.229	0.264	0.342	0.382	0.522	0.468	0.428

Age	1989	1990	1991	1992	1993	1994	1995	1996
1	0.103	0.092	0.035	0.056	0.052	0.051	0.053	0.088
2	0.190	0.184	0.076	0.082	0.075	0.067	0.082	0.108
3	0.303	0.293	0.123	0.131	0.122	0.116	0.143	0.190
4	0.387	0.384	0.159	0.169	0.162	0.150	0.187	0.251
5	0.475	0.471	0.205	0.207	0.195	0.190	0.237	0.305
6	0.670	0.691	0.299	0.298	0.270	0.253	0.303	0.397
7	0.670	0.691	0.299	0.298	0.270	0.253	0.303	0.397
8	0.670	0.691	0.299	0.298	0.270	0.253	0.303	0.397
9	0.670	0.691	0.299	0.298	0.270	0.253	0.303	0.397
10	0.670	0.691	0.299	0.298	0.270	0.253	0.303	0.397
Fref	0.501	0.506	0.217	0.221	0.204	0.192	0.235	0.308

Age	1997	1998	1999	2000	2001	2002	2003	2004
1	0.079	0.086	0.059	0.059	0.071	0.055	0.068	0.073
2	0.113	0.160	0.138	0.153	0.165	0.146	0.137	0.152
3	0.205	0.298	0.281	0.321	0.342	0.303	0.289	0.323
4	0.264	0.380	0.380	0.454	0.494	0.455	0.437	0.481
5	0.313	0.424	0.380	0.453	0.495	0.464	0.474	0.539
6	0.405	0.561	0.491	0.598	0.619	0.593	0.569	0.680
7	0.405	0.561	0.491	0.598	0.619	0.593	0.569	0.680
8	0.405	0.561	0.491	0.598	0.619	0.593	0.569	0.680
9	0.405	0.561	0.491	0.598	0.619	0.593	0.569	0.680
10	0.405	0.561	0.491	0.598	0.619	0.593	0.569	0.680
Fref	0.318	0.445	0.404	0.484	0.514	0.482	0.468	0.541

Age	2005	2006
1	0.066	0.098
2	0.130	0.115
3	0.286	0.270
4	0.443	0.426
5	0.496	0.486
6	0.615	0.564
7	0.615	0.564
8	0.615	0.564
9	0.615	0.564
10	0.615	0.564
Fref	0.491	0.462

Table 4.3.3.2. Blue whiting AMCI final run. Stock numbers in millions.

Age	1981	1982	1983	1984	1985	1986	1987	1988
1	3638.9	4079.8	10877.8	18337.7	12311.2	9495.8	8991.5	7672.9
2	3982.5	2768.3	3183.3	7628.3	12603	8603.4	6706.6	6521.2
3	4753.7	2960.1	2098.5	2352.3	5334.5	8647.8	5601.8	4506
4	3025	3231.6	2108.5	1460	1553.5	3365.9	4995.7	3392.4
5	2417.8	1972.1	2220.8	1410.7	922.3	958.2	1809.7	2753.3
6	2294	1505.4	1319.1	1443.9	858.8	547.3	498.3	966.7
7	1864	1224.4	900.5	751.5	739.8	417.5	223.8	222.1
8	1786.9	994.9	732.4	513	385	359.7	170.7	99.8
9	1481.6	953.7	595.1	417.2	262.8	187.2	147.1	76.1
10	3099.4	2445.1	2033	1497.2	980.8	604.7	323.8	209.9

Age	1989	1990	1991	1992	1993	1994	1995	1996
1	8860.4	22029.1	8987.9	6166.1	5496.8	6486.9	7618.2	20433.6
2	5782.1	6544.5	16448.8	7104.8	4774.6	4270.5	5045.8	5915.2
3	4510.9	3913.1	4459.1	12482.3	5361.8	3626.3	3269.8	3806.4
4	2861.6	2728.9	2390.1	3227.6	8969.4	3885.2	2643.7	2320.2
5	1983	1590.5	1522.2	1669.6	2230.8	6246.1	2738	1796.2
6	1511.8	1009.5	813.1	1015	1111	1503.1	4229.1	1768.3
7	445.7	633.5	414.1	493.6	616.8	694.8	955.4	2557.9
8	102.4	186.8	259.9	251.4	299.9	385.7	441.6	577.9
9	46	42.9	76.6	157.7	152.8	187.5	245.2	267.1
10	131.9	74.5	48.2	75.8	141.9	184.3	236.3	291.2

Age	1997	1998	1999	2000	2001	2002	2003	2004
1	37195.1	30092.7	21971.9	39743.1	62497.4	45631.2	48220.4	33551.6
2	15324	28154.9	22616.8	16963.6	30681.3	47661.7	35374.2	36878.8
3	4347.9	11203.9	19649.3	16123.1	11916	21291.1	33737.2	25251.3
4	2576.6	2900.8	6811.9	12150.7	9579.3	6932.3	12869.4	20690.6
5	1478.4	1619.5	1624.2	3813.6	6318.9	4784.9	3602.6	6808.6
6	1084.3	885.5	867.9	909.8	1985.9	3153.4	2463.2	1835.3
7	972.9	592	413.7	435	409.8	875.3	1427.3	1141.7
8	1407.4	531.2	276.6	207.4	196	180.6	396.2	661.6
9	318	768.4	248.2	138.7	93.4	86.4	81.8	183.6
10	307.2	341.3	518.5	384.3	235.6	145	104.7	86.4

Age	2005	2006
1	24040.7	1141
2	25544.5	18435
3	25948.5	18369.9
4	14962.8	15955.9
5	10467.8	7862.8
6	3252.9	5220.1
7	761.2	1440.2
8	473.5	337
9	274.4	209.6
10	112	171.1

Table 4.3.3.3. Blue whiting AMCI final run. Stock summary.

Year	Recruits (000)	SSB	F 3-7	Catch SOP
1981	3638881	2820340	0.3086	922980
1982	4079777	2330482	0.2289	550643
1983	10877760	1895630	0.2641	553344
1984	18337739	1541015	0.3416	615569
1985	12311231	1649803	0.3815	678214
1986	9495826	1864678	0.5223	847145
1987	8991503	1666461	0.4681	654718
1988	7672889	1474555	0.4278	552264
1989	8860439	1420439	0.5009	630316
1990	22029064	1340950	0.5059	558128
1991	8987940	1791197	0.2171	364008
1992	6166066	2422155	0.2207	474592
1993	5496808	2377382	0.2036	475198
1994	6486854	2355872	0.1924	457696
1995	7618156	2184153	0.2345	505175
1996	20433605	2018529	0.3081	621104
1997	37195060	2041837	0.3184	639680
1998	30092683	2745833	0.4447	1131954
1999	21971865	3312492	0.4043	1261033
2000	39743149	3497886	0.4844	1412449
2001	62497442	3978177	0.5139	1771805
2002	45631246	4862443	0.4815	1556954
2003	48220355	5860119	0.4676	2365319
2004	33551601	5608323	0.5407	2400794
2005	24040708	5139067	0.4910	2018344
2006	1141025	4800669	0.4617	1956239
2007		3727194		
Arith. Mean	19444987			
Geo. Mean	13333986			

Table 4.3.4.1. Blue Whiting. Results of TISVPA stock assessment for the "pessimistic" run.

	R(1)	B(1+)	SSB (Jan.1)	SSB (sp.time)	F(3-7)
1981	3564	4271.8	3745.3	3304.0	0.237
1982	4501	3300.6	2824.4	2540.7	0.184
1983	16916	3009.9	2024.7	1796.4	0.216
1984	19503	3030.5	1771.2	1563.7	0.269
1985	10717	3225.4	2066.9	1817.1	0.329
1986	8600	3370.1	2444.4	2086.5	0.484
1987	8822	3004.3	2051.5	1774.5	0.403
1988	7067	2571.4	1739.8	1511.9	0.498
1989	9341	2600.2	1660.8	1439.6	0.526
1990	21034	2857.5	1570.3	1360.2	0.483
1991	9069	3456.3	1972.4	1800.6	0.252
1992	6353	3637.5	2593.7	2365.0	0.181
1993	5983	3408.4	2506.7	2281.3	0.201
1994	6770	3299.0	2446.3	2216.0	0.199
1995	8775	3253.1	2262.1	2021.9	0.249
1996	24911	3550.4	2152.3	1898.7	0.305
1997	42281	5156.6	2407.3	2157.6	0.277
1998	29108	6314.9	3329.3	2926.2	0.408
1999	23645	6890.6	3996.4	3540.5	0.360
2000	37668	7346.1	4084.1	3541.2	0.513
2001	55258	8851.5	4533.4	3988.3	0.479
2002	47227	9940.9	5270.6	4582.2	0.536
2003	42924	10798.5	6429.1	5629.3	0.527
2004	23160	8718.0	5821.7	4957.2	0.664
2005	7689	6427.1	4806.7	3999.7	0.732
2006	3024	4742.1	3887.9	3074.2	0.831
2007			2035.6	1585.4	

Table 4.3.4.2. Blue Whiting. TISVPA estimates of abundance for the "pessimistic" run.

	1	2	3	4	5	6	7	8	9	10+
1981	3563.94	4064.76	5011.24	3335.90	2429.38	2254.86	1995.70	2203.79	2021.35	5105.84
1982	4500.98	2684.46	3013.06	3486.66	2428.99	1493.16	1340.32	1212.29	1230.64	2916.27
1983	16915.60	3551.18	1949.92	2171.91	2358.79	1749.81	972.76	856.68	746.42	1108.02
1984	19503.12	11783.58	2394.42	1352.16	1519.42	1660.66	1157.55	536.74	442.60	732.88
1985	10716.96	13894.82	7538.40	1548.68	871.79	986.12	956.98	710.66	264.81	737.49
1986	8599.82	7593.49	9526.63	4422.87	993.79	543.66	516.91	550.97	424.39	970.74
1987	8822.27	6452.80	5478.67	6114.94	2067.53	458.04	275.90	241.34	271.94	514.83
1988	7067.11	6464.81	4760.11	3826.84	3290.01	1035.84	251.05	130.88	86.30	130.76
1989	9341.49	5401.50	4640.55	3341.68	2515.15	1514.63	288.89	129.54	59.20	89.99
1990	21034.37	6865.48	3772.70	2586.88	2020.21	1301.88	599.45	110.75	60.81	213.98
1991	9068.94	15763.79	4984.88	2480.78	1436.62	1183.49	543.80	220.24	20.10	37.83
1992	6353.48	7183.70	11979.29	3616.19	1758.19	847.57	735.51	301.17	135.62	49.59
1993	5982.93	4832.89	5289.94	8322.34	2445.74	1242.77	554.58	503.02	174.46	80.13
1994	6769.76	4660.26	3680.68	3769.04	5392.08	1630.15	844.49	357.24	353.20	136.81
1995	8775.47	5264.83	3717.86	2680.50	2733.57	3309.04	1080.31	533.70	210.68	147.51
1996	24910.89	6916.82	3990.26	2662.45	1773.50	1680.68	1985.16	654.83	292.36	245.12
1997	42281.20	18682.00	5179.65	2694.73	1693.66	1159.48	925.87	1025.32	325.85	528.60
1998	29107.55	32688.26	13920.81	3422.68	1683.53	1119.09	721.65	502.78	471.28	189.62
1999	23644.78	22332.02	22979.58	8193.18	1856.78	1031.17	624.15	316.58	172.68	352.63
2000	37668.38	18645.51	16882.23	13547.21	3576.73	1146.69	656.77	374.20	120.66	289.34
2001	55258.41	29198.11	14186.46	10686.10	6553.85	1525.79	474.02	344.90	169.38	146.81
2002	47227.01	41293.33	19846.02	8934.58	5304.78	3019.68	719.25	234.25	194.58	270.63
2003	42924.30	37018.45	30883.50	13270.00	5285.73	2692.67	981.95	277.25	39.05	544.94
2004	23159.94	31756.82	26622.29	17703.73	6499.08	2486.16	1193.69	442.02	117.23	57.21
2005	7688.69	17024.74	22024.07	15756.43	8477.69	2585.67	888.88	393.51	138.13	75.98
2006	3024.03	5003.51	12564.28	13431.95	7587.61	2914.24	832.92	258.78	96.51	524.02
2007	0	2102.21	3246.1	6481.02	5431.78	2743.49	830.77	223.91	47.93	17.88

Table 4.3.4.3. Blue whiting. TISVPA estimates of fishing mortality for the "pessimistic" run.

	1	2	3	4	5	6	7	8	9	10+
1981	0.0834	0.0994	0.1627	0.1173	0.2867	0.3202	0.2985	0.3826	0.3798	0.3798
1982	0.0370	0.1197	0.1274	0.1908	0.1280	0.2285	0.2476	0.2850	0.2944	0.2944
1983	0.1615	0.1941	0.1661	0.1573	0.1509	0.2132	0.3946	0.4604	0.4052	0.4052
1984	0.1391	0.2467	0.2357	0.2389	0.2323	0.3512	0.2879	0.5065	0.4854	0.4854
1985	0.1445	0.1774	0.3332	0.2436	0.2722	0.4459	0.3521	0.3155	0.4912	0.4912
1986	0.0872	0.1264	0.2434	0.5604	0.5746	0.4783	0.5617	0.5061	0.6035	0.6035
1987	0.1109	0.1042	0.1588	0.4198	0.4911	0.4013	0.5458	0.8284	0.5423	0.5423
1988	0.0688	0.1315	0.1538	0.2197	0.5757	1.0769	0.4617	0.5934	0.5492	0.5492
1989	0.1080	0.1589	0.3844	0.3033	0.4585	0.7269	0.7588	0.5561	0.6287	0.6287
1990	0.0884	0.1201	0.2192	0.3882	0.3347	0.6730	0.8013	1.5068	0.6747	0.6747
1991	0.0330	0.0745	0.1210	0.1443	0.3277	0.2757	0.3909	0.2849	0.3292	0.3292
1992	0.0736	0.1060	0.1642	0.1911	0.1469	0.2242	0.1799	0.3460	0.3021	0.3021
1993	0.0498	0.0724	0.1390	0.2340	0.2057	0.1864	0.2398	0.1536	0.2762	0.2762
1994	0.0514	0.0259	0.1171	0.1212	0.2883	0.2114	0.2589	0.3280	0.2839	0.2839
1995	0.0380	0.0772	0.1339	0.2131	0.2864	0.3110	0.3006	0.4018	0.3757	0.3757
1996	0.0877	0.0892	0.1926	0.2524	0.2250	0.3962	0.4607	0.4980	0.4652	0.4652
1997	0.0573	0.0942	0.2143	0.2704	0.2144	0.2742	0.4106	0.5773	0.4366	0.4366
1998	0.0650	0.1524	0.3301	0.4116	0.2902	0.3839	0.6240	0.8687	0.6898	0.6898
1999	0.0375	0.0798	0.3284	0.6289	0.2820	0.2511	0.3116	0.7646	0.5804	0.5804
2000	0.0547	0.0733	0.2573	0.5261	0.6519	0.6834	0.4441	0.5927	0.7635	0.7635
2001	0.0913	0.1861	0.2624	0.5003	0.5749	0.5521	0.5049	0.3724	0.6930	0.6930
2002	0.0436	0.0905	0.2025	0.3249	0.4781	0.9234	0.7533	1.5915	0.8740	0.8740
2003	0.1013	0.1297	0.3565	0.5139	0.5543	0.6135	0.5982	0.6607	0.8153	0.8153
2004	0.1078	0.1660	0.3245	0.5363	0.7217	0.8285	0.9097	0.9632	1.2213	1.2213
2005	0.2296	0.1038	0.2945	0.5307	0.8678	0.9328	1.0340	1.2055	1.6261	1.6261
2006	0.1636	0.2327	0.4620	0.7054	0.8173	1.0550	1.1137	1.4862	1.4862	1.4862

Table 4.3.4.4. Blue whiting. Results of TISVPA stock assessment for the "optimistic" run.

	R(1)	B(1+)	SSB (Jan.1)	SSB (sp.time)	F(3-7)
1981	3684	4228.0	3695.5	3256.1	0.239
1982	4409	3275.1	2797.0	2514.3	0.185
1983	16802	2998.1	2018.3	1788.8	0.216
1984	18859	3017.7	1763.7	1556.4	0.271
1985	10959	3251.5	2083.0	1830.4	0.335
1986	8298	3413.0	2471.4	2106.7	0.493
1987	8476	2983.7	2051.3	1769.6	0.395
1988	6937	2513.1	1701.2	1475.1	0.515
1989	9187	2526.0	1608.5	1393.1	0.520
1990	20710	2818.2	1547.7	1338.1	0.495
1991	8986	3382.2	1930.8	1761.3	0.262
1992	6565	3560.5	2526.3	2302.3	0.183
1993	5997	3357.4	2452.1	2230.1	0.207
1994	6961	3288.5	2422.0	2192.2	0.205
1995	8884	3263.2	2254.8	2013.9	0.252
1996	24031	3506.6	2137.5	1883.8	0.309
1997	41061	5048.2	2374.6	2125.9	0.279
1998	29304	6185.8	3254.0	2856.7	0.416
1999	24245	6788.9	3891.4	3444.3	0.367
2000	39821	7433.3	4067.1	3525.4	0.520
2001	60093	9124.1	4556.6	4009.1	0.482
2002	56616	10888.4	5576.7	4847.0	0.479
2003	58136	12250.1	6885.0	6079.8	0.502
2004	34292	10859.4	6920.3	6023.1	0.606
2005	11149	8867.0	6503.9	5657.3	0.544
2006	4916	7470.5	6115.6	5267.6	0.438
2007			4291.1	3657.4	

Table 4.3.4.5. Blue whiting. TISVPA estimates of abundance for the "optimistic" run.

	1	2	3	4	5	6	7	8	9	10+
1981	3684.10	4104.99	4990.41	3302.01	2418.88	2247.35	1977.49	2173.31	1972.84	4983.31
1982	4409.14	2806.44	3057.49	3509.67	2358.65	1493.47	1324.62	1189.58	1204.21	2853.65
1983	16802.08	3451.29	2094.13	2197.99	2418.65	1690.40	956.01	835.90	725.96	1077.65
1984	18858.88	12069.82	2443.16	1448.05	1457.40	1626.05	1113.05	533.49	430.99	713.65
1985	10958.68	13720.57	8065.27	1602.89	906.63	885.34	940.83	690.19	256.06	713.10
1986	8298.41	8033.94	9592.78	4760.60	992.96	543.62	459.60	538.77	408.61	934.64
1987	8475.92	6271.45	5770.42	5905.40	2177.26	501.41	268.88	210.98	259.28	490.86
1988	6936.75	6251.59	4645.02	3851.67	3138.36	996.70	266.63	131.00	82.45	124.93
1989	9187.02	5277.96	4465.12	3216.08	2335.26	1503.97	325.02	136.04	58.17	88.42
1990	20709.78	6810.88	3761.09	2622.68	1969.12	1196.35	616.92	111.04	59.10	207.96
1991	8986.08	15299.97	4896.89	2447.02	1413.40	1154.14	510.42	235.36	19.68	37.04
1992	6564.82	7027.68	11517.87	3512.94	1699.82	867.60	743.64	293.76	133.21	48.70
1993	5997.05	5057.57	5250.17	8015.93	2382.02	1174.46	551.82	505.11	170.16	78.16
1994	6960.56	4704.32	3866.97	3755.66	5262.09	1599.48	786.40	350.10	342.78	132.77
1995	8884.13	5455.66	3702.16	2806.62	2625.12	3318.82	1046.57	504.07	205.03	143.55
1996	24030.81	6909.70	4160.51	2664.58	1843.58	1614.51	1925.47	627.42	282.42	236.78
1997	41060.76	18055.70	5114.27	2884.43	1733.80	1144.46	873.80	977.45	313.04	507.83
1998	29304.08	31426.86	13314.01	3403.72	1887.35	1141.44	672.17	470.73	447.63	180.11
1999	24245.13	22122.20	21967.79	7860.53	1819.81	1139.25	628.60	291.84	162.49	331.83
2000	39820.98	18718.74	16342.04	13334.85	3917.33	1029.76	689.17	364.66	116.20	278.64
2001	60092.98	30165.13	13776.58	10159.84	6639.76	1822.80	416.81	361.96	166.40	144.22
2002	56616.02	45067.63	21152.11	8773.53	5393.17	3255.61	859.66	186.57	189.15	263.08
2003	58135.66	43753.28	32661.17	13419.41	4910.86	2688.56	1231.36	335.81	40.94	571.34
2004	34292.23	44296.48	32304.13	19959.51	7120.98	2483.01	1248.23	564.90	128.84	62.87
2005	11148.89	26252.29	32183.86	20783.15	10194.95	3247.75	1011.62	474.93	166.93	91.83
2006	4915.98	7931.35	19832.77	21174.80	11944.65	4567.08	1308.57	395.74	147.59	801.36
2007	0	3651.2	5643.21	12431.95	11771.09	6310.73	2184	613.33	160.07	59.7

Table 4.3.4.6. Blue whiting. TISVPA estimates of fishing mortality for the "optimistic" run.

	1	2	3	4	5	6	7	8	9	10+
1981	0.0806	0.0984	0.1635	0.1186	0.2882	0.3214	0.3017	0.3892	0.3913	0.3913
1982	0.0378	0.1142	0.1254	0.1894	0.1321	0.2285	0.2509	0.2913	0.3020	0.3020
1983	0.1627	0.2004	0.1537	0.1553	0.1469	0.2216	0.4031	0.4750	0.4194	0.4194
1984	0.1442	0.2401	0.2305	0.2212	0.2435	0.3602	0.3013	0.5105	0.5024	0.5024
1985	0.1411	0.1799	0.3077	0.2344	0.2603	0.5120	0.3594	0.3266	0.5132	0.5132
1986	0.0905	0.1191	0.2415	0.5085	0.5752	0.4783	0.6604	0.5211	0.6360	0.6360
1987	0.1157	0.1074	0.1502	0.4385	0.4597	0.3595	0.5649	1.0337	0.5781	0.5781
1988	0.0701	0.1364	0.1579	0.2181	0.6141	1.1560	0.4280	0.5926	0.5840	0.5840
1989	0.1099	0.1629	0.4030	0.3172	0.5044	0.7345	0.6399	0.5212	0.6443	0.6443
1990	0.0899	0.1211	0.2200	0.3817	0.3451	0.7615	0.7671	1.4976	0.7029	0.7029
1991	0.0334	0.0769	0.1233	0.1464	0.3341	0.2838	0.4227	0.2639	0.3374	0.3374
1992	0.0711	0.1085	0.1714	0.1973	0.1524	0.2184	0.1778	0.3565	0.3086	0.3086
1993	0.0497	0.0690	0.1401	0.2441	0.2118	0.1984	0.2412	0.1529	0.2843	0.2843
1994	0.0500	0.0257	0.1111	0.1217	0.2966	0.2160	0.2810	0.3360	0.2940	0.2940
1995	0.0375	0.0744	0.1345	0.2024	0.3002	0.3099	0.3120	0.4313	0.3883	0.3883
1996	0.0911	0.0893	0.1839	0.2521	0.2154	0.4164	0.4790	0.5266	0.4862	0.4862
1997	0.0591	0.0976	0.2174	0.2502	0.2089	0.2783	0.4413	0.6163	0.4592	0.4592
1998	0.0645	0.1590	0.3481	0.4144	0.2545	0.3748	0.6899	0.9677	0.7437	0.7437
1999	0.0366	0.0806	0.3465	0.6666	0.2886	0.2244	0.3090	0.8670	0.6310	0.6310
2000	0.0517	0.0730	0.2671	0.5372	0.5750	0.8014	0.4181	0.6140	0.8085	0.8085
2001	0.0837	0.1796	0.2713	0.5346	0.5649	0.4387	0.5993	0.3514	0.7111	0.7111
2002	0.0362	0.0826	0.1887	0.3320	0.4681	0.8190	0.5848	9.3848	0.9149	0.9149
2003	0.0738	0.1086	0.3334	0.5064	0.6125	0.6148	0.4447	0.5095	0.7588	0.7588
2004	0.0715	0.1161	0.2593	0.4592	0.6333	0.8302	0.8469	0.6613	1.0261	1.0261
2005	0.1526	0.0661	0.1919	0.3743	0.6586	0.6595	0.8352	0.8684	1.0928	1.0928
2006	0.0974	0.1404	0.2671	0.3872	0.4380	0.5377	0.5578	0.7052	0.7052	0.7052

Table 4.3.5.1. Blue whiting. Stock Summary from the final ICA Run 2007.

Year	Recruits Age 1 (000's)	Total Biomass (t)	Spawning Biomass (t)	Landings (t)	Yield /SSB ratio	Mean F Ages 3–7	SoP (%)
1981	3632280	5344954	4315342	907732	0.2103	0.2113	98
1982	4583990	3836494	3036528	513203	0.169	0.1669	93
1983	16821290	3274267	2051765	561332	0.2736	0.1947	101
1984	19695420	3189272	1709277	626592	0.3666	0.2455	101
1985	11147100	3404444	1969377	676812	0.3437	0.3087	99
1986	9915570	3630813	2294984	801786	0.3494	0.4572	94
1987	9372680	3257951	1950491	656588	0.3366	0.3763	100
1988	7809840	2804377	1661744	552020	0.3322	0.4599	99
1989	9990850	2882829	1616856	598147	0.3699	0.4679	94
1990	21875800	3186835	1601641	558788	0.3489	0.3922	100
1991	9535450	3846020	2088766	363724	0.1741	0.1954	99
1992	6627620	4048647	2698846	473789	0.1756	0.1466	99
1993	5938080	3763970	2582861	475143	0.184	0.1706	99
1994	6736850	3633819	2519969	458028	0.1818	0.1728	100
1995	8681920	3481072	2243076	505938	0.2256	0.2232	100
1996	23092330	3684510	2094087	629286	0.3005	0.2777	101
1997	41000010	5145849	2261667	640089	0.283	0.2574	100
1998	29976370	6259707	2906203	1123732	0.3867	0.396	99
1999	23127680	6815414	3535271	1251463	0.354	0.3583	99
2000	43318490	7878204	3781631	1409143	0.3726	0.4555	99
2001	66028790	9870308	4265616	1775305	0.4162	0.4775	100
2002	49122050	*******	5300874	1556955	0.2937	0.4864	100
2003	53487280	*******	6282427	2321407	0.3695	0.4224	98
2004	38252740	*******	6084402	2377568	0.3908	0.51	99
2005	29490740	9559663	5675975	1996530	0.3518	0.4377	98
2006	1916540	8029891	5400071	1966139	0.3641	0.4055	101

Table 4.3.6.1. Blue whiting SMS data exploration. SMS diagnostics output from the final run.

```
objective function (negative log likelihood):  -190.556

objective function weight:
                          Catch  CPUE   S/R
                             1     1   0.01

unweighted objective function contributions (total):
               Catch    CPUE     S/R       Sum
             -174.3   -16.3      8.5      -182.1


unweighted objective function contributions (per observation):
                Catch   CPUE    S/R
              -0.67   -0.15    0.33


contribution by fleet:
----------------------
Norw. Spawning Stock Surv.  total:  -1.865   mean:  -0.026
Intl. Surv. in Nord. Seas.  total:   2.523   mean:   0.168
IBWSSS                      total: -16.989   mean:  -0.708


F, Year effect:
---------------
         sp. 1
1981:    1.000
1982:    0.807
1983:    0.928
1984:    1.213
1985:    1.354
1986:    1.780
1987:    1.358
1988:    1.344
1989:    1.791
1990:    1.736
1991:    0.855
1992:    0.761
1993:    1.000
1994:    0.885
1995:    1.174
1996:    1.567
1997:    1.549
1998:    2.141
1999:    1.858
2000:    2.335
2001:    2.067
2002:    1.946
2003:    2.236
2004:    2.484
2005:    2.153
2006:    2.049

F, age effect:
--------------
                1     2     3     4     5     6     7   8-10
1981-1992:   0.074 0.112 0.166 0.214 0.261 0.347 0.428 0.438
1993-2006:   0.037 0.051 0.133 0.209 0.231 0.261 0.270 0.299


Exploitation pattern (scaled to mean F=1)
-----------------------------------------
                1      2      3      4      5      6      7   8-10
1981-1992:  0.261  0.397  0.587  0.756  0.921  1.224  1.512  1.546
1993-2006:  0.169  0.230  0.603  0.946  1.046  1.184  1.221  1.355


sqrt(catch variance) ~ CV:
--------------------------

 1       0.431
 2       0.361
```

```
 3       0.173
 4       0.173
 5       0.173
 6       0.173
 7       0.494
 8       0.494
 9       0.494
10       0.494


Survey catchability:
--------------------          age 1    age 2    age 3    age 4    age 5-8
 Norw. Spawning Stock Surv.                     1.723    2.228    1.264
 Intl. Surv. in Nord. Seas.   0.819    0.561
 IBWSSS                                         1.166    2.130    2.281

sqrt(Survey variance) ~ CV:
---------------------------   age 1    age 2    age 3    age 4    age 5-8
 Norw. Spawning Stock Surv.                      0.43     0.43     0.67
 Intl. Surv. in Nord. Seas.    0.85     0.62
 IBWSSS                                          0.40     0.40     0.40
```

Table 4.3.6.2. Blue whiting SMS data exploration. Fishing mortality estimated by SMS final run.

Age	1981	1982	1983	1984	1985	1986	1987	1988
1	0.074	0.060	0.069	0.090	0.100	0.132	0.101	0.099
2	0.113	0.091	0.104	0.136	0.152	0.200	0.153	0.151
3	0.166	0.134	0.154	0.202	0.225	0.296	0.226	0.223
4	0.214	0.173	0.199	0.260	0.290	0.381	0.291	0.288
5	0.261	0.210	0.242	0.316	0.353	0.464	0.354	0.351
6	0.347	0.280	0.322	0.420	0.469	0.617	0.471	0.466
7	0.428	0.345	0.398	0.519	0.580	0.762	0.582	0.575
8	0.438	0.353	0.406	0.531	0.593	0.779	0.594	0.588
9	0.438	0.353	0.406	0.531	0.593	0.779	0.594	0.588
10	0.438	0.353	0.406	0.531	0.593	0.779	0.594	0.588
Avg.F(3-7)	0.283	0.228	0.263	0.343	0.383	0.504	0.385	0.381

Age	1989	1990	1991	1992	1993	1994	1995	1996
1	0.133	0.128	0.063	0.056	0.037	0.033	0.044	0.058
2	0.202	0.195	0.096	0.086	0.051	0.045	0.060	0.080
3	0.298	0.289	0.142	0.127	0.133	0.118	0.157	0.209
4	0.383	0.372	0.183	0.163	0.209	0.185	0.245	0.327
5	0.467	0.453	0.223	0.199	0.231	0.204	0.271	0.362
6	0.621	0.602	0.296	0.264	0.262	0.231	0.307	0.410
7	0.767	0.743	0.366	0.326	0.270	0.239	0.317	0.423
8	0.784	0.760	0.374	0.333	0.299	0.265	0.351	0.469
9	0.784	0.760	0.374	0.333	0.299	0.265	0.351	0.469
10	0.784	0.760	0.374	0.333	0.299	0.265	0.351	0.469
Avg.F(3-7)	0.507	0.492	0.242	0.215	0.221	0.195	0.259	0.346

Age	1997	1998	1999	2000	2001	2002	2003	2004
1	0.058	0.080	0.069	0.087	0.077	0.073	0.083	0.093
2	0.079	0.109	0.095	0.119	0.105	0.099	0.114	0.126
3	0.206	0.285	0.248	0.311	0.275	0.259	0.298	0.331
4	0.324	0.447	0.388	0.488	0.432	0.406	0.467	0.519
5	0.358	0.494	0.429	0.539	0.478	0.449	0.516	0.574
6	0.405	0.560	0.486	0.611	0.541	0.509	0.585	0.650
7	0.418	0.577	0.501	0.630	0.558	0.525	0.603	0.670
8	0.463	0.640	0.556	0.699	0.619	0.582	0.669	0.743
9	0.463	0.640	0.556	0.699	0.619	0.582	0.669	0.743
10	0.463	0.640	0.556	0.699	0.619	0.582	0.669	0.743
Avg.F(3-7)	0.342	0.473	0.410	0.516	0.457	0.430	0.494	0.549

Age	2005	2006
1	0.080	0.076
2	0.110	0.104
3	0.287	0.273
4	0.450	0.428
5	0.497	0.473
6	0.563	0.536
7	0.581	0.553
8	0.644	0.613
9	0.644	0.613
10	0.644	0.613
Avg.F(3-7)	0.475	0.453

Table 4.3.6.3. Blue whiting SMS data exploration run. Stock numbers from the SMS final run in thousands.

Age	1981	1982	1983	1984	1985	1986	1987	1988
1	3308512	4139149	14997222	18577992	10686679	8611111	9000322	6783949
2	3809866	2515606	3192542	11463559	13905011	7915436	6180108	6664551
3	4551537	2787417	1880980	2354634	8188733	9776102	5304549	4343193
4	2445472	3155780	1995793	1319768	1575831	5353053	5953606	3465496
5	2310300	1616471	2174150	1339582	833539	965618	2994232	3645281
6	2145588	1457189	1072336	1397147	799297	479353	496874	1720261
7	1835798	1242105	902083	636373	751314	409276	211740	254095
8	1762610	979457	719938	496263	309953	344449	156333	96921
9	1490513	931556	563390	392596	238954	140293	129373	70646
10	3097742	2424936	1930675	1360063	843917	490137	236786	165465
TSB	3416870	2826457	2823882	2916411	3147440	3258423	2959589	2642113
SSB	2938714	2394968	1947816	1707159	1980242	2297635	2006746	1817486

Age	1989	1990	1991	1992	1993	1994	1995	1996
1	9462018	24242833	8394020	5485551	5218745	5681802	8227983	23058221
2	5028631	6785260	17455918	6451240	4245351	4116558	4501080	6448232
3	4691099	3365774	4569857	12981485	4848601	3303388	3221993	3471433
4	2844113	2851631	2064882	3245852	9365613	3474551	2403836	2255875
5	2128287	1587107	1610243	1407953	2258174	6222644	2364738	1540009
6	2102044	1091998	826156	1054827	945208	1467579	4153074	1476160
7	884040	924977	489817	502945	663420	595812	953370	2501179
8	117014	336090	360078	278090	297272	414766	384249	568653
9	44070	43738	128703	202786	163190	180456	260605	221395
10	107359	56602	38425	94122	174232	204829	242081	289635
TSB	2656130	2947954	3480911	3550335	3322396	3145332	3114031	3353885
SSB	1735503	1546719	1954965	2575723	2489048	2382635	2208657	2067173

Age	1997	1998	1999	2000	2001	2002	2003	2004
1	43276240	28408399	23710748	39719997	61664776	51954453	48896185	35328274
2	17808078	33445775	21476717	18115264	29811549	46745633	39563529	36834177
3	4874715	13475230	24557559	15998033	13170154	21970722	34664901	28908663
4	2306537	3246953	8295144	15698270	9596220	8186720	13880504	21069293
5	1331335	1366526	1700039	4607687	7892092	5101716	4464420	7123977
6	877924	762227	682437	906350	2199982	4008408	2665034	2180860
7	802194	479416	356566	343768	402961	1049009	1973118	1215931
8	1341837	432525	220360	176895	149935	188907	508183	883859
9	291301	691207	186653	103499	72022	66134	86414	213123
10	261783	284905	421234	285513	158385	101630	76743	68425
TSB	4932011	6175989	6844143	7572783	9218616	10811132	11708107	10247180
SSB	2198366	3206237	3965308	4202746	4598276	5641212	6897723	6606022

Age	2005	2006	2007
1	22162109	2901353*	NA
2	26368420	16746768	2200900**
3	26576617	19348761	12353500
4	16999135	16333062	12056500
5	10267246	8877306	8716170
6	3286173	5112708	4527690
7	932497	1532262	2449440
8	509409	427179	721837
9	344148	219015	189447
10	109626	195095	183651
TSB	8504059	7014875	
SSB	5890104	5475018	

* substituted by 11670000 in prediction
** substituted by 8850000 in prediction

Table 4.3.6.4. Blue whiting SMS data exploration. Stock summary 1981–2007 estimated by final SMS run. SSB in 2007 does not include contributions from age 1.

Year	Recruits (1000)	SSB (tonnes)	TSB (tonnes)	SOP (tonnes)	mean-F age 3-7
1981	3308512	2938714	3416870	922980	0.283
1982	4139149	2394968	2826457	550643	0.228
1983	14997222	1947816	2823882	553344	0.263
1984	18577992	1707159	2916411	615569	0.343
1985	10686679	1980242	3147440	678214	0.383
1986	8611111	2297635	3258423	847145	0.504
1987	9000322	2006746	2959589	654718	0.385
1988	6783949	1817486	2642113	552264	0.381
1989	9462018	1735503	2656130	630316	0.507
1990	24242833	1546719	2947954	558128	0.492
1991	8394020	1954965	3480911	364008	0.242
1992	5485551	2575723	3550335	474592	0.215
1993	5218745	2489048	3322396	475198	0.221
1994	5681802	2382635	3145332	457696	0.195
1995	8227983	2208657	3114031	505176	0.259
1996	23058221	2067173	3353885	621104	0.346
1997	43276240	2198366	4932011	639681	0.342
1998	28408399	3206237	6175989	1131955	0.473
1999	23710748	3965308	6844143	1261033	0.410
2000	39719997	4202746	7572783	1412449	0.516
2001	61664776	4598276	9218616	1771805	0.457
2002	51954453	5641212	10811132	1556955	0.430
2003	48896185	6897723	11708107	2365319	0.494
2004	35328274	6606022	10247180	2400795	0.549
2005	22162109	5890104	8504059	2018344	0.475
2006	2901353*	5475018	7014875	1956239	0.453
2007		4245452			

Arith Mean 20840000
Geo Mean 14800000

* substituted by 11.67 billions in forecast

Table 4.7.1.1. Blue Whiting. Input to short term projection.

Age	Weight in the stock (kg)	Weight in the catch (kg)	Proportion Mature	F	Stock Numbers 2007 (thousands)
1	0.043	0.043	0.11	0.083	4840000
2	0.069	0.069	0.40	0.113	8850000
3	0.087	0.087	0.82	0.297	12353500
4	0.102	0.102	0.86	0.466	12056500
5	0.119	0.119	0.91	0.515	8716170
6	0.140	0.140	0.94	0.583	4527690
7	0.160	0.160	1	0.601	2449440
8	0.176	0.176	1	0.667	721837
9	0.205	0.205	1	0.667	189447
10+	0.297	0.297	1	0.667	183651

Table 4.7.1.2. Blue Whiting. Short term projection results.

2007 Biomass	SSB	FMult	FBar	Landings
5413164	**4363782**	**1.123**	**0.553**	**1800000**

2008 Biomass	SSB	FMult	FBar	Landings	2009 Biomass	SSB
4032647	3012851	0.00	0.00	0	4719614	3424512
.	.	0.10	0.05	145896	4564791	3281443
.	.	0.20	0.10	284908	4417434	3145503
.	.	0.30	0.15	417389	4277155	3016317
.	.	0.40	0.20	543675	4143584	2893528
.	.	0.50	0.25	664082	4016373	2776800
.	.	0.60	0.30	778910	3895193	2665815
.	**.**	**0.66**	**0.32**	**845249**	**3825248**	**2601855**
.	.	0.70	0.34	888445	3779730	2560272
.	.	0.80	0.39	992954	3669691	2459886
.	.	0.90	0.44	1092693	3564795	2364389
.	.	1.00	0.49	1187903	3464779	2273525
.	.	1.04	0.51	1222029	3428959	2241030
.	.	1.10	0.54	1278813	3369391	2187053
.	.	1.20	0.59	1365638	3278395	2104745
.	.	1.30	0.64	1448585	3191567	2026386
.	.	1.40	0.69	1527847	3108694	1951772
.	.	1.50	0.74	1603608	3029575	1880708
.	.	1.60	0.79	1676043	2954020	1813013
.	.	1.70	0.84	1745316	2881849	1748513
.	.	1.80	0.89	1811585	2812890	1687044
.	.	1.90	0.94	1874998	2746983	1628452
.	.	2.00	0.98	1935695	2683974	1572588

Input units are thousands and kg - output in tonnes

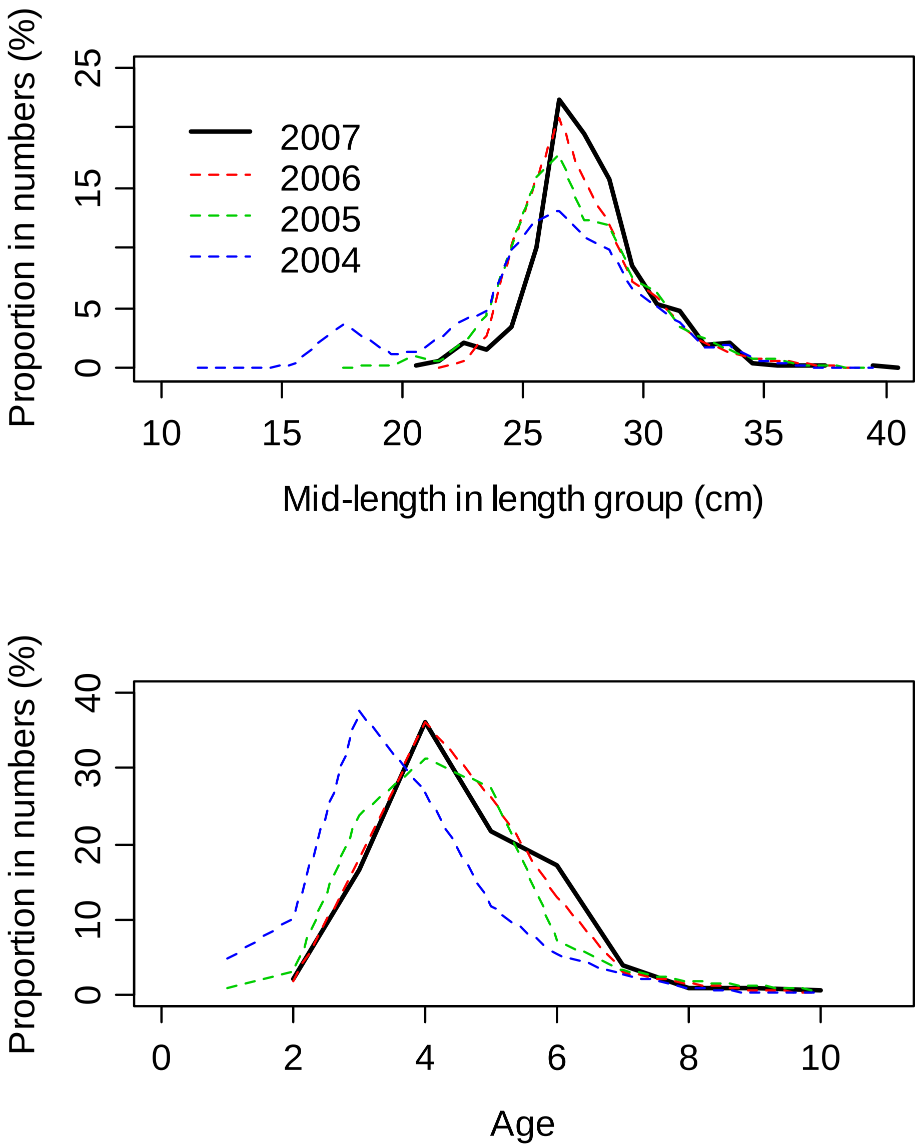


Figure 4.1.5.7.1. Blue whiting. Length and age distributions from sampled Norwegian commercial trawl catches on theblue whiting spawning grounds (west of 4°W) in February-March.

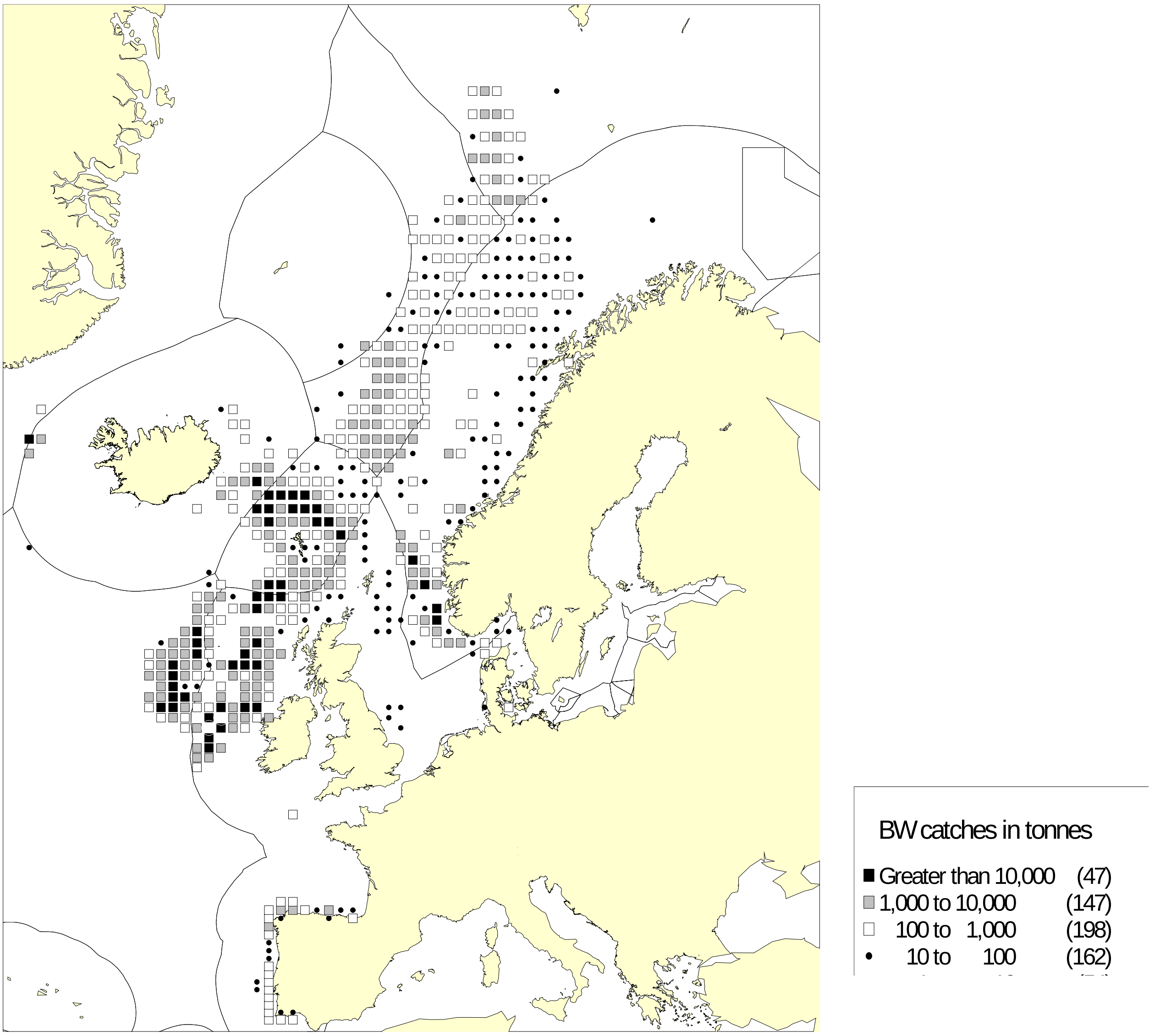
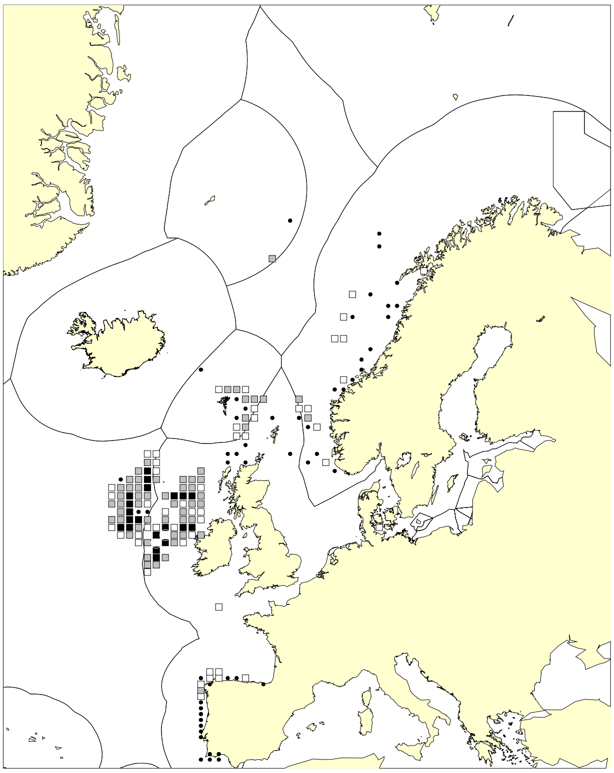
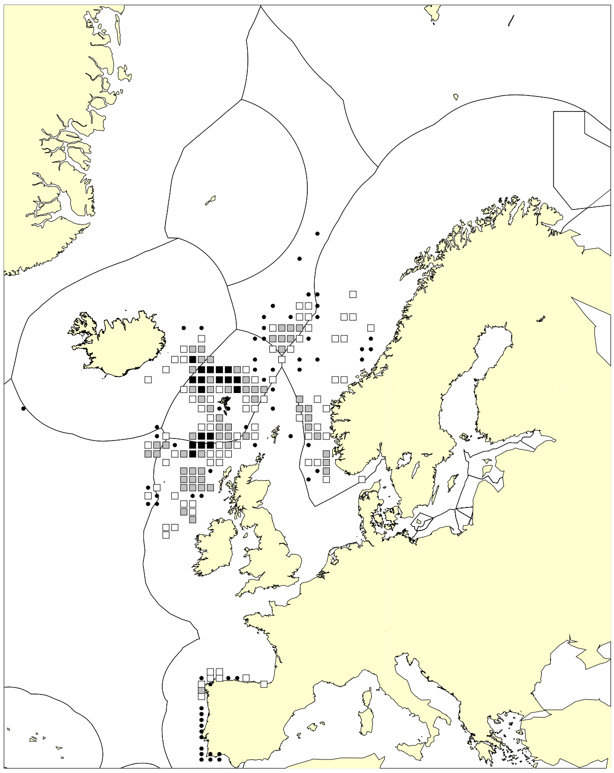


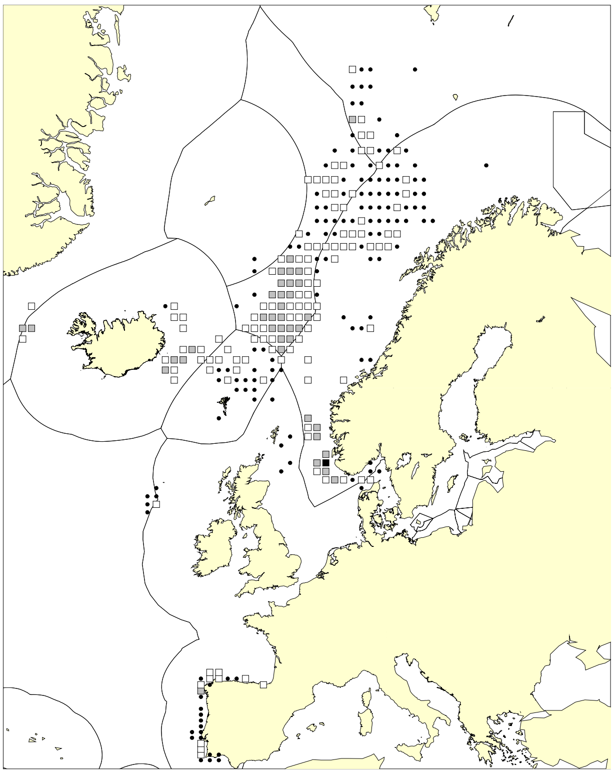
Figure 4.2.1.1. Blue whiting. Total catches in 2006 by ICES rectangle. Grading of the symbols: small dots 10–100 t, white squares 100–1000 t, grey squares 1000–10 000 t, and black squares > 10 000 t. Catches below 10 t are not shown on the map.



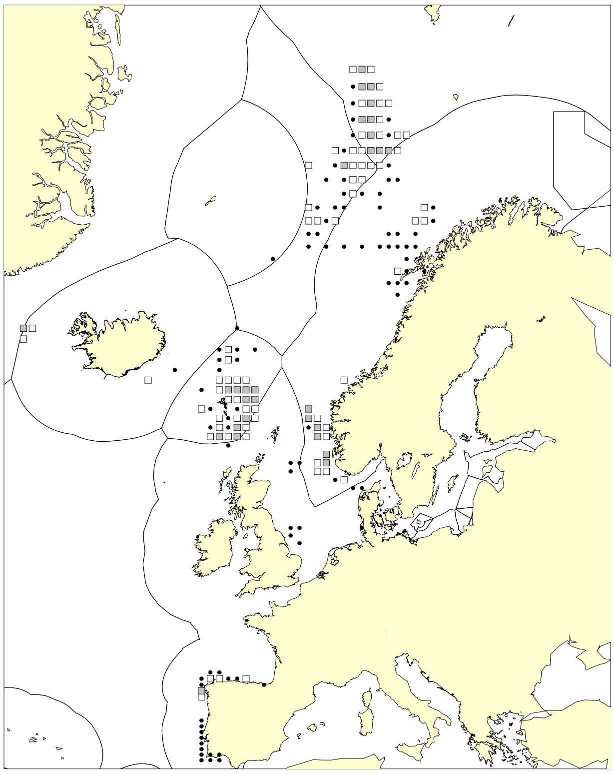
Quarter 1



Quarter 2



Quarter 3



Quarter 4

Figure 4.2.1.2. Blue whiting.Total catches in 2006 by quarter and ICES rectangle. Grading of the symbols: small dots 10–100 t, white squares 100–1000 t, grey squares 1000–10 000 t, and black squares > 10 000 t. Catches below 10 t are not shown on the map.

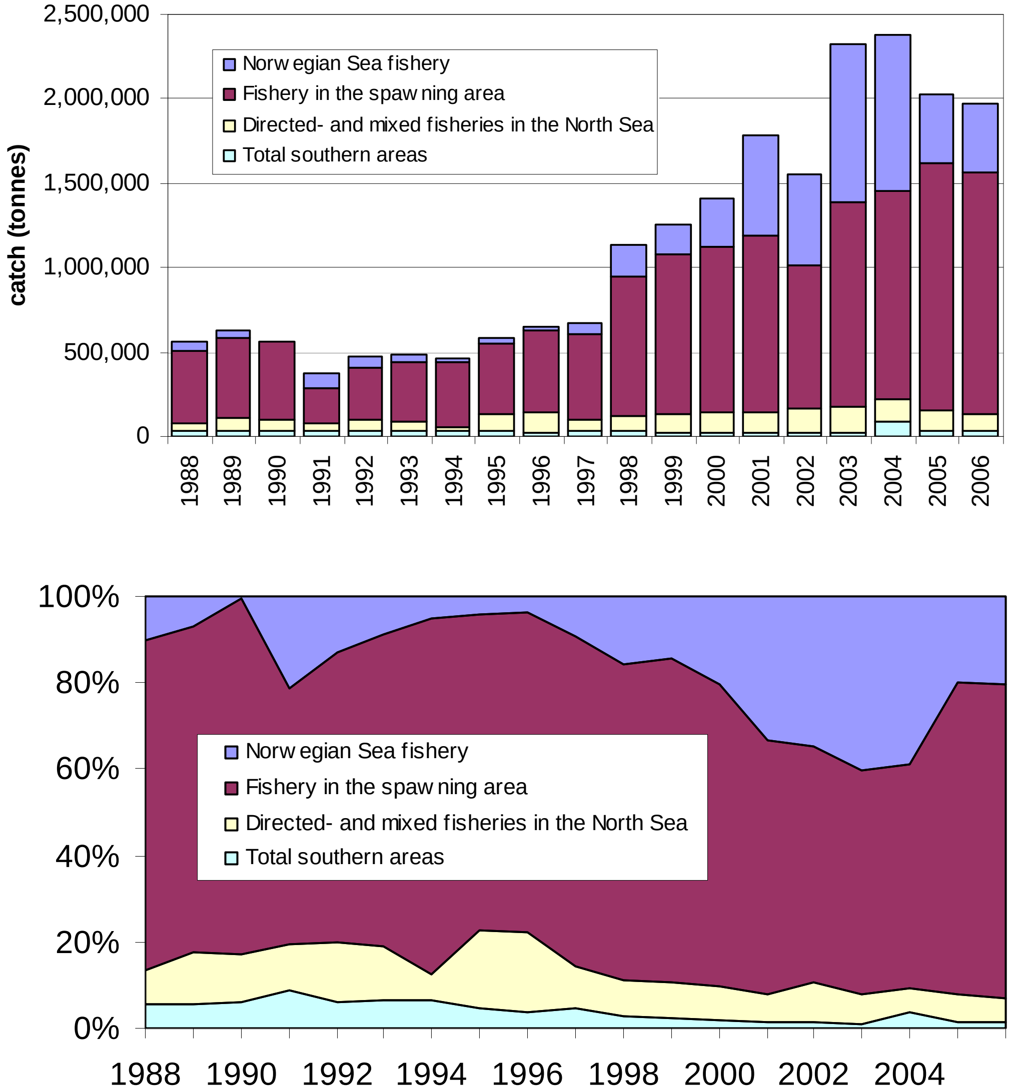


Figure 4.2.1.3. Blue whiting. Development of blue whiting fisheries in different sub-areas in terms of absolute (top) and relative catches.

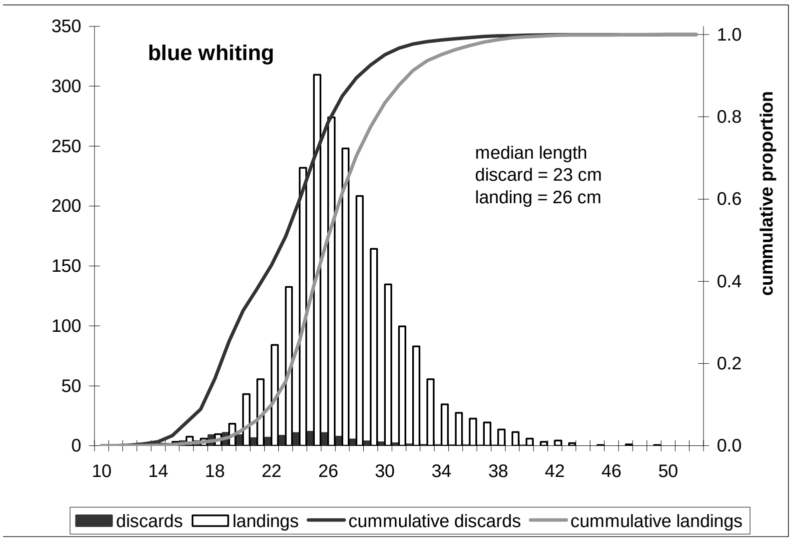


Figure 4.2.1.4. Blue whiting. Average length distribution of landings and discards in the Dutch pelagic fleet in the period 2002–2005.

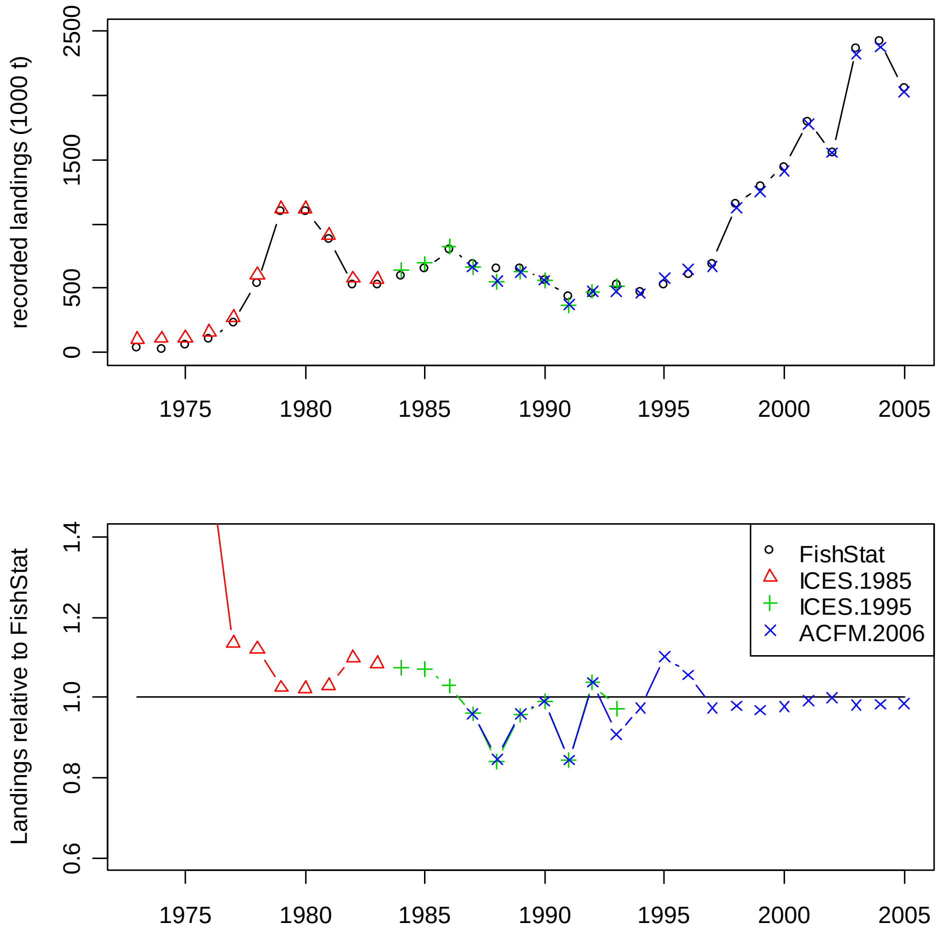


Figure 4.2.1.1.2. Blue whiting. Recorded landings by various WG overlaid by FistSta estimates of landing (upper panel) and WG landings relative FishStat (lowe panel).

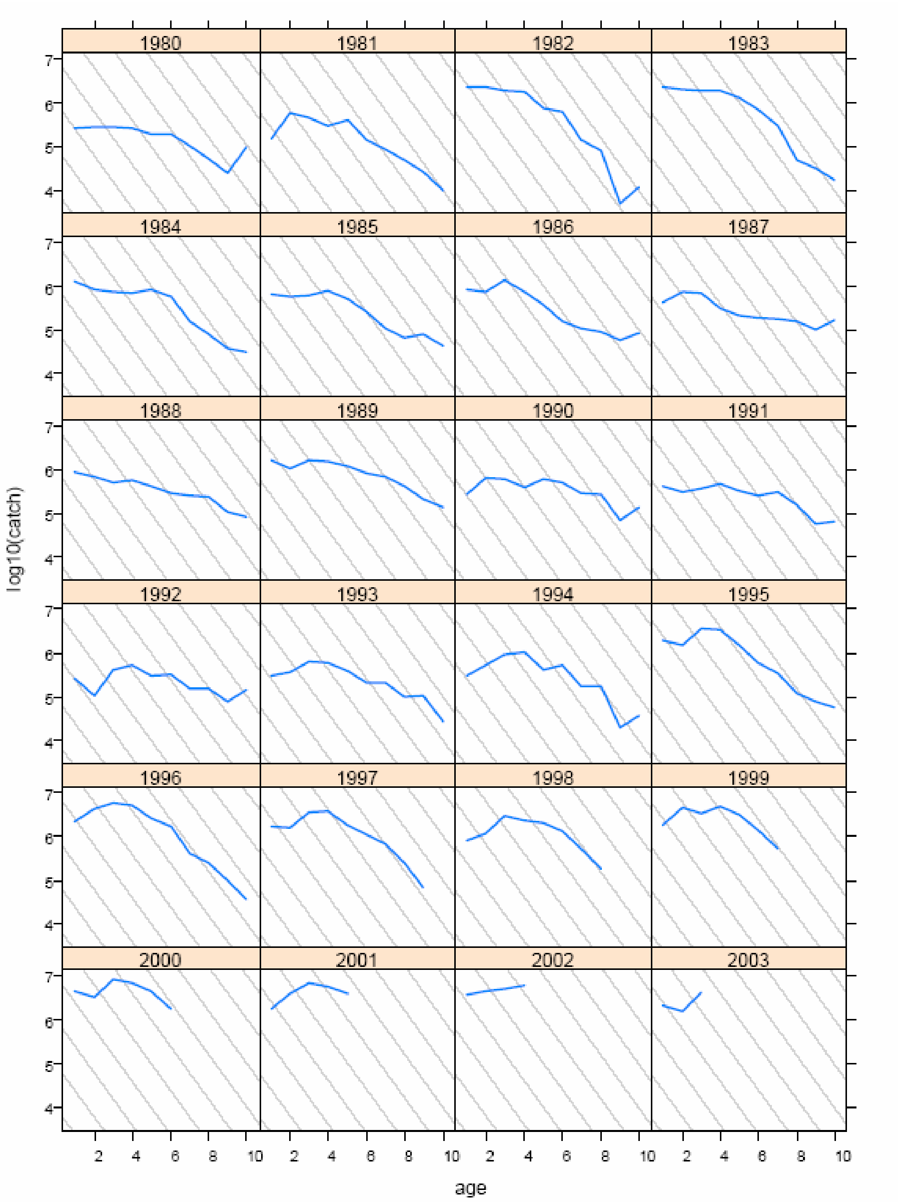


Figure 4.2.2.1. Blue whiting. Age disaggregated catch in numbers plotted on log scale. The labels behind each panel indicate year classes. The grey lines correspond to Z=0.6.

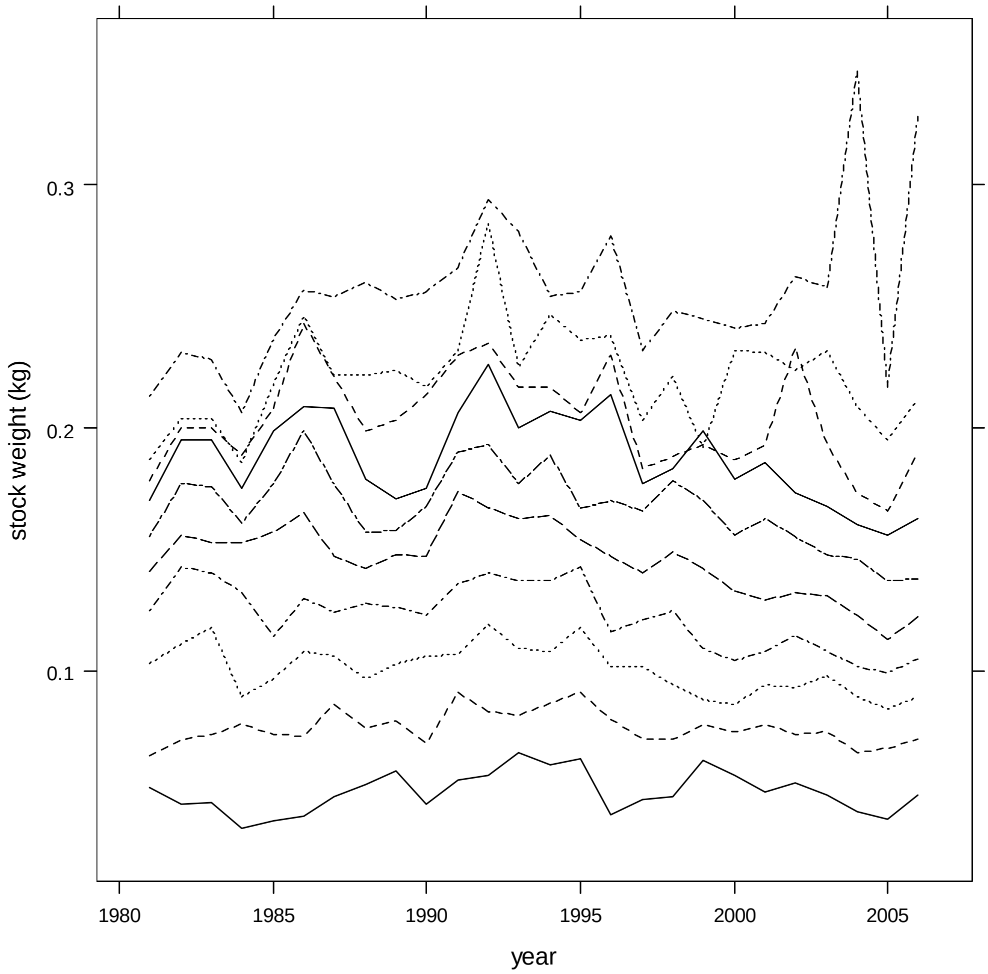


Figure 4.2.3.1. Blue whiting. Mean weight-at-age for the total catch during 1982–2006.

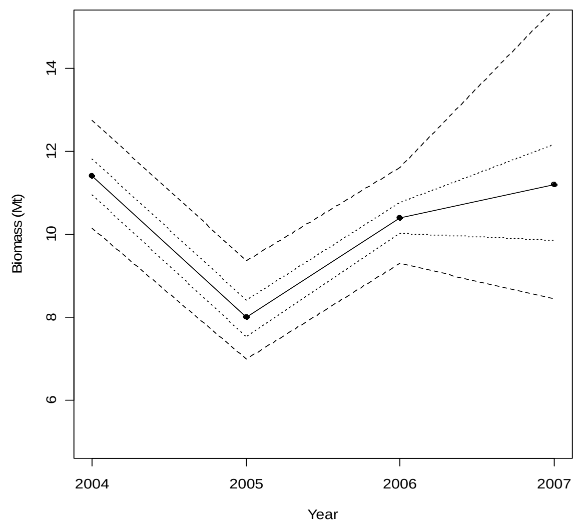
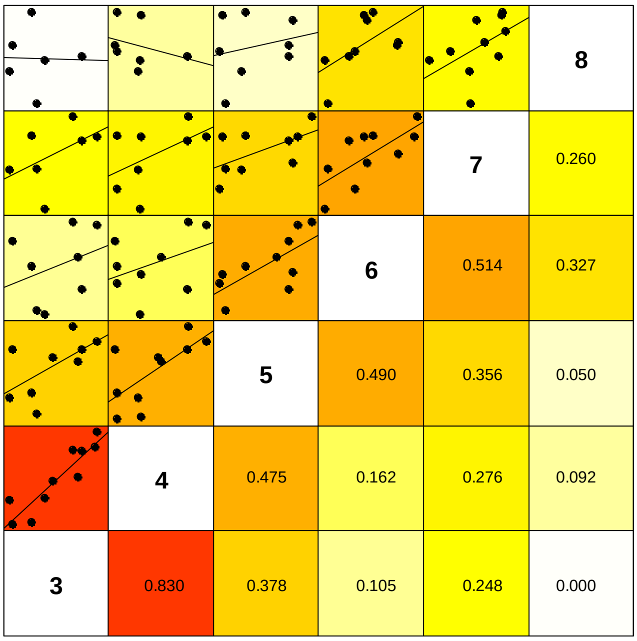


Figure 4.2.5.1. Blue whiting. Approximate 50% and 95% confidence limits for total blue whiting biomass based on variability in mean acoustic density.

Norwegian spawning stock survey.



International blue whiting spawning stock survey

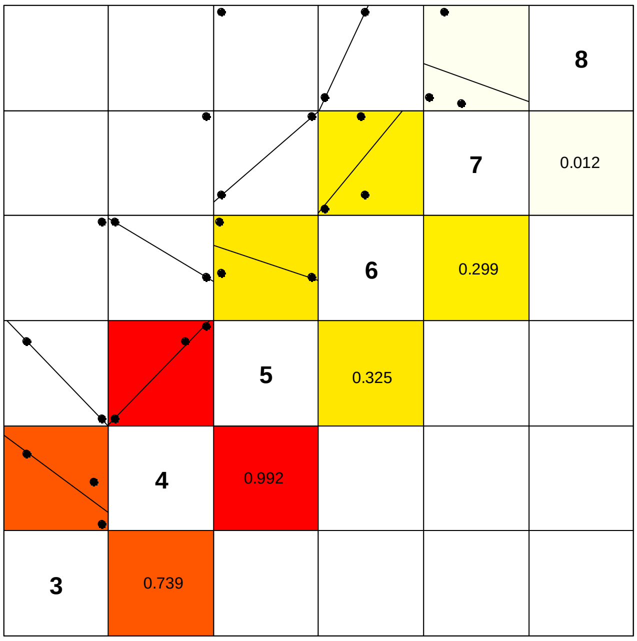


Figure 4.2.5.2. Blue whiting. Internal consistency within the Norwegian spawning stock survey (top panel) and the International blue whiting spawning stock survey (bottom panel). The upper left part of the plots shows the relationship between log index-at-age within a cohort. Linear regression line shows the best fit to the log-transformed indices. The ages plotted on the x- and y- axes of each panel can be found by moving either vertically (for the x-axis) or horizontally (y-axis) to the main diagonal. The lower-right part of the plots shows the regression coefficient (r^2) for the two ages plotted in that panel. The background color of each panel is determined by the r^2 value, where red equates to r^2=1 and white to r^2=0.

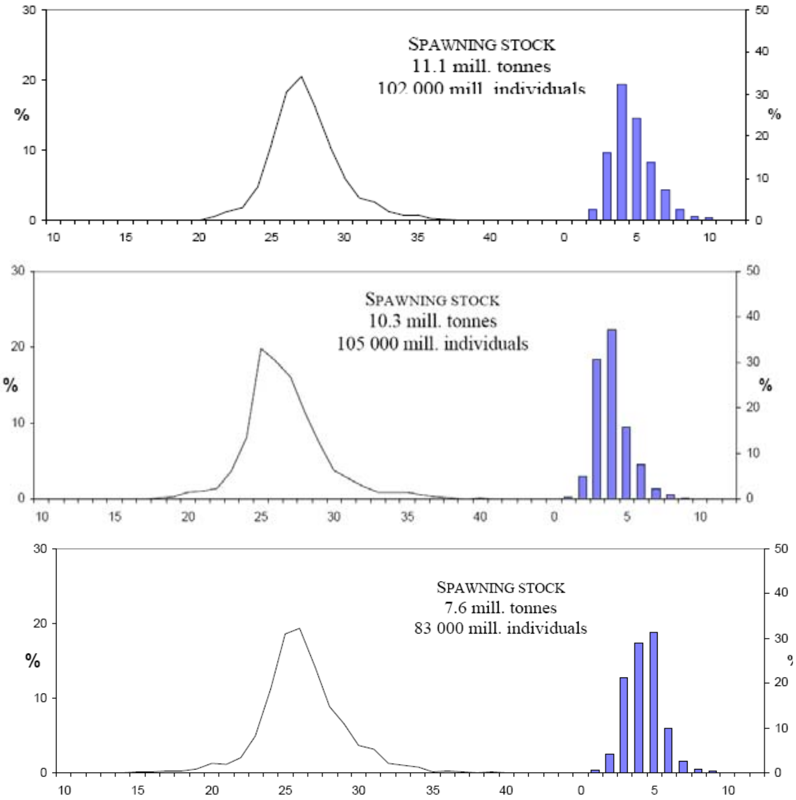


Figure 4.2.5.4. Blue whiting. Length and age distribution in the total and spawning stock of blue whiting in the area to the west of the British Isles, spring 2007 (upper panel), 2006 (middle panel) and 2005 (lower panel).

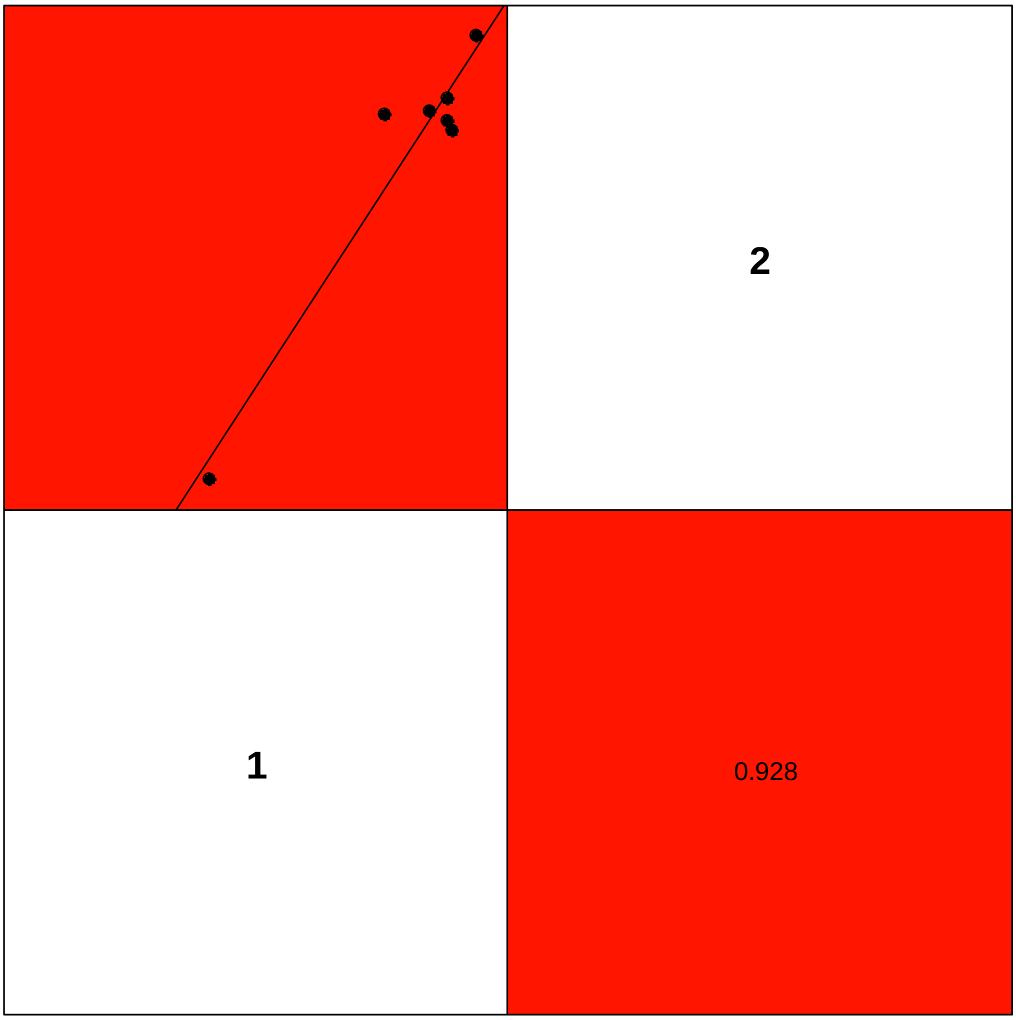


Figure 4.2.5.6. Blue whiting. Internal consistency plot for the International ecosystem survey in the Nordic seas. The upper left part of the plots shows the relationship between log index-at-age within a cohort. Linear regression line shows the best fit to the log-transformed indices. The lower-right part of the plots shows the regression coefficient (r^2) for the two ages plotted in that panel. The background color of each panel is determined by the r^2 value, where red equates to r^2=1 and white to r^2=0.

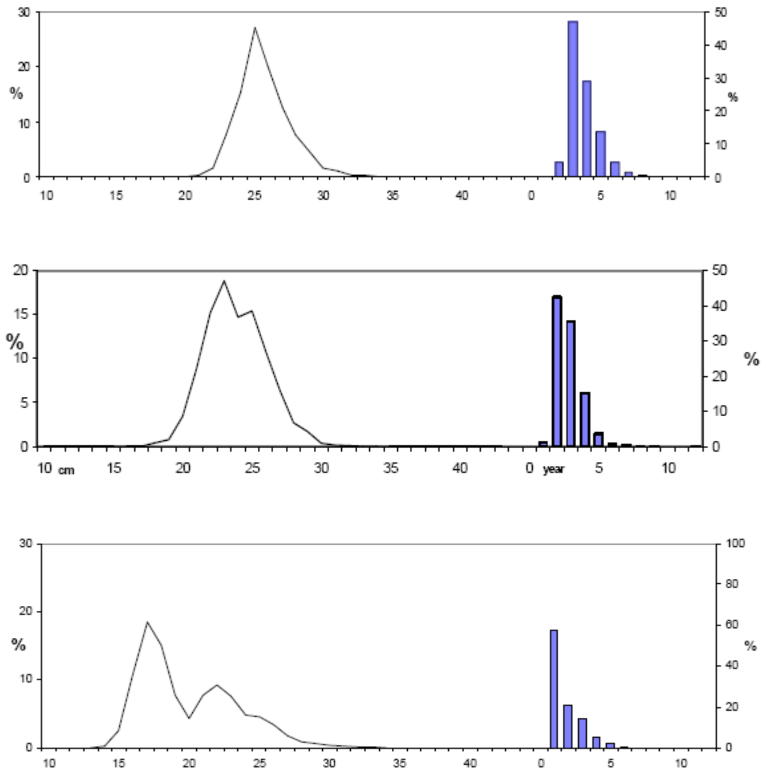


Figure 4.2.5.8. Blue whiting. Length and age distribution of blue whiting in the standard area in the Norwegian Sea, spring 2007 (upper panel), 2006 (middle panel) and 2005 (lower panel).

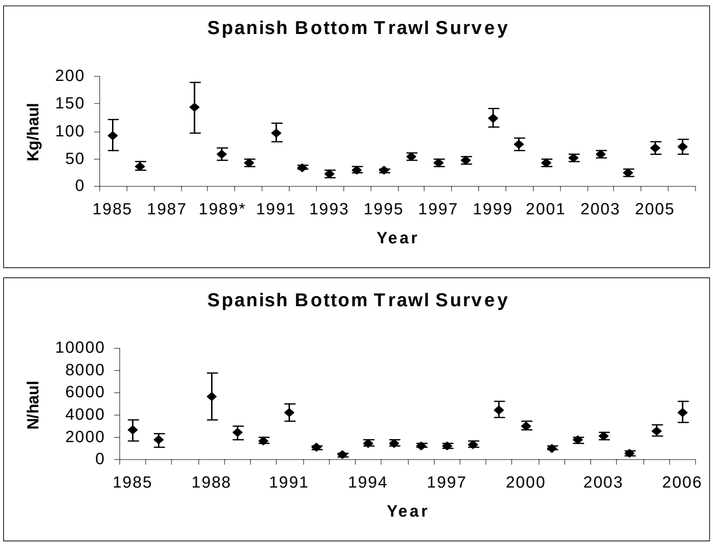


Figure 4.2.5.9. Blue whiting mean catch rates (Kg/haul and Number/haul) in Spanish bottom trawl survey.

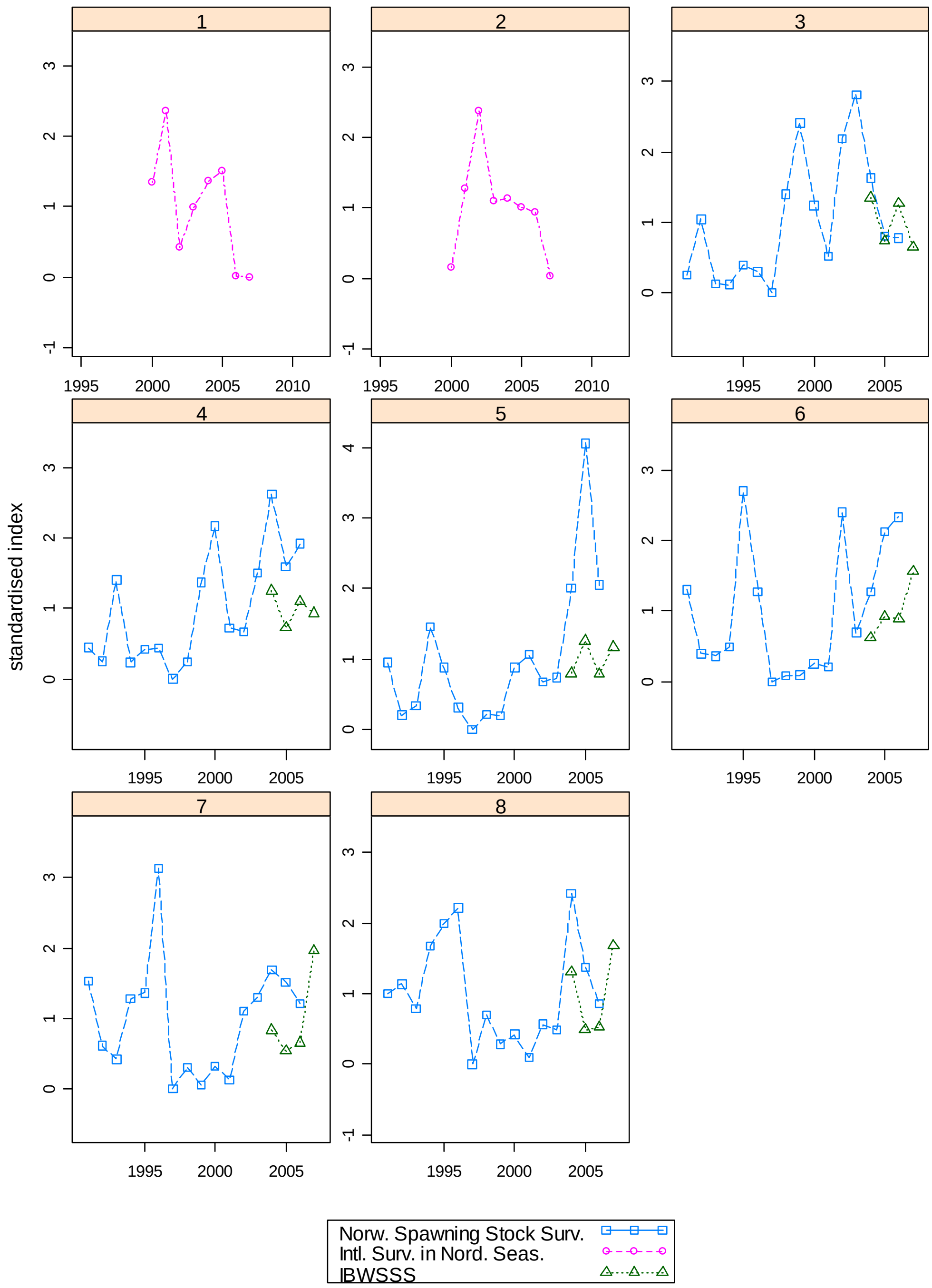


Figure 4.3.2.2. Blue Whiting. Standardised survey indices used for exploratory runs for each age.

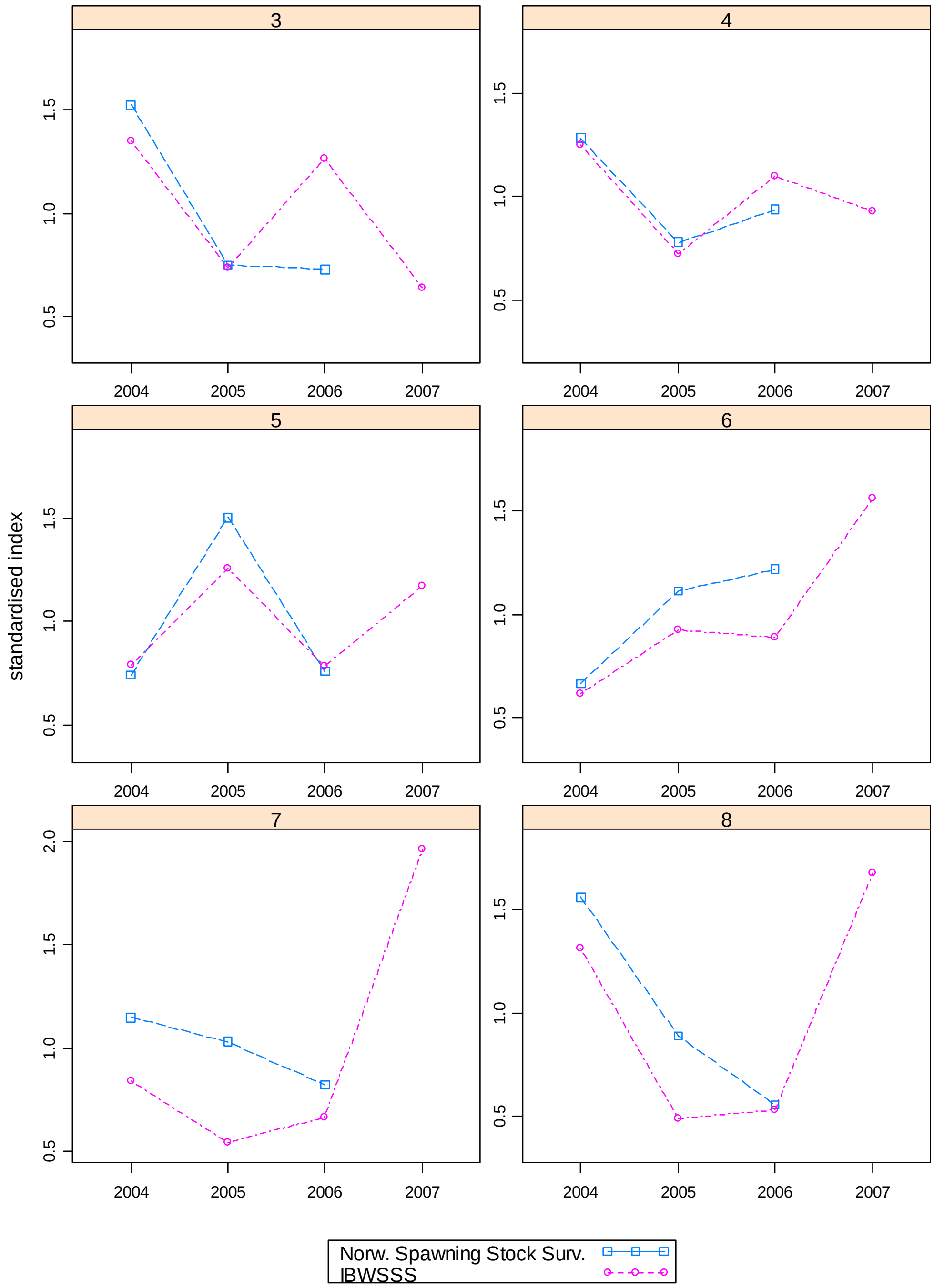


Figure 4.3.2.3. Blue Whiting. Standardised survey indices used for exploratory runs.

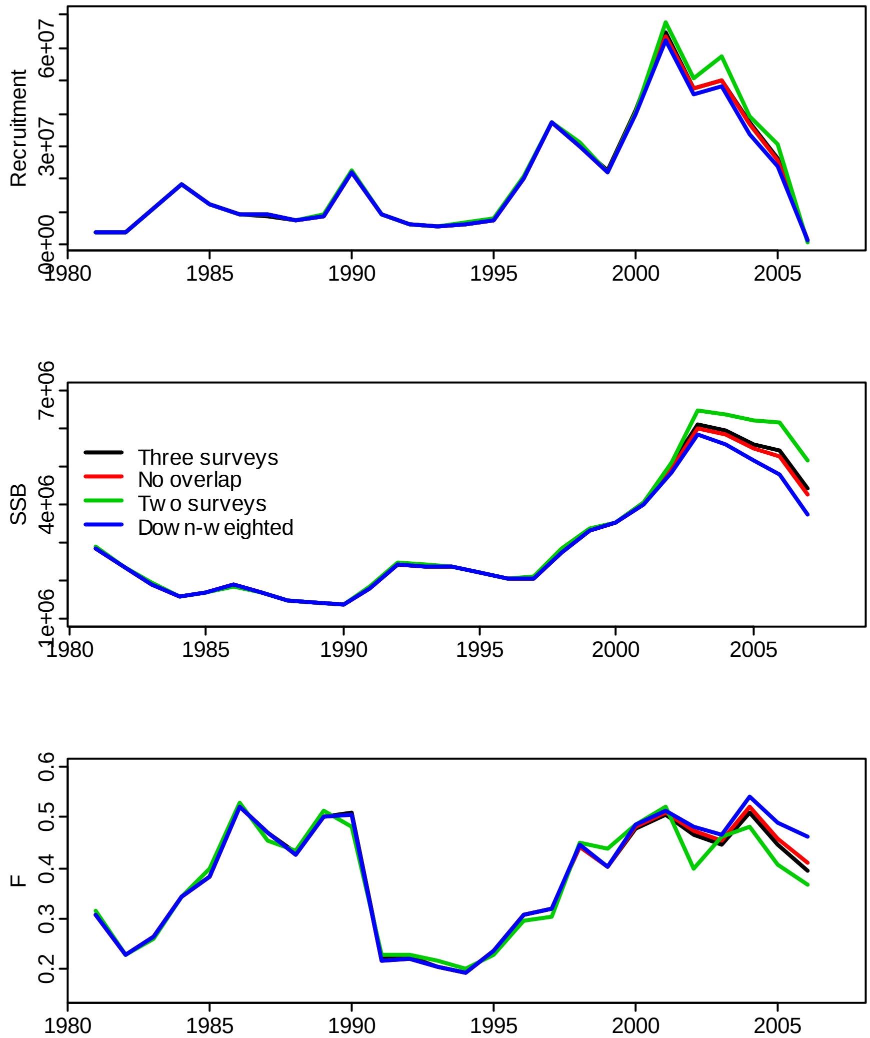


Figure 4.3.3.1. Blue whiting. AMCI data exploration. Recruitment (top panel), SSB (middle panel) and fishing mortality (ages 3–7; bottom panel) for the four scenarios.

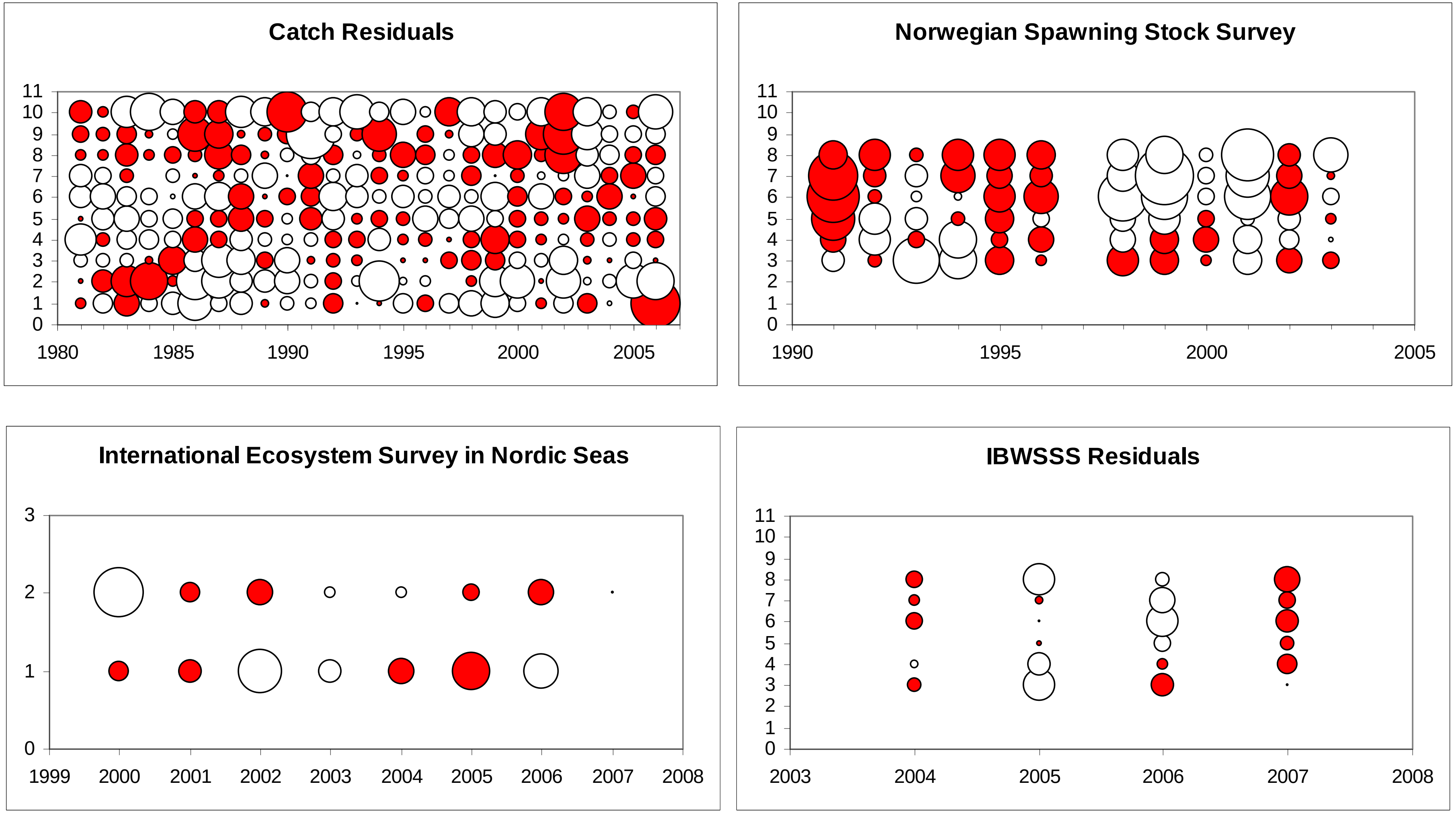


Figure 4.3.3.2. Blue whiting. AMCI final run. Catch and Survey Residual Patterns.

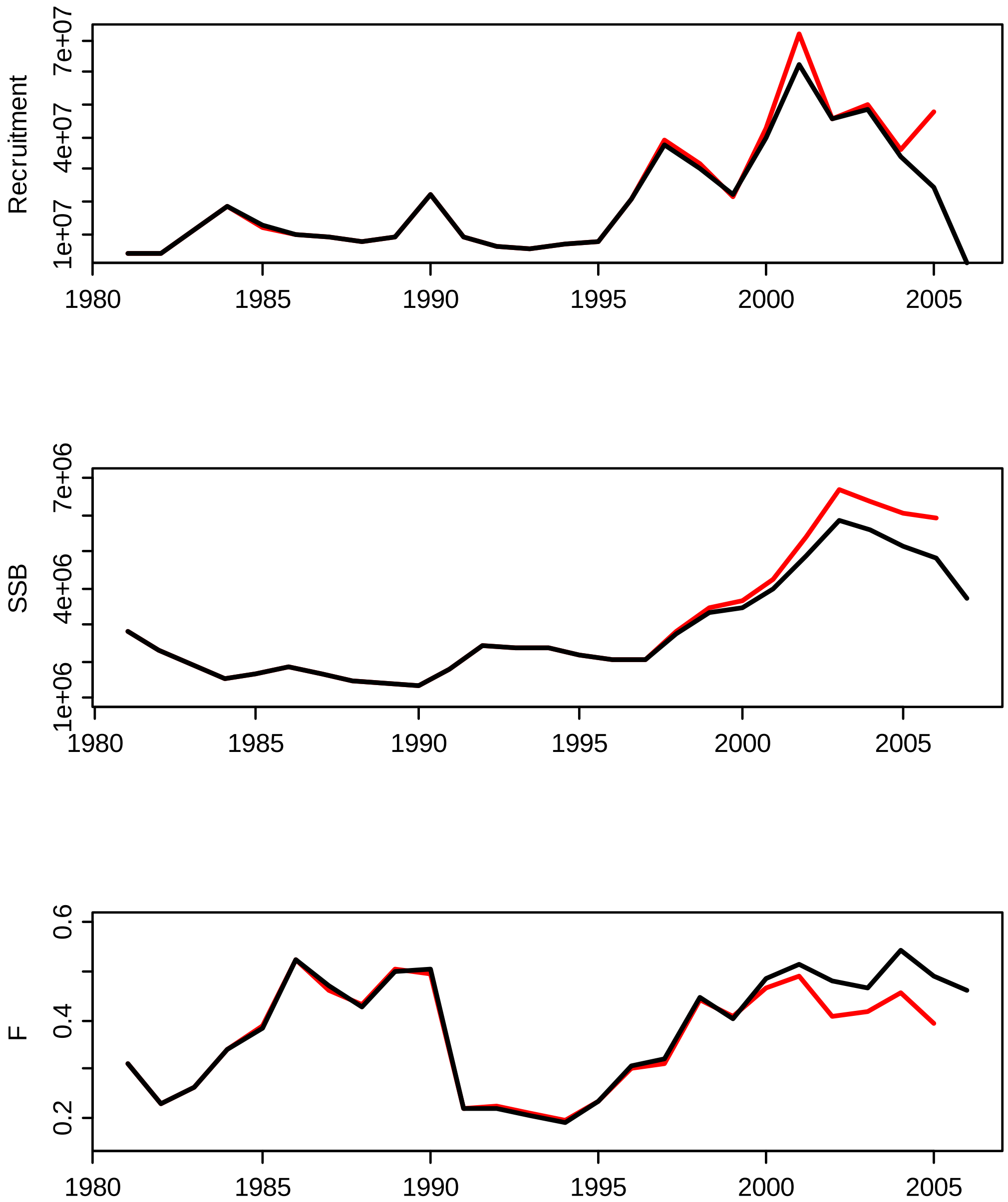


Figure 4.3.3.3. Blue whiting. Comparison of results from this year's and last year's final AMCI assessments.

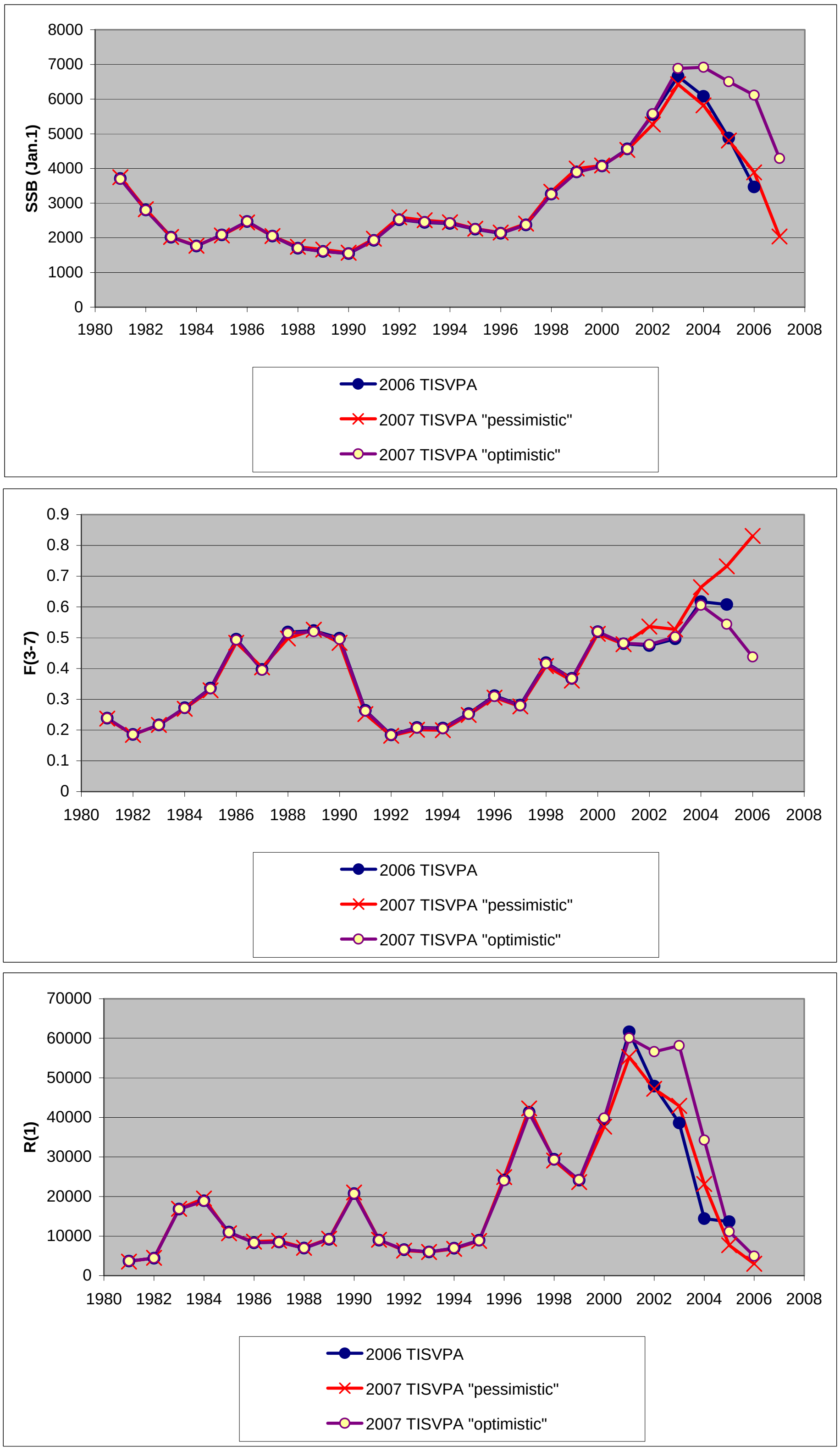


Figure 4.3.4.1. Blue whiting. Comparison of the TISVPA runs to the results of its run in 2006.

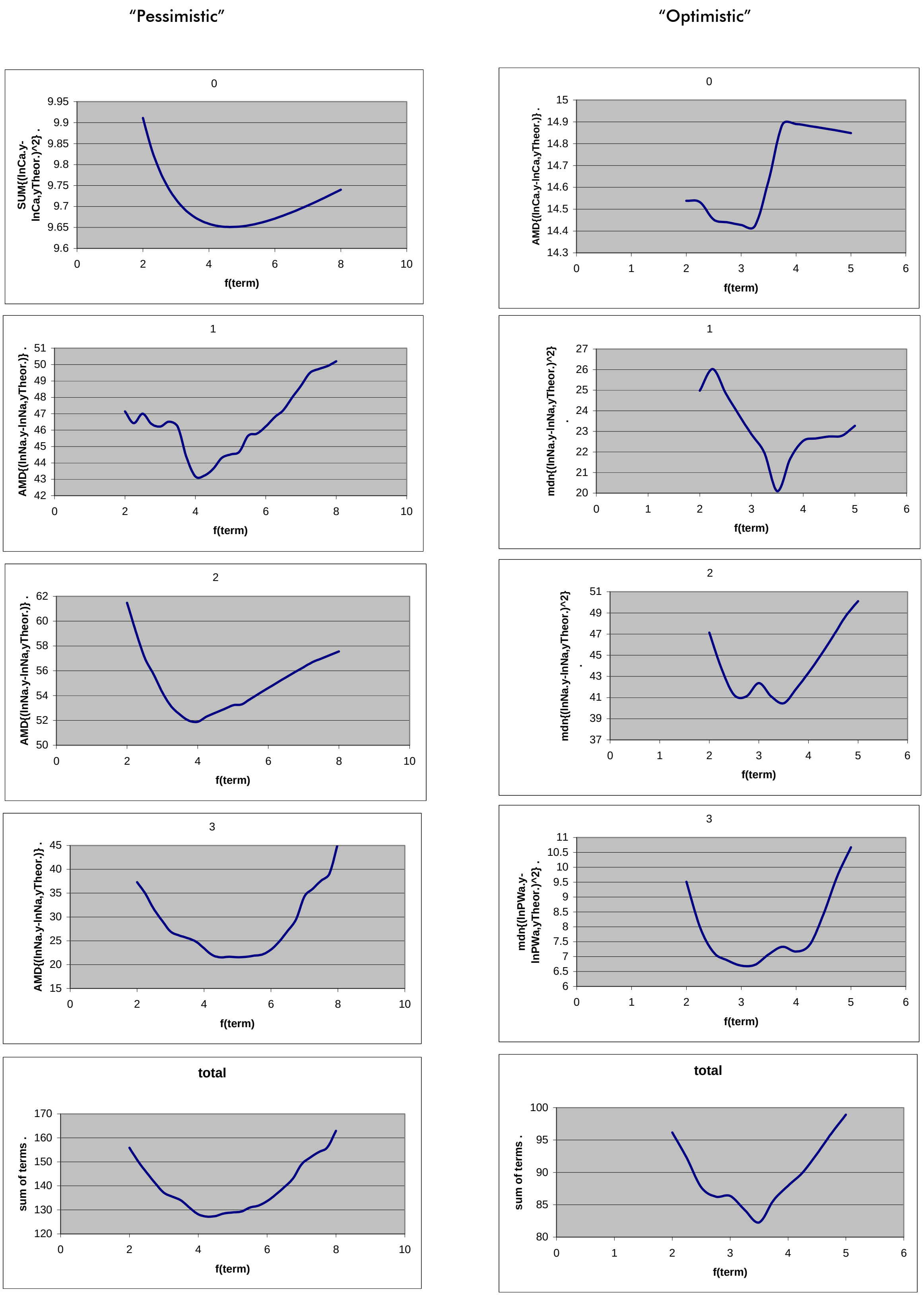


Figure 4.3.4.2. Blue whiting. Profiles of components of the TISVPA loss function for "pessimistic" and "optimistic" solutions. 0–signal from catch-at-age. 1–signal from Norway spawning stock acoustic survey (91–2006). 2–signal from International ecosystem survey in the Nordic seas (2000–2007). 3–signal from International Blue Whiting Spawning Stock Survey (2004–2007).

"Pessimistic" "Optimistic"

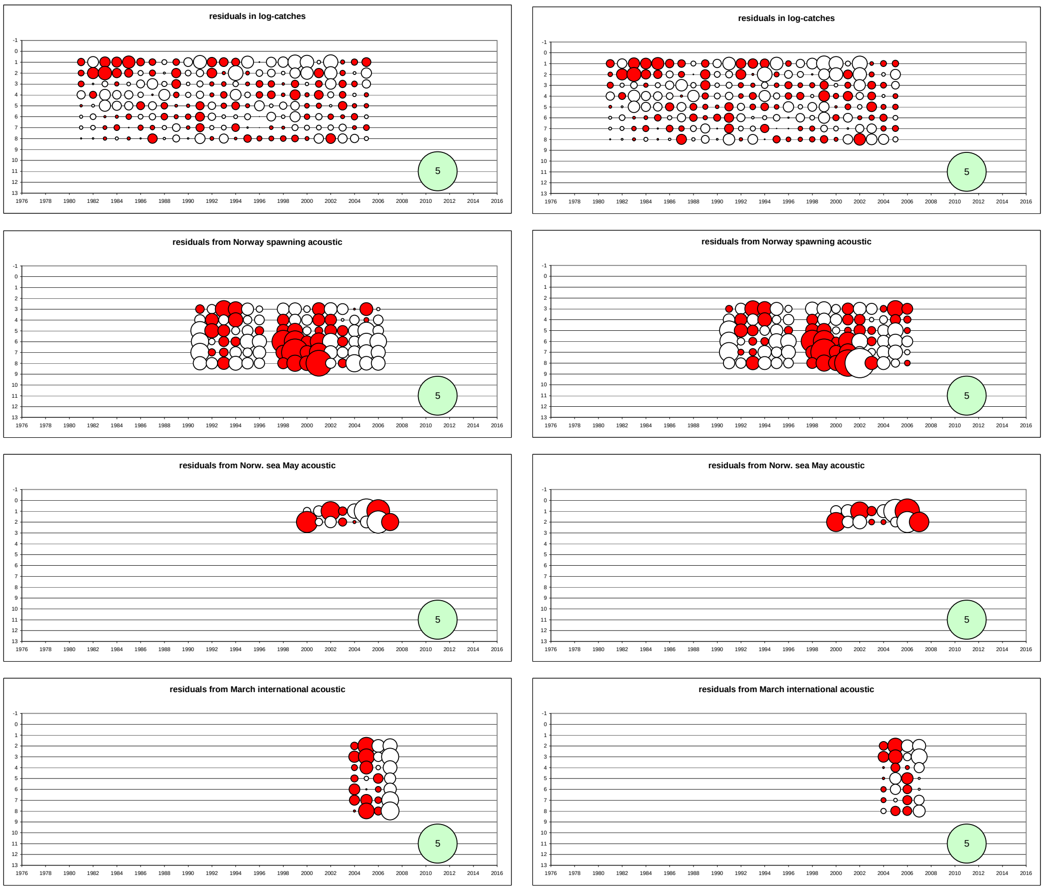


Figure 4.3.4.3. Blue whiting. The TISVPA residuals for the pessimistic and optimistic cases. Residuals are shown for the catches (top two panels), the Norwegian acoustic spawning stock survey (second row), the international ecosystem survey in the Nordic seas (third row) and the International Blue Whiting Spawning Stock Survey (bottom row).

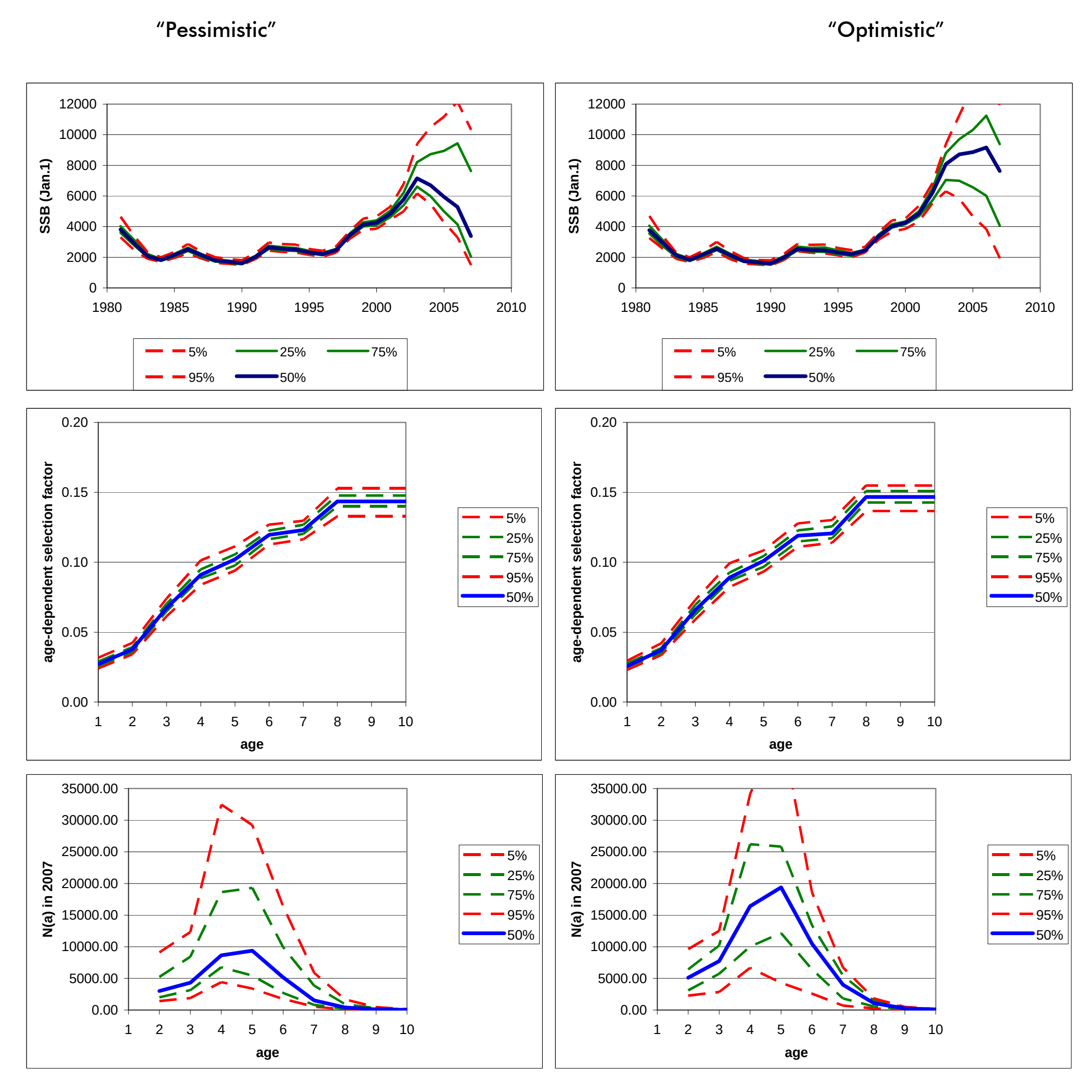
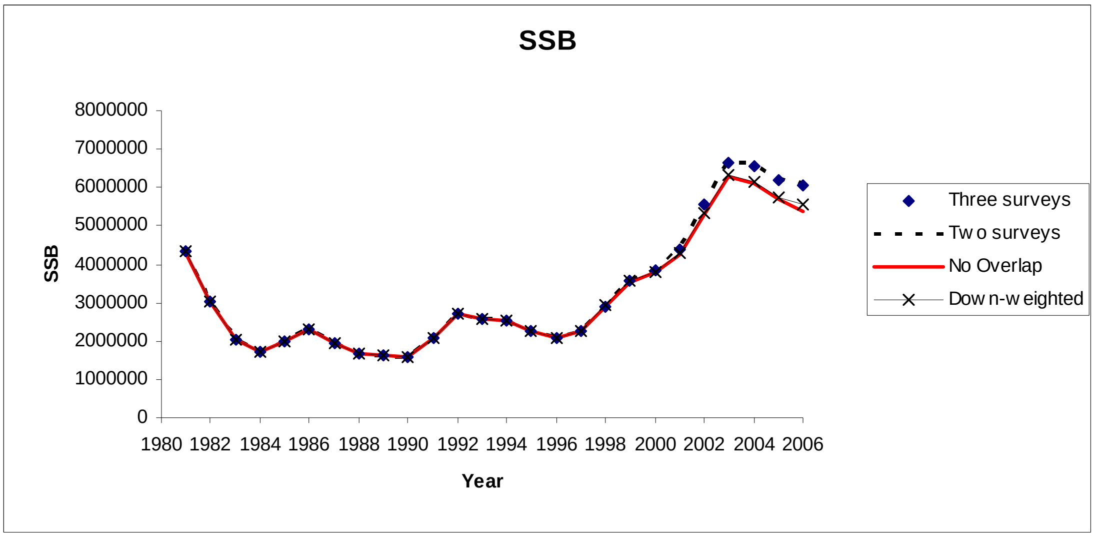
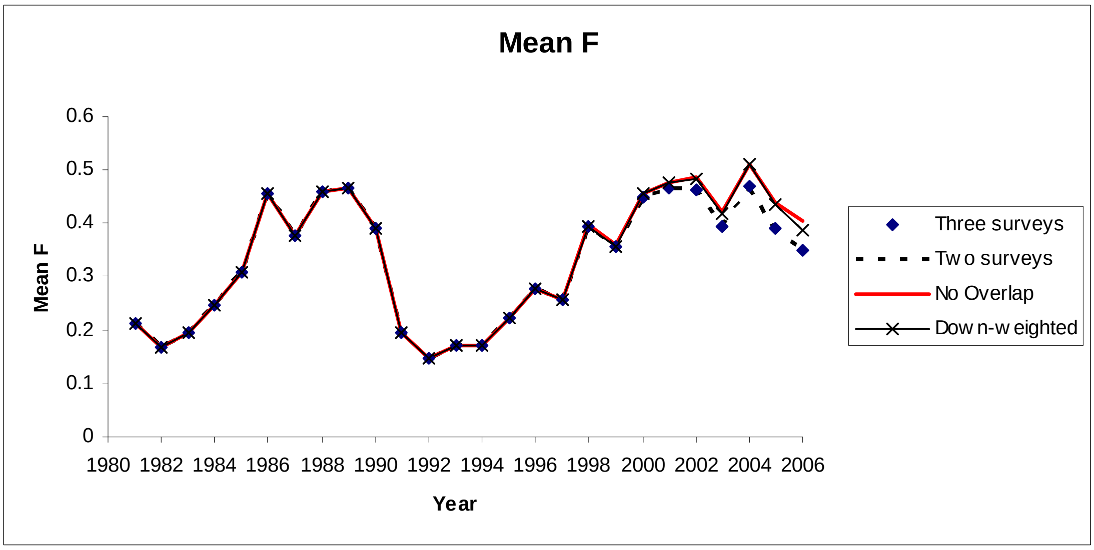


Figure 4.3.4.4. Blue whiting. TISVPA. Bootstrap.





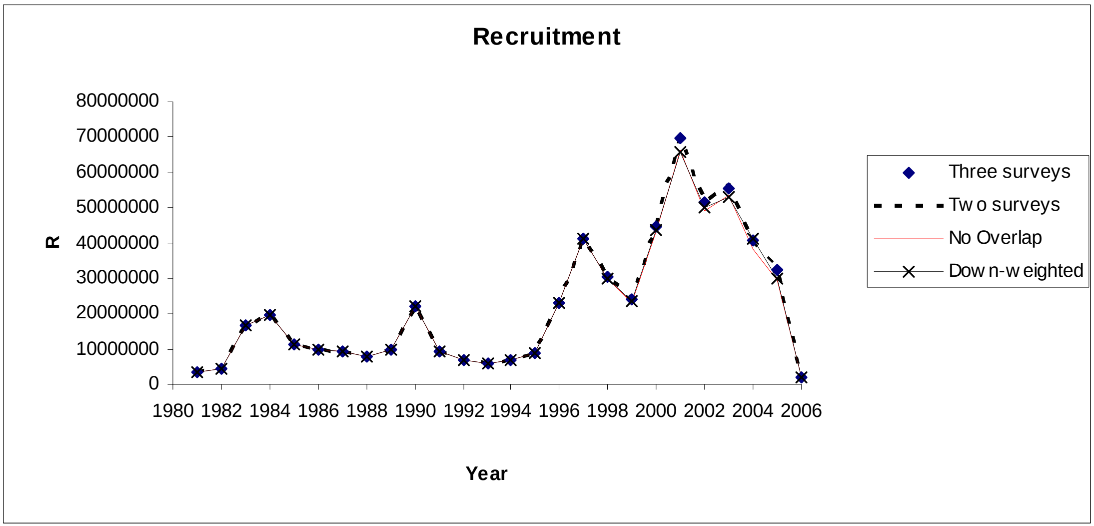


Figure 4.3.5.1. Blue Whiting. Comparisons of the ICA runs.

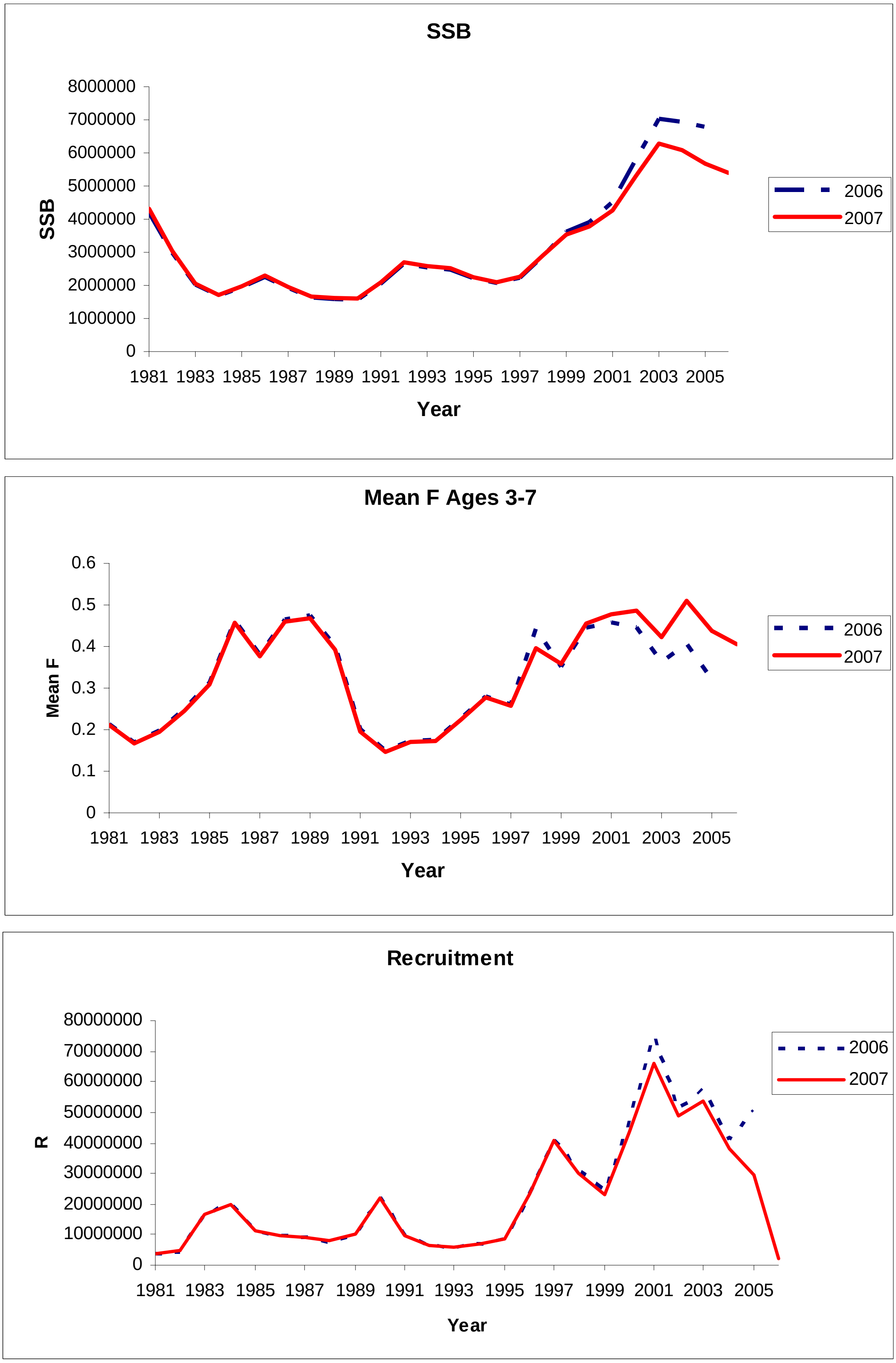


Figure 4.3.5.2. Blue Whiting. Final ICA runs carried out at the 2006 and 2007 Working groups.

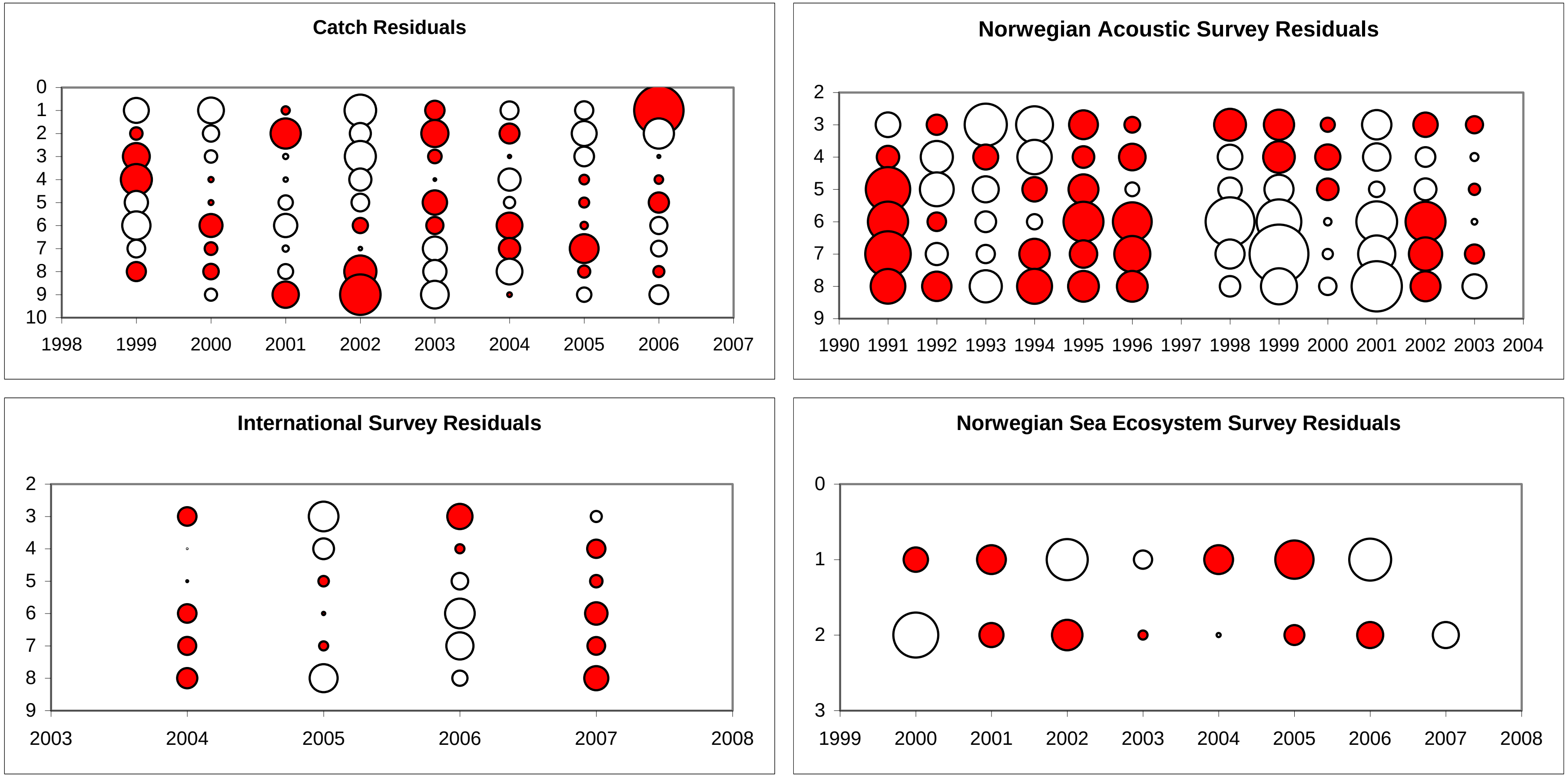


Figure 4.3.5.3. Blue Whiting. Catch and Survey Residual patterns from the final ICA Run 2007.

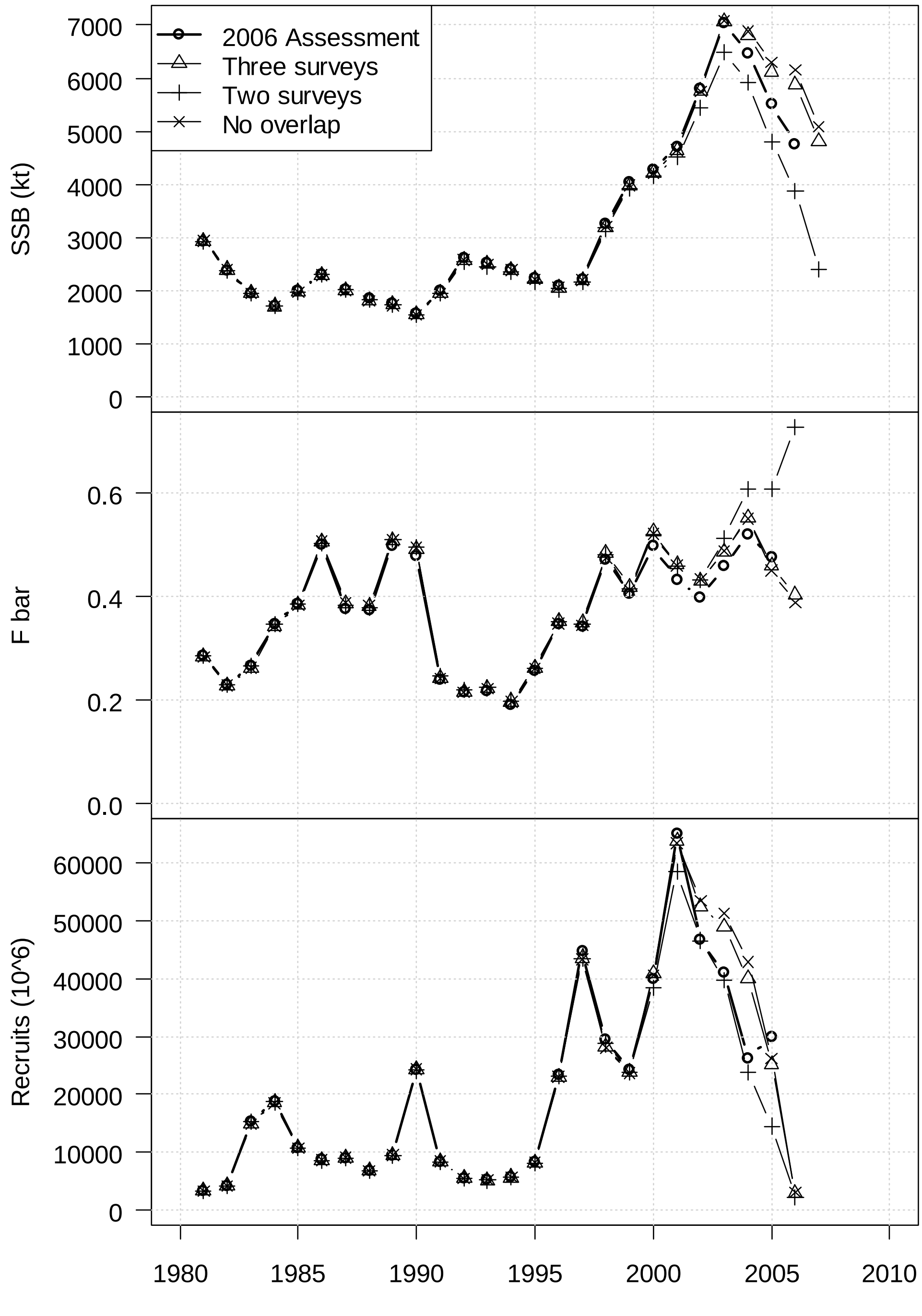


Figure 4.3.6.1. Blue Whiting SMS exploratory runs. Results of the three exploratory runs showing SSB (top panel), mean fishing mortality, F bar (ages 3–7; middle panel) and estimated recruitment (bottom panel). For comparison, the results of the blue whiting assessment made with SMS during the 2006 WGNPBW are shown. The "two surveys" run can be considered as an ASPALY (Almost the Same Procedure as Last Year) run.

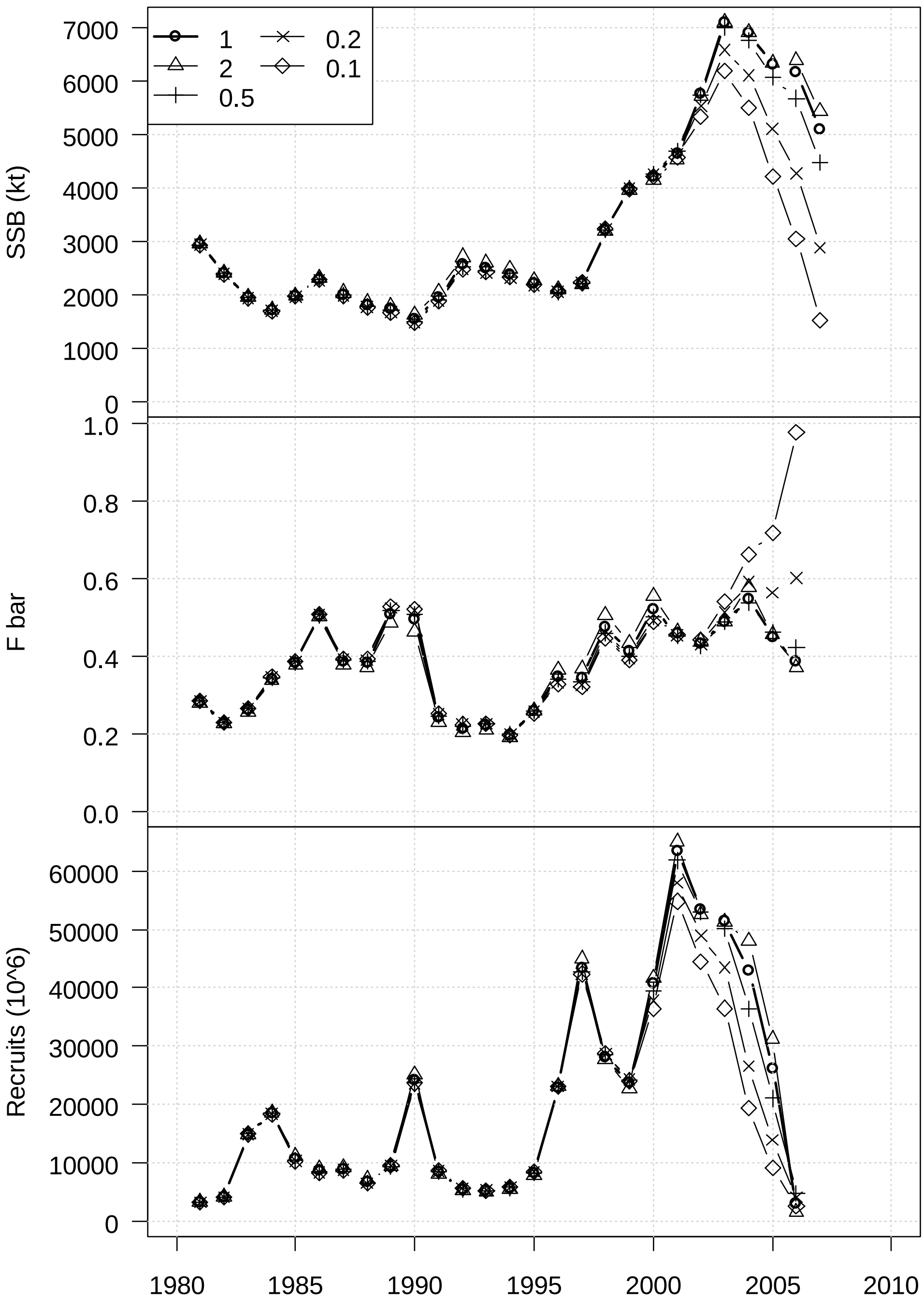


Figure 4.3.6.2. Blue Whiting SMS data exploration. Effect on SSB (top panel), mean fishing mortality F bar (ages 3–7; middle panel) and estimated recruitment (bottom panel) of changing the a priori weighting on the survey observations for the "no overlap" configuration. The *a priori* weight on catch observations is kept constant at 1.0, and thus a weighting factor of, for example, 2 represents a relative weight on the survey twice that of the catches.

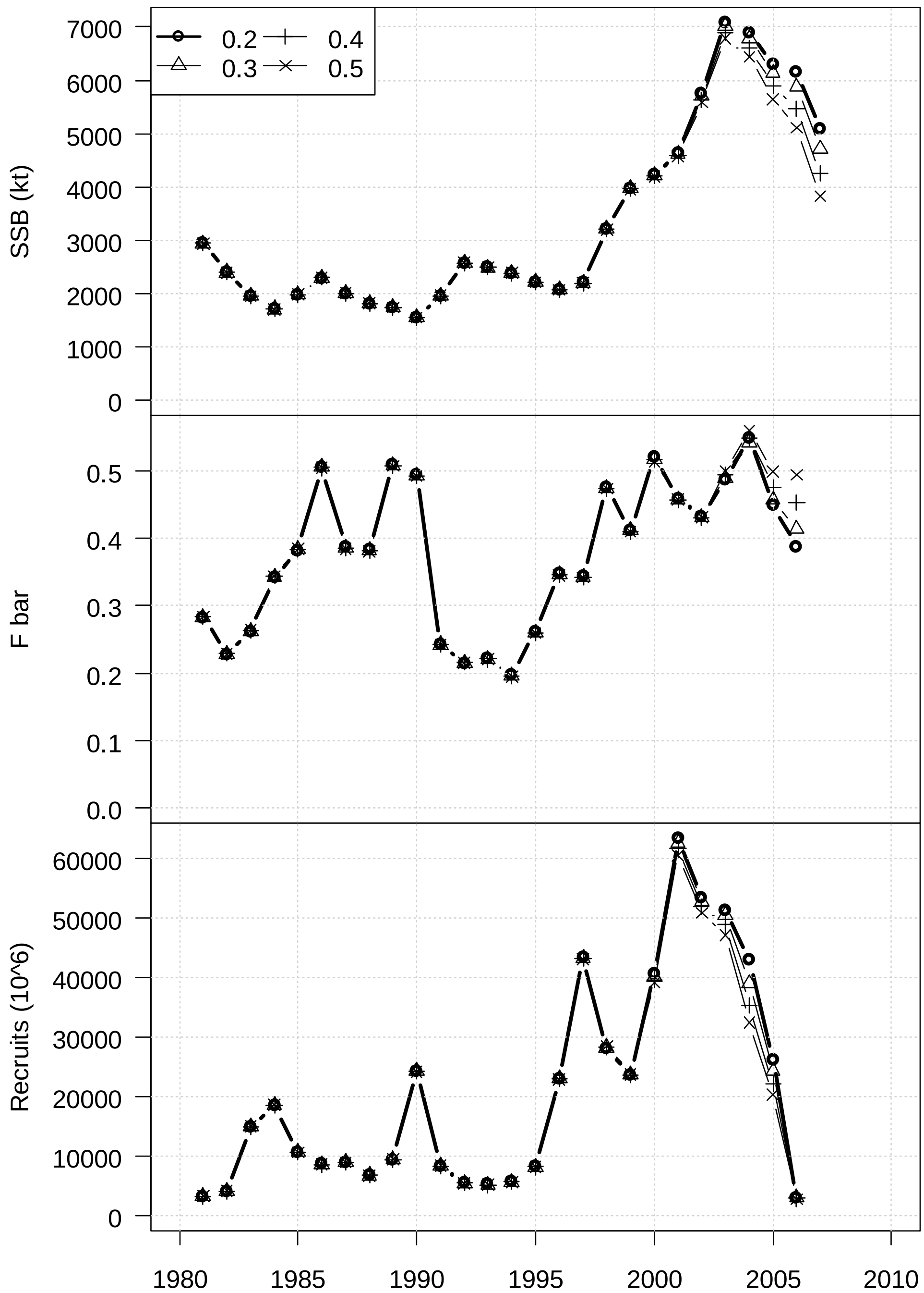


Figure 4.3.6.3. Blue Whiting SMS data exploration. Effect on SSB (top panel), mean fishing mortality, F bar (ages 3–7; middle panel) and estimated recruitment (bottom panel) of the "minimum CV [standard deviation in log-normal distribution] on survey observations" constraint. Values less than 0.2 gave results indistinguishable from the 0.2 line. The minimum standard deviation of the survey observations was set to be 0.2 to 0.5 and the *a priori* weighting on the catches and surveys were both set to be 1.

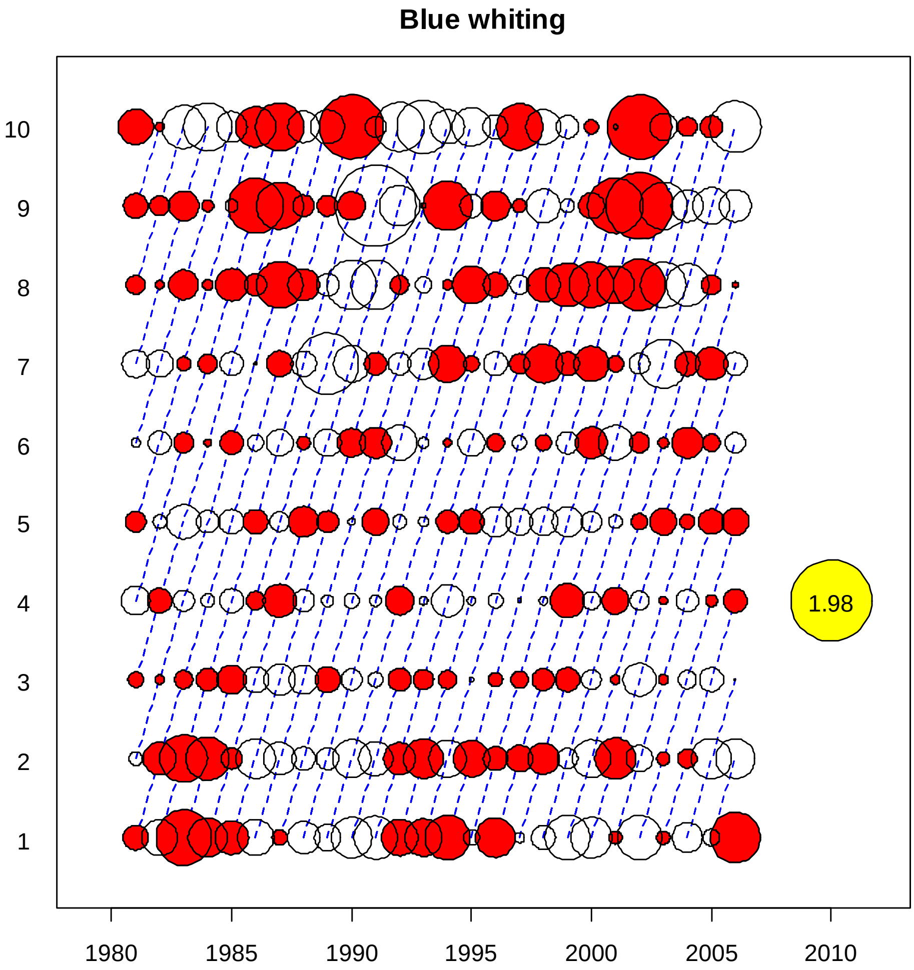


Figure 4.3.6.4. Blue Whiting SMS data exploration. Residuals for catch observations. Red (dark) bubbles show that the observed value is larger than the expected value. The bubble at right is the size of the largest residual.

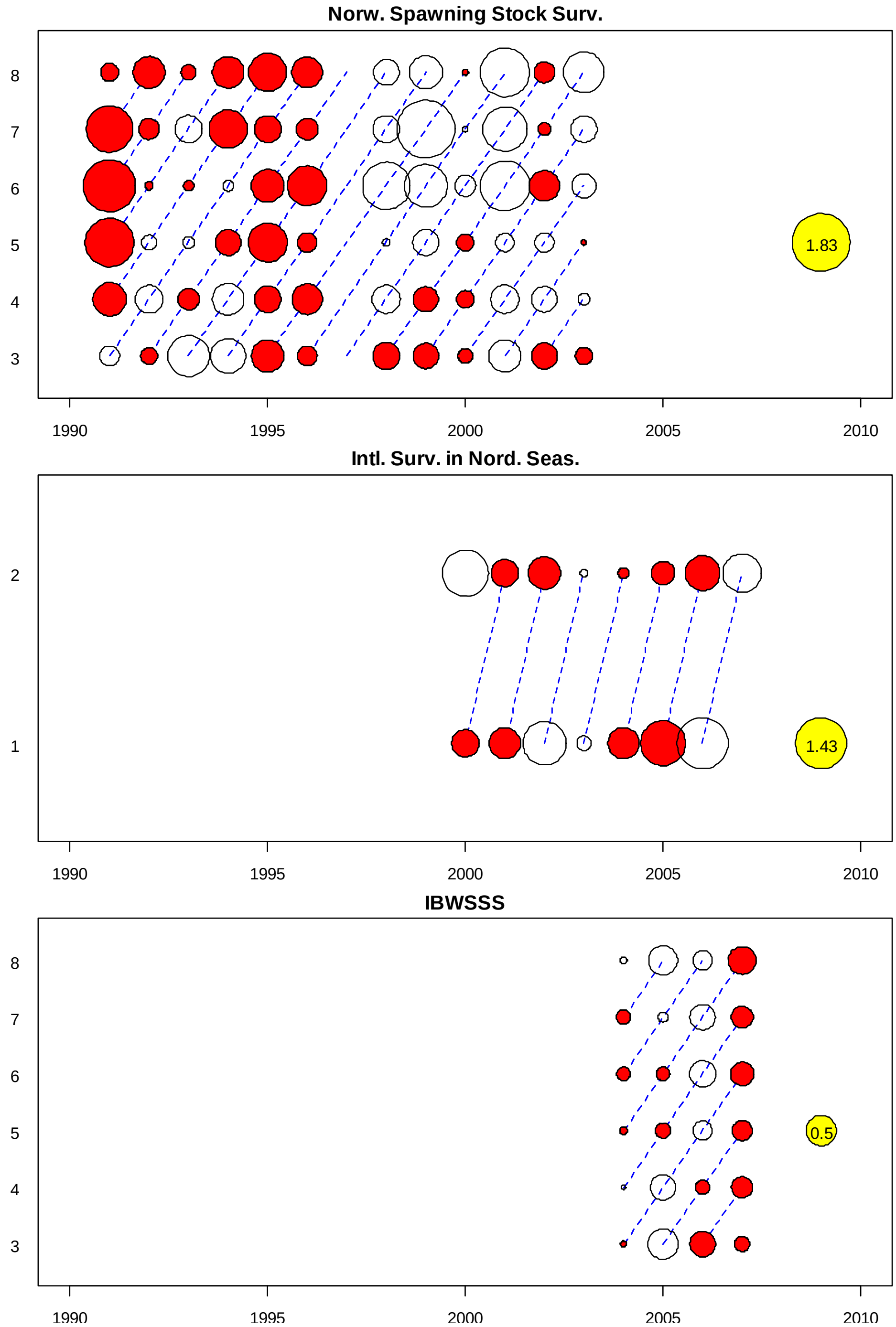


Figure 4.3.6.5. Blue Whiting SMS data exploration. Residuals for survey observations for the Norwegian spawning stock survey (top panel), the International ecosystem survey in the Nordic seas (middle panel) and the International Blue Whiting Spawning Stock Survey (IBWSSS; bottom panel). Red (dark) bubbles show that the observed value is larger than the expected value. The bubble at right is the size of the largest residual. The bubble-size scale is constant between the individual surveys. The minimum standard deviation of the survey observations was set to be 0.4 which affects only the IBWSSS.

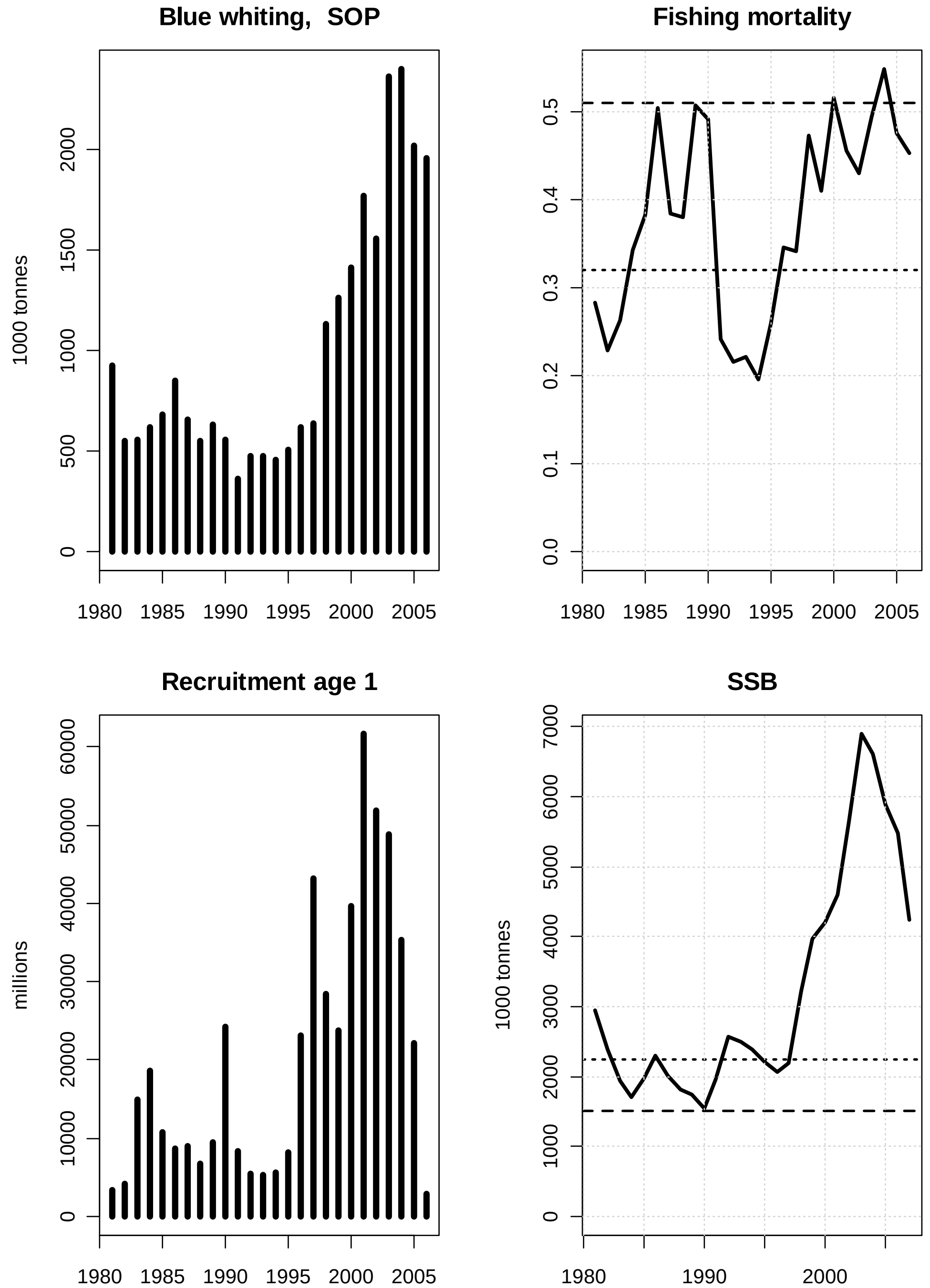


Figure 4.3.6.6. Blue whiting SMS data exploration. Stock summary, 1981–2007 based on final SMS run. SSB at 1st January 2007 does not include age 1.

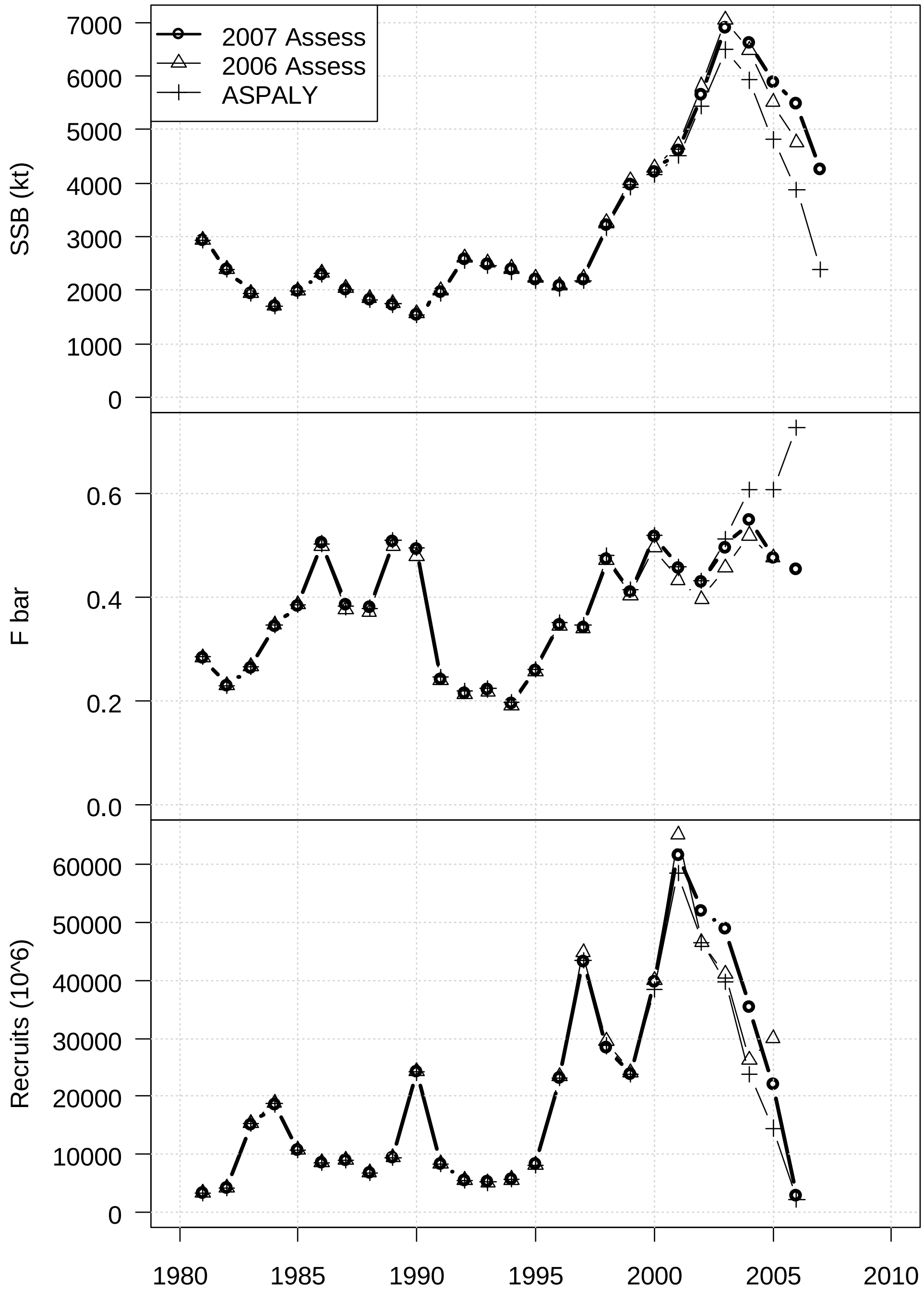


Figure 4.3.6.7. Blue whiting SMS data exploration. Quality plot for final SMS run. Time series of estimated SSB (top panel), mean fishing mortality, F bar (ages 3–7; middle panel) and estimated recruitment (bottom panel) from the SMS method. For comparison, the results of the blue whiting assessment made with SMS during the 2006 WGNPBW, and the "Almost Same Procedure as Last Year" (ASAPLY) run are shown. The ASPALY run uses the same configuration as the 2006 working group, with the inclusion of 2006 data; however, the absence of a 2007 Norwegian survey meant that it was not possible to fully replicate the previous years methodology, hence the "ASPALY" name.

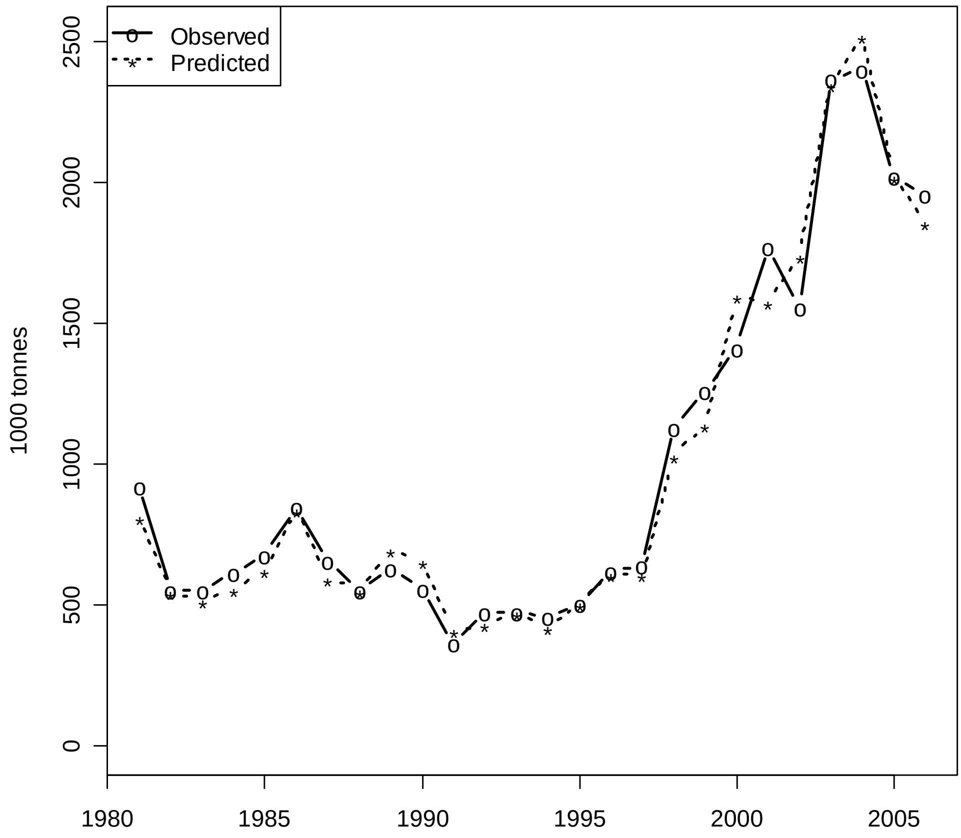


Figure 4.3.6.8. Blue whiting SMS data exploration. Comparison of observed and predicted catch weight from the final SMS run.

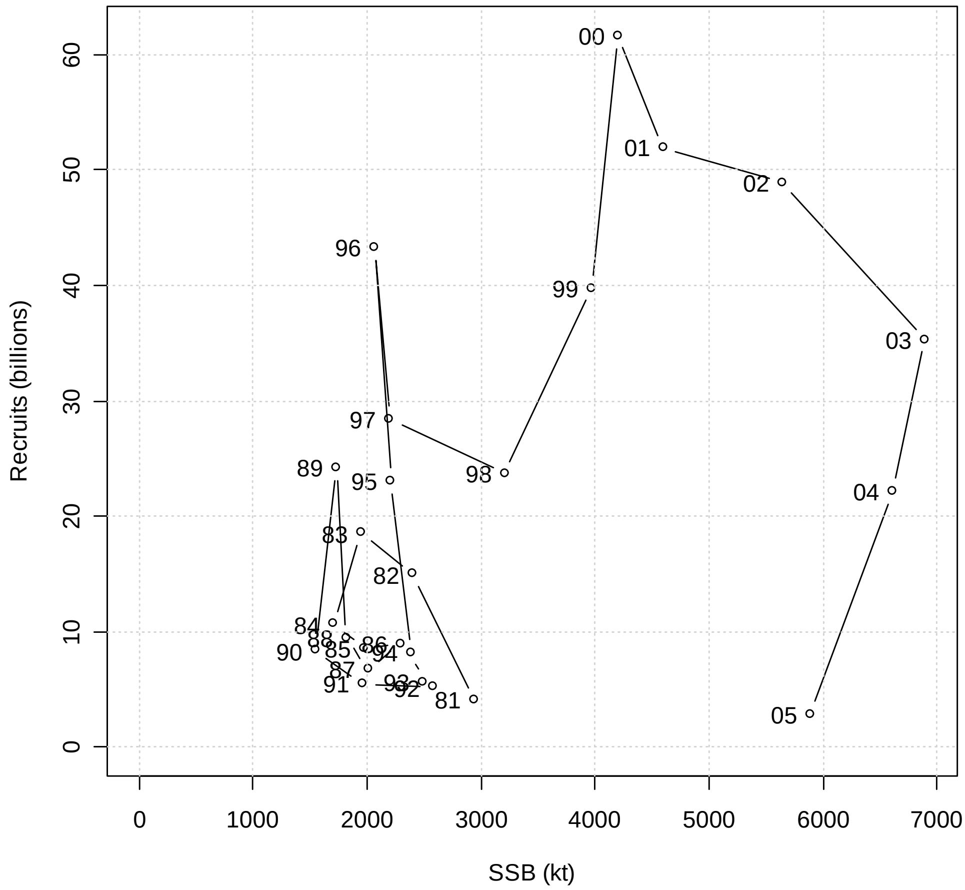


Figure 4.3.6.9. Blue whiting SMS data exploration. Stock-recruitment plot derived from the final SMS run. The labels correspond to the year class.

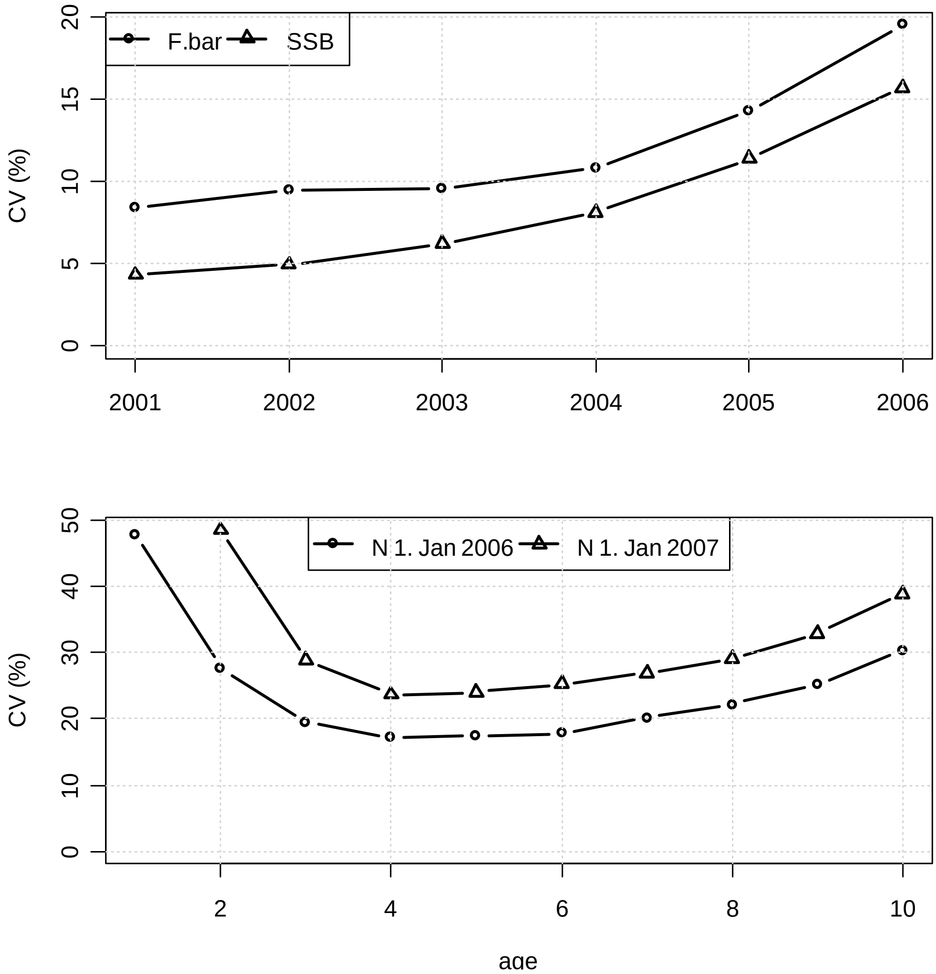


Figure 4.3.6.10. Blue whiting SMS data exploration. Estimates of CV of SSB and F-bar (3–7) (top panel) and CV of stock number-at-age in the terminal assessment year and the following. Year, CVs are estimated by SMS from the Hessian matrix.

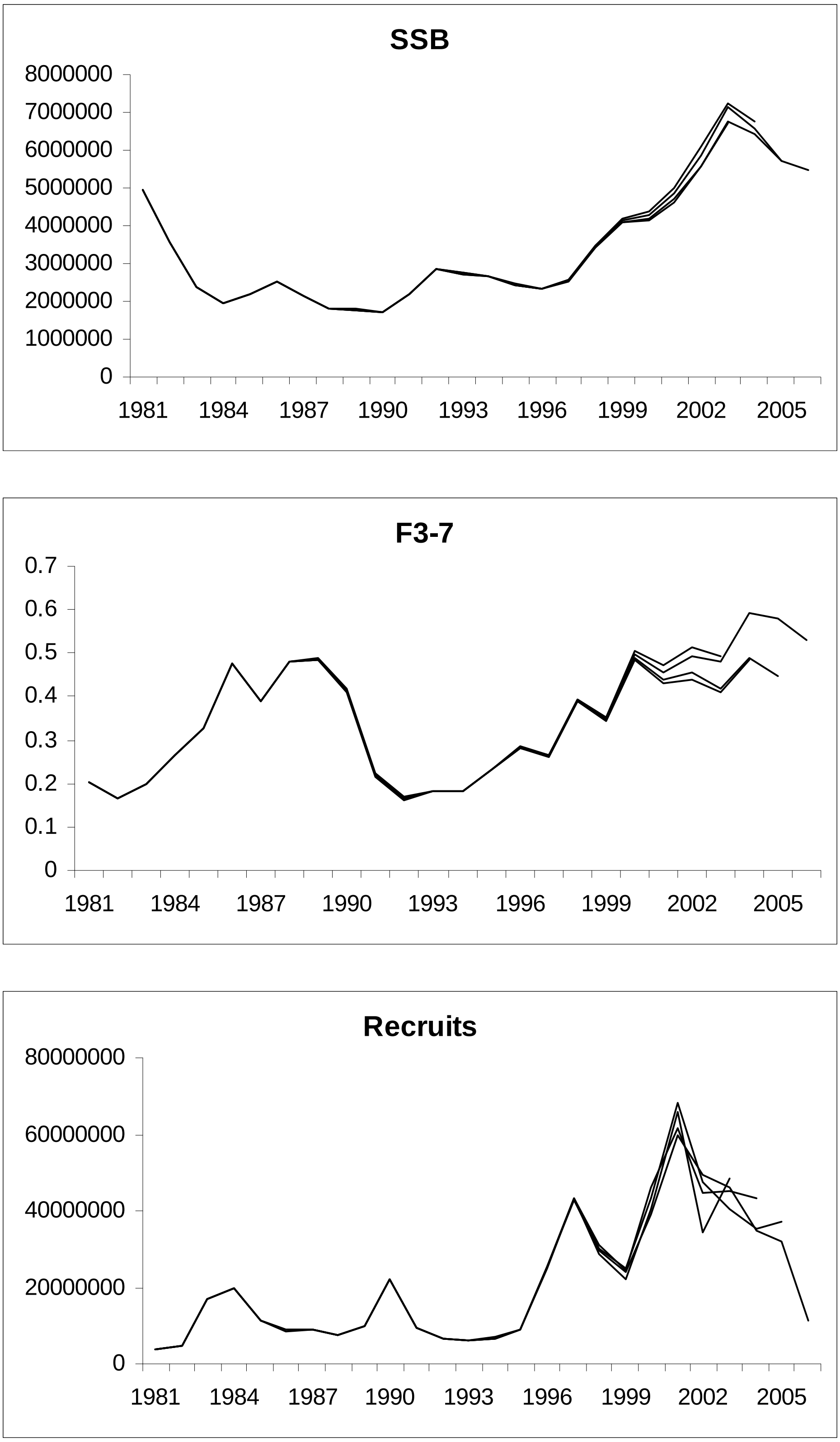
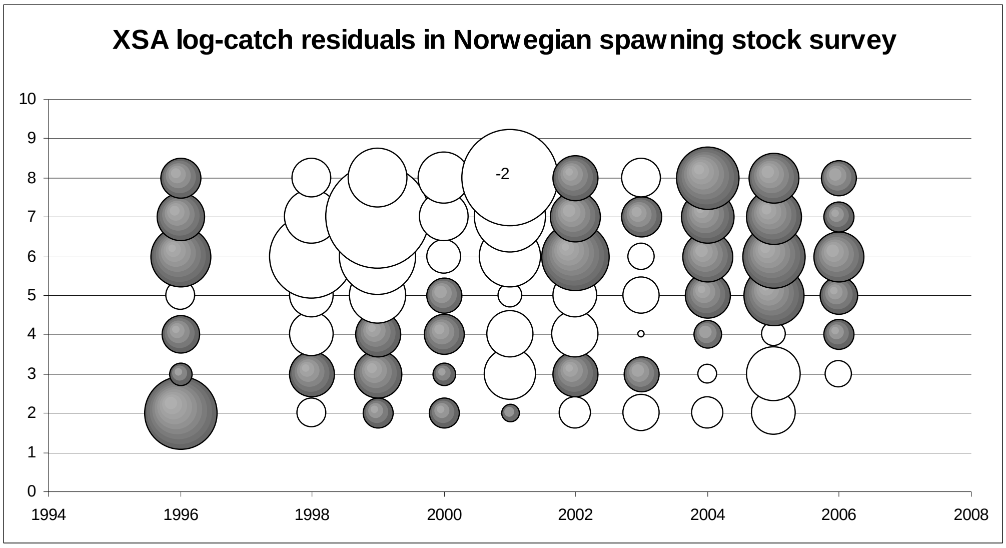
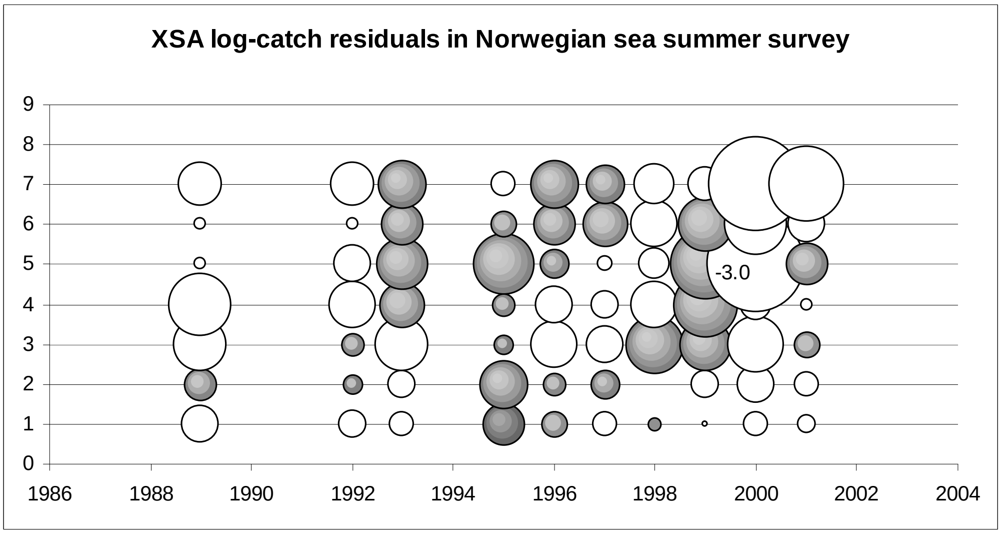


Figure 4.3.7.1. Blue Whiting, XSA. Final runs, with retrospective plots shown.





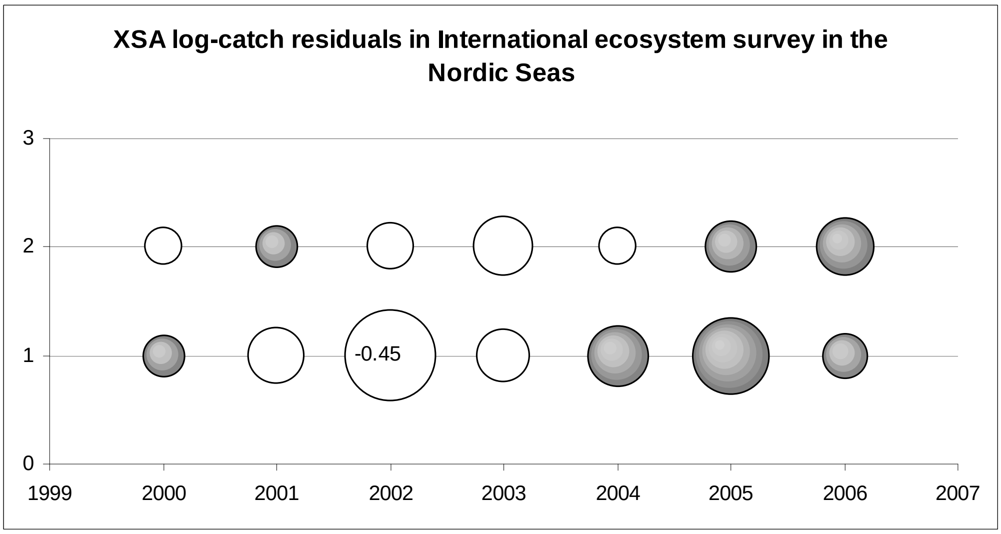


Figure 4.3.7.2. Blue Whiting, XSA. Residual plots from final runs.

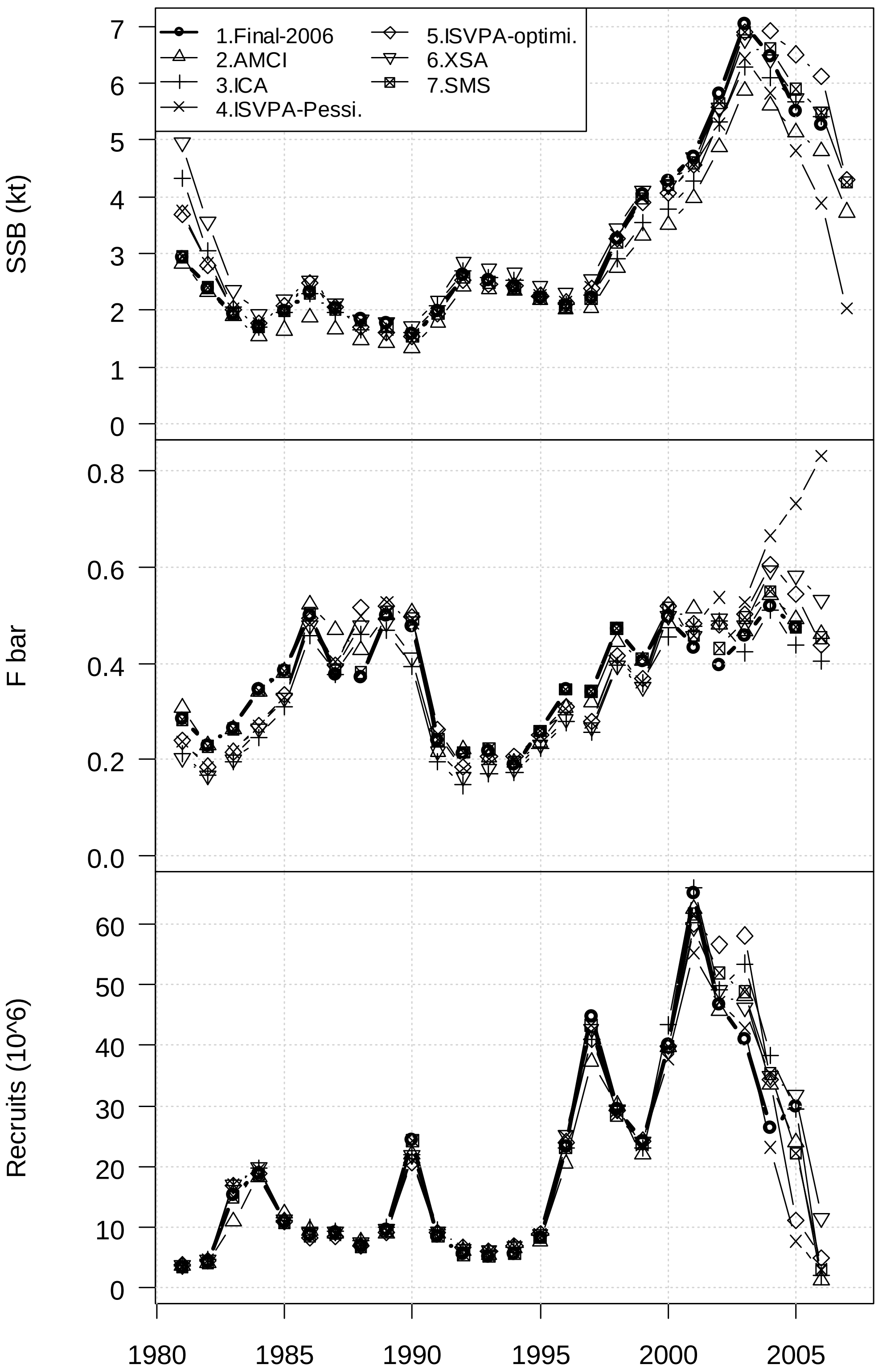


Figure 4.3.8.1. Blue whiting. Comparisons between final exploratory AMCI, ISVPA, ICA, XSA and SMS assessments.

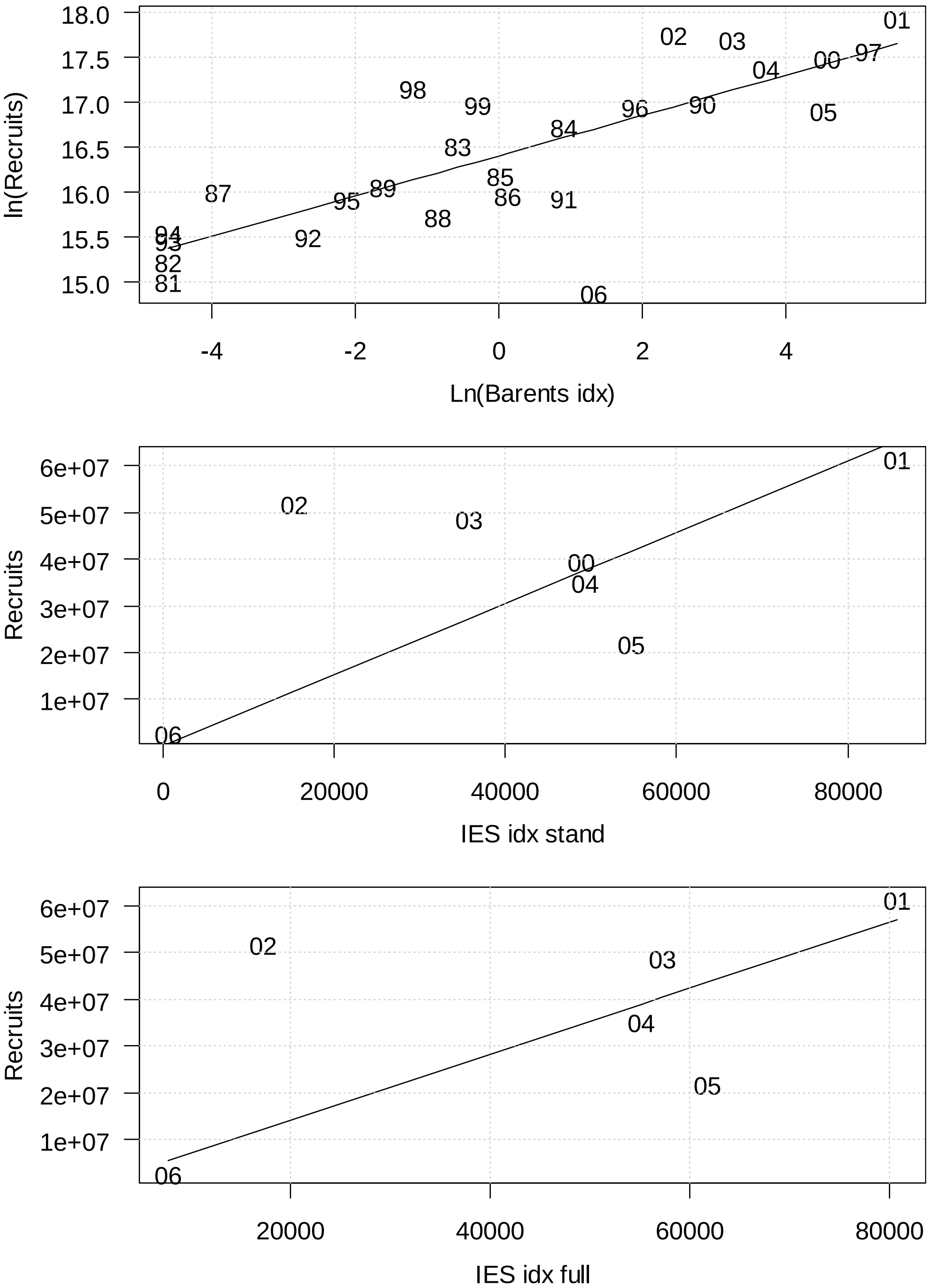


Figure 4.6.1. Blue whiting. Recruitment from the final SMS assessment and abundance indices of age 1 from the Barents Sea winter survey (Barents idx; top panel), the International ecosystem survey in the Nordic Seas with standard coverage (IES idx stand; middle panel) and the International ecosystem survey in the Nordic Seas with full coverage (IES idx stand; bottom panel). The labels indicate year (i.e. year class + 1). The regression lines in the two panels with the International ecosystem survey are forced through the origin.

5 Development of a new assessment software (TASACS)

5.1 Background

The background for developing the program were discussions about the assessment of Norwegian Spring-Spawning Herring between Norwegian and Russian scientists that have been ongoing for a number of years. A framework for a new program that would include essential elements and experiences from several methods was agreed by Norwegian and Russian scientists in a series of meetings from 2004 to 2006. This development was followed up by requests from NEAFC and Norway-Russia to ICES. ICES referred to the ongoing development, and agreed to monitor the development, primarily through the NPBWWG, and to evaluate the final product in due time.

The software development is done by IMR, in accordance with the agreed framework. It has been delayed, but is now well underway. Progress was reported to the NPBWWG this year (Skagen and Skålevik, TASACS.doc: “A Toolbox for Age-structured Stock Assessment using Catch and Survey data (TASACS)”). In this Section, a brief overview of the program is given, as well as the comments by the NPBWWG.

5.2 The software: A Toolbox for Age-structured Stock Assessment using Catch and Survey data (TASACS)

The software consists of a computer program to perform historic assessments, and an interface for data handling and book-keeping of runs and results. The assessment software is written in FORTRAN 95 and can be run under most operating systems. The interface requires Windows. All software, including source code, will be made freely available.

5.2.1 The assessment software

The assessment software is a collection of sub-models for population, observations, objective functions and optimisation, as outlined in Figure 5.2.1. Each of these categories has several optional model choices. The purpose is to allow combining and comparing models, rather than decide *a priori* on one singe model formulation at each step.

The assessment method is basically to construct a model population driven by parameters and optionally by data, derive expected observations, and estimate the model parameters that lead to a best possible fit between model and observations. The population model with these parameters is taken as the assessed stock. The user can decide which parameters to estimate, by attaching an 'active flag' to each parameter. The model data are generated from a population model and catchability models. The fit is expressed through an objective function. The optimisation is by a searching routine. Both for the population model, catchability models and objective functions several options are available.

The population model has 3 options at present:

- A standard VPA, using Popes equation to back-calculate cohorts from the catch numbers at age and assumed natural mortalities.
- A standard separable model, generating a population matrix from selections at age, annual fishing mortalities, natural mortalities and terminal stock numbers for each cohort. The population is calculated backwards in time for compatibility with the other models.
- An ISVPA like algorithm, following the algorithm outlined by Vasilyev (2005). This is a method for reducing the number of unknown parameters in a separable model by using the catch data. The implementation here corresponds to the 'catch controlled' and the 'effort controlled' versions and 'weighted arithmetic mean procedure' Vasilyev (2005), but operates on fishing mortalities defined the standard way instead of instantaneous fishing mortalities.

The catchability model at present is only proportionality between survey index at age and stock number at age. Other models can be incorporated if needed.

The objective functions at present are:

- Weighted sum of squared log residuals
- Median of squared log residuals (Vasilyev, 2005)
- It is planned to include at least a Gamma likelihood function and a Poisson likelihood function as well.

The WG suggested allowing using different objective functions for different kinds of data and for different periods. This will be implemented.

Optimisation is at present by the searching algorithm used in AMCI. AD-model builder was suggested as an alternative, and will be considered further.

Specification of model parameters are on files covering all parameters needed for all models. The user can decide which parameters to estimate in the optimisation, and parameters that are redundant with the applied population model are not estimated.

The software is written in FORTRAN 95 as agreed. Emphasis has been on making the code modular with self-contained elements. Hence the design of the code is as close to object oriented as FORTRAN allows for. All communication with the program itself is through ASCII-files. The standard for the data input is the Lowestoft format.

5.2.2 User interface

To facilitate handling of input and output files, a Windows software interface has been developed. This software organises the assessment for a stock as a project, which consists of a collection of runs. Each run is stored in a separate folder, and contains a set of input files for a run of the assessment program and the output from that run. The assessment program can be started from that interface, and during optimisation, the N-matrix and F-matrix are displayed as colour graphs. Likewise, the files belonging to the run can be opened and edited from the interface. Data files in Lowestoft format are displayed by the interface program in a spreadsheet like lay-out, to facilitate editing and checking. Weights can be attached to individual data with this editing facility, and are stored in files with a format similar to the Lowestoft format. A similar editor can be called from the interface to edit the parameter input files, and to control active flags for the parameters.

This interface is not part of the assessment program, but was made to make the program easier to use, and to give better control over input and run options.

The WG pointed out the FLR as an emerging interface framework for assessment software. Including the new assessment program in the FLR framework at first sight looks relatively straightforward. This option will be explored with high priority, and implemented if at all possible.

At present, the assessment program is running, but still not well controlled for bugs. It would be premature to use it for a final assessment this year. Several diagnostics, as well as bootstrap routines to estimate uncertainty are planned, but have not been coded yet.

5.2.3 Time schedule for further work

The plan is to implement the elements already planned, and as far as possible, those suggested by the NPBWWG (see below) during the winter 2007–8. This is now a high priority task at IMR. Further testing of the code and developing documentation will be done in parallel. The plan is to have a fully developed and controlled program ready and distributed to the NPBWWG well in advance of next year’s meeting.

5.2.4 Comments by the NPBWWG

The WG appreciates the work done so far, encourages the further development and anticipates program that is ready for use as a candidate assessment tool for next year. Some suggestions were made, and are listed below. Some of these have been discussed above.

- Include the assessment program in FLR.
- Explore the use of AD-model builder facilities, in particular as an alternative to the present optimisation routine.
- Consider ways of separate handling of small year classes with very noisy data.
- Allow different objective functions both for different sets of data and for different time periods.
- Consider ways of binding the fishing mortality at oldest true age to that of younger ages, in particular in years where there are no supporting survey data.
- Since the software allows a range of options for population models and objective functions, objective criteria for deciding the best model choice should be explored.
- Observation models and objective functions should include use of tag return data.
- Uncertainty estimates may be considered not only for the assessment as a whole but also for each source of data.

6 Working documents

Toresen and Østvedt (2002) Variation in abundance of Norwegian spring-spawning herring (*Clupea harengus*, Clupeidae) throughout the 20th century and the influence of climatic fluctuation. Fish and Fisheries. 2000, 1 231–256.

Godinho, S., A. Fernandes, C. Chaves and G. Pestana. 2007. Analysis of Blue Whiting landings, discards and abundance and biomass indices data from Portuguese continental coast: review and update. Working Document for the ICES Assessment of Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW). Vigo, 27 August–1 September 2007.

Skagen and Skålevik, 2007. A Toolbox for Age-structured Stock Assessment using Catch and Survey data (TASACS) WD to the meeting of WGNPBW 2007.

Stenevik, Erling Kåre and Laura Rey, 2007. Distribution and abundance of Norwegian spring spawning herring larvae on the Norwegian shelf 28 March to 11 April 2007. Toktrapport/Havforskningsinstituttet/ISSN 1503–6294/Nr. 8_2007 RV Håkon Mosby 28.03–11.04.2007.

Slotte, Aril and Øyvind Tangen, 2007. Distribution and abundance of Norwegian spring spawning herring during the spawning season in 2007 Toktrapport Havforskningsinstituttet ISSN 1503–6294/Nr. 2–2007 «Cruise report» MS "Gardar" 16.02–05.03.2007.

Hátún, Hjálmar, Jan Arge Jacobsen and Anne Britt Sandø, 2007. Environmental influence on the spawning distribution and migration pattern of northern blue whiting (*Micromesistius poutassou*) ICES Northern Pelagic and Blue Whiting Working Group, Vigo 27/8–2/9 2007, WD#__ICES CM 2007/B:06.

Elena Eriksen, Dmitry Prozorkevich and Gjert E. Dingsør. An evaluation of 0–group abundance indices of Barents Sea fish stocks.

Jacobsen, Jan Arge and Mourits Mohr Joensen. 2007. Exploratory investigations on Norwegian spring-spawning herring in the Norwegian Sea 17–24 November 2006. Cruise Report Cruise no. 06NG-06TG ICES Northern Pelagic and blue whiting Working Group, Vigo, Spain 27/8–2/9 2007 WD#.

Heino, M., C. O'Donnel, G. Johnston, E. Mullins, J. Ullgren, S. Bettie, V. Anthonypillai J. Jensen, S. Ratushnyy, I. Oganin, V. Shnar O. Rune Godø, Ø. Tangen, R. Pedersen, G. Lien, J. de Lange, E. Meland, Jacobsen, J. A., L. Smith, M. Mohr Joensen, J. Alvarez; S. Ybema, T. Pasterkamp, K. Bakker, P. Tjoe-Awie, E. Armstrong, D. Gloe, D. Tijssen, K. Eriksen. 2007. International blue whiting spawning stock survey spring 2007. Tokrapport Havforskningsinstituttet. ISSN 1503–6294/Nr. X–2007.

Jacobsen, Jan Arge, Súni Lamhauge and Mourits Mohr Joensen. 2007. Herring and capelin survey north of the Faroes. 18–25 January 2006 R/V Magnus Heinason OW2252 Cruise Report Cruise no. 0604 Working document to the ICES Northern Pelagic and Blue Whiting Working Group WD. Vigo 27/8–2/9 2007.

7 References

Godø, O. R., Heino, M., Søiland, H., Alvarez, J., Dahl, M., de Lange, J., Gullaksen, O., Tangen, Ø. & Torkelsen, T. 2002. Blue whiting survey during spring 2002. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Vigo, Spain, 29 April-8 May 2002. 27 pp.

Hátún, H., A. B. Sandø, H. Drange, B. Hansen, and H. Valdimarsson, 2005: Influence of the Atlantic subpolar gyre on the thermohaline circulation. Science, 309, 1841–184.

Hátún, H., Jacobsen, J. A., and Sandø, A. B. 2007. Environmental influence on the spawning distribution and migration pattern of northern blue whiting (*Micromesistius poutassou*). ICES CM 2007/B:06, 10 pp.

Heino, M., Godø, O. R., Søiland, H., Nygaard, J. E., Alvarez, J., de Lange, J., Drivenes, L., Gullaksen, O., Tangen, Ø. and Torkelsen, T. 2003. Blue whiting survey during spring 2003. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Copenhagen, 29 April-8 May 2003.

Heino, M. , Søiland, H., Dahl, M., Pedersen, G., Alvarez, J., Anthonypillai, V., Hovland, T., de Lange, J., Meland, E. S., Myklevol, S., Svendsen, B. V., Tangen, Ø., Torkelsen, T., Stowasser, G. and Varne, R. 2005. Blue whiting survey during spring 2005.

Toktrapport/Havforskningsinstituttet/ISSN 1503-6294/Nr. 5–2005.

Heino, M., C. O'Donnel, G. Johnston, E. Mullins, J. Ullgren, S. Bettie, V. Anthonypillai J. Jensen, S. Ratushnyy, I. Oganin, V. Shnar O. Rune Godø, Ø. Tangen, R. Pedersen, G. Lien, J. de Lange, E. Meland, Jacobsen, J. A., L. Smith, M. Mohr Joensen, J. Alvarez; S. Ybema, T. Pasterkamp, K. Bakker, P. Tjoe-Awie, E. Armstrong, D. Gloe, D. Tijssen, K. Eriksen. 2007. International blue whiting spawning stock survey spring 2007. Tokrapport Havforskningsinstituttet. ISSN 1503–6294/Nr. X-2007.

ICES 2006. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group [WGNPBW], ICES Headquarters Copenhagen 24–30 August 2006 ICES CM 2007/ACFM:34.

ICES 2007. Report of the Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys (PGNAPES) 14–17 August 2007. IJmuiden, The Netherlands ICES CM 2007/RMC:08 Ref. LRC, ACFM, ACE (draft).

ICES. 1983. Report of the Blue Whiting Assessment Working Group, Copenhagen, 15–21 September, 1982. ICES, Doc. C. M.1983/Assess:

ICES. 1986. Report of the Blue Whiting Assessment Working Group, Copenhagen, 25 September–2 October, 1985. ICES, Doc. C. M.1986/Assess:

ICES. 1996. Report of the Atlanto-Scandian Herring, Capelin and Blue Whiting Assessment Working Group, Institute of Marine Research, Bergen, Norway, 12–18 October, 1995. ICES, Doc. CM 1996/Assess:

ICES. 2003. Study Group on Precautionary Reference Points for Advice on Fishery Management. Copenhagen, 24–26 February, 2003. ICES CM 2003/ACFM:1.

ICES. 2007. Report of the Workshop on Limit and Target Reference Points [WKREF], 29 January–2 February, 2007, Gdynia, Poland. ICES CM 2007/ACFM:05.

ICES-ACFM 2007, Report of the Annual Meeting of Assessment-related Working Group Chairs (AMAWGC) ICES Headquarters 19–23 February 2007 ICES CM 2007/ACFM:07.

ICES-ACFM, 2007, Report of the Workshop on Limit and Target Reference Points (WKREF), Gdynia, Poland 29 January–2 February 2007. ICES CM 2007/ACFM:05.

Lewy P., M. Vinther 2004. A stochastic age-length-structured multispecies model applied to North Sea stocks ICES CM 2004/ FF:20

Pedersen, G., Pedersen, R. and Torkelsen, T. 2006. *In situ* target strength measurements of blue whiting. Appendix 7 in Heino *et al*., 2006

Vasilyev D. 2005. Key aspects of robust fish stock assessment. M: VNIRO Publishing, 2005. 105 p.

Annex 1: List of participants

Name	Address	Phone/Fax	Email
Beek, Frans van (Chair)	Centre for Fisheries Research P.O. Box 68 NL–1970 CP IJmuiden Netherlands		frans.vanbeek@wur.nl
Belikov, S.	Knipovich Polar Research Institute of Marine Fisheries and Oceanography 6 Knipovitch St. RU–183763 Murmansk Russia		belikov@pinro.ru
Egan, Afra	The Marine Institute Rinville Co. Galway Oranmore Ireland	Phone +353 9173 0400 Fax +353 9173 0470	afra.egan@marine.ie
Gudmundsdóttir, Asta	Marine Research Institute Skúlagata 4 IS–121 Reykjavík Iceland	Phone +354 5752001 Fax +354 5752000	asta@hafro.is
Iriondo, Ane	AZTI-Tecnalia AZTI Sukarrieta Txatxarramendi ugartea z/g E–48395 Sukarrieta (Bizkaia), Spain	Phone +34 94 602 94 00 Fax +3494 687 00 06	airiondo@suk.azti.es
Jacobsen, Jan Arge	Faroese Fisheries Laboratory P.O. Box 3051 FO–110 Tórshavn Faroe Islands	Phone +298 353900 Fax +298 353901	janarge@frs.fo
Krysov, Alexander	Knipovich Polar Research Institute of Marine Fisheries and Oceanography 6 Knipovitch Street RU–183763 Murmansk Russia	Phone +7 (8152) 47 34 24 Fax +7 47 789 10 518	a_krysov@pinro.ru
Meixide, Manolo	Instituto Español de Oceanografía Centro Oceanográfico de Vigo P.O. Box 1552 E–36200 Vigo (Pontevedra) Spain	Phone +34 986 492111 Fax +34 986 498626	manolo.meixide@vi.ieo.es
Mullins, Eugene	The Marine Institute Rinville Co. Galway Oranmore Ireland		Eugene.mullins@marine.ie

NAME	ADDRESS	PHONE/FAX	EMAIL
Payne, Mark	Danish Institute for Fishery Research Department of Sea Fisheries Charlottenlund Slot DK–2920 Charlottenlund Denmark	Phone +45 3396 3474 Fax +45 3396 3333	mpa@difres.dk
Salthaug, Are	Institute of Marine Research P.O. Box 1870 N–5817 Bergen Norway	Phone +47 55 23 86 73 Fax +47 55 23 86 87	are.salthaug@imr.no
Skagen, Dankert	Institute of Marine Research P.O. Box 1870 N–5817 Bergen Norway	Phone +47 55 238419 Fax +47 55 238687	dankert.skagen@imr.no
Skaalevik, Aasmund	Institute of Marine Research P.O. Box 1 Nordnes Norway	Phone +47 55236957 Fax +47	aasmunds@imr.no
Timoshenko, Nikolay	AtlantNIRO 5 Dmitry Donskogo Street RU–236000 Kaliningrad Russia	Phone +7 4012 925554 Fax +7 4012 219997	timoshenko@atlant.baltnet.ru
Tjelmeland, Sigurd	Institute of Marine Research P.O. Box 1870 N–5817 Bergen Norway	Phone +47 55 238500 Fax +47 55 238531	sigurd.tjelmeland@imr.no
Vasilyev, Dmitry A.	Russian Federal Research Institute of Fisheries & Oceanography 17 Verkhne Krasnoselskaya RU–107140 Moscow, Russia	Phone +7 095 264 99 65 Fax +7 095 264 91 87	dvasilyev@vniro.ru
Vinther, Morten (Chair)	Danish Institute for Fishery Research Department of Sea Fisheries Charlottenlund Slot DK–2920 Charlottenlund Denmark	Phone +45 33 96 33 53 Fax +45 33 96 33 33	mv@difres.dk
Ybema, Sytse	IMARES, Wageningen UR P.O. Box 68 NL–1970 AB IJmuiden Netherlands		Sytse.Ybema@wur.nl

Annex 2: Tagging data for Norwegian spring spawning herring

Tagging data for Norwegian spring spawning herring. Tagging data for the 1983 year class. Number of herring screened by thousand, tagged herring and tags recovered are actual numbers.

Year	Number screened	2002 Release		2000 Release		1998 Release		1997 Release		1996 Release		1995 Release		1994 Release		1993 Release		1992 Release		1991 Release		1990 Release		1989 Release		1988 Release		1987 Release	
		Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered
1987																												33067	0
1988																										38152	27		78
1989	10695																							20620	0		17		12
1990	5489																					24585	34		4		10		4
1991	5545																			12558	0		4		5		7		1
1992	1737																	15262	0		2		2		2		0		4
1993	9372															15839	1		8		9		12		6		13		6
1994	9474													5364	0		9		11		4		8		7		10		2
1995	11554											859	0		4		7		9		6		15		5		10		6
1996	4038									2879	3		0		3		4		1		2		10		6		2		3
1997	3867							2 266	0		1		0		0		0		3		2		3		2		3		0
1998	509					648	0		0		1		0		0		0		2		2		1		1		3		1
1999	379						1		1		0		0		0		1		0		0		1		1		0		0
2000	413			0	0		0		0		0		0		0		0		1		0		3		0		1		0
2001	35						0		0		0		0		0		0		0		0		0		0		1		0
2002	221	0	0		0		0		0		0		0		0		0		0		0		0		0		1		0
2003	0		0		0		0		0		0		0		0		0		0		0		0		0		0		0
2004	0		0		0		0		0		0		0		0		0		0		0		0		0		0		0
2005	0		0		0		0		0		0		0		0		0		0		0		0		1		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1984 year class.

Year	Number screened	2002 Release		2000 Release		1998 Release		1997 Release		1996 Release		1995 Release		1994 Release		1993 Release		1992 Release		1991 Release		1990 Release		1989 Release		1988 Release	
		Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered
1988																										1342	1
1989																								1175	0		0
1990	157																					1097	0		0		0
1991	138																			257	0		1		0		0
1992	30																	767	0		0		0		0		0
1993	287															479	0		1		0		1		1		2
1994	267													160	0		0		1		2		0		0		0
1995	264											56	0		1		0		0		0		0		0		0
1996	281									113	0		0		0		0		0		0		0		0		0
1997	0							0	0		0		0		0		0		0		0		0		0		0
1998	1					0	0		0		0		0		0		0		0		0		0		0		0
1999	0						0		0		0		0		0		0		0		0		0		0		0
2000	0			0	0		0		0		0		0		0		0		0		0		0		0		0
2001	0				0		0		0		0		0		0		0		0		0		0		0		0
2002	0	0	0		0		0		0		0		0		0		0		0		0		0		0		0
2003	0		0		0		0		0		0		0		0		0		0		0		0		0		0
2004	0		0		0		0		0		0		0		0		0		0		0		0		0		0
2005	0		0		0		0		0		0		0		0		0		0		0		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

**** Will not be updated after 2003.**

Table cont. Norwegian spring spawning herring. Tagging data for the 1985 year class.

YEAR	NUMBER SCREENED	2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE		1994 RELEASE		1993 RELEASE		1992 RELEASE		1991 RELEASE		1990 RELEASE		1989 RELEASE	
		RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED
1989																								2982	0
1990																						1081	2		0
1991	355																			1154	0		1		0
1992	114																	851	0		0		0		0
1993	573															1465	0		0		1		1		1
1994	345													368	0		1		1		0		0		2
1995	735											167	0		1		1		2		0		0		0
1996	427									564	0		0		0		0		0		0		0		1
1997	888							555	0		1		1		1		1		3		0		2		0
1998	497					778	0		0		0		0		0		1		0		0		1		0
1999	623						2		1		0		0		0		0		0		0		0		1
2000	703			299	0		2		0		0		0		0		1		0		0		0		0
2001	139				0		1		0		0		0		0		0		0		0		0		1
2002	194	0	0		0		2		0		0		0		0		0		0		0		0		1
2003	105		0		0		0		0		0		0		0		0		1		0		0		0
2004	0		0		0		0		0		0		0		0		0		0		0		0		0
2005	20		0		0		0		0		0		0		0		0		0		0		0		0

***1985+ group**

**** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1986 year class.

YEAR	NUMBER SCREENED	2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE		1994 RELEASE		1993 RELEASE		1992 RELEASE		1991 RELEASE		1990 RELEASE	
		RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED
1990																						381	0
1991																				165	0		0
1992	17																	210	0		0		0
1993	19															52	0		1		0		0
1994	65													256	0		0		0		0		0
1995	104											0	0		0		0		0		0		1
1996	92									213	0		0		0		0		1		0		0
1997	166							15	0		0		0		0		0		0		0		0
1998	0					84	0		0		0		0		0		0		0		0		0
1999	0						0		0		0		0		0		0		0		0		0
2000	3			0	0		0		0		0		0		0		0		0		0		0
2001	0				0		0		0		0		0		0		0		0		0		0
2002	10	0	0		0		0		0		0		0		0		0		0		0		0
2003	0		0		0		0		0		0		0		0		0		0		0		0
2004	0		0		0		0		0		0		0		0		0		0		0		0
2005	0		0		0		0		0		0		0		0		0		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

**** Will not be updated after 2003.**

Table cont. Norwegian spring spawning herring. Tagging data for the 1987 year class.

Year	Number screened	2002 release		2000 release		1998 release		1997 release		1996 release		1995 release		1994 release		1993 release		1992 release		1991 release	
		Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered	Released	Recovered
1991																				634	0
1992																		1146	0		0
1993	329															1569	0		2		0
1994	259													315	0		0		0		0
1995	90											27	0		1		1		0		1
1996	43									0	0		0		0		1		0		0
1997	224							135	0		0		0		0		0		0		0
1998	8					0	0		0		0		0		0		0		1		0
1999	81						0		0		0		0		0		0		0		0
2000	0			0	0		0		0		0		0		0		0		0		0
2001	22				0		0		0		0		0		0		0		0		0
2002	29	606	0		0		0		0		0		0		0		0		0		0
2003	0		0		0		0		0		0		0		1		0		0		0
2004	0		0		0		0		0		0		0		0		0		1		0
2005	0		0		0		0		0		0		0		0		0		0		0

***1987+group**

**** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1988 year class.

YEAR	NUMBER SCREENED	2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE		1994 RELEASE		1993 RELEASE		1992 RELEASE	
		RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED
1992																		5827	0
1993																5267	0		1
1994	3506													4473	0		2		3
1995	3729											1041	0		0		0		4
1996	1176									2109	1		0		2		3		3
1997	811							1940	0		0		0		0		0		0
1998	148					215	0		0		0		0		1		0		1
1999	12						0		0		0		0		0		0		0
2000	75			118			0		0		0		0		0		0		0
2001	0				0		0		0		0		0		0		1		0
2002	77	37	0		1		0		1		0		0		0		0		0
2003	2		0		0		0		0		0		0		0		0		0
2004	0		0		0		0		0		0		0		0		0		0
2005	0		0		0		0		0		0		0		0		0		0

**** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1989 year class.

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE		1994 RELEASE		1993 RELEASE		1992 RELEASE		1991 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED	RELESED	RECOVERED
1991	0																									801	0
1992	2																							1,737	0		0
1993	3,198																					7584	1		2		0
1994	8,801																			11873	0		2		1		0
1995	9463																	2348	2		10		4		1		0
1996	4636															5170	3		3		5		1		1		0
1997	3346													4103	3		2		0		7		2		2		1
1998	1183											1176	0		0		1		0		0		0		0		1
1999	1179												1		1		1		0		0		1		1		0
2000	790									470	0		1		0		0		0		2		0		1		0
2001	841										0		0		0		2		0		1		1		0		1
2002	286							319	0		0		1		0		0		0		0		0		0		0
2003	460					59	0		0		0		0		0		1		0		0		0		0		0
2004	758			67	0		0		0		0		0		0		0		0		0		0		0		0
2005	306				0		0		0		0		0		0		0		0		0		0		0		0
2006	24	0	0		0		0		0		0		0		0		0		0		1		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1990 year class.

YEARCLASS 1990

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE		1994 RELEASE		1993 RELEASE		1992 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED	RELESED	RECOVERED
1992	0																							0	0
1993	220																					511	0		0
1994	3772																			10784	0		0		0
1995	11632																	3868	0		3		1		0
1996	9009															6171	3		3		9		1		0
1997	9830													4057	2		3		3		7		0		0
1998	2828											2381	2		3		1		1		1		0		0
1999	3402												3		1		2		2		1		0		0
2000	3146									1219	0		1		0		2		2		0		1		1
2001	1057										0		0		0		0		0		2		0		0
2002	1348							1605	0		0		1		0		1		0		0		0		0
2003	1129					56	0		0		0		0		0		1		0		1		0		0
2004	1176			0	0		0		0		0		0		1		1		1		0		0		0
2005	183				0		0		0		0		1		0		0		0		0		0		0
2006	88	0	0		0		0		0		0		0		0		0		0		0		0		

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1991 year class.

YEARCLASS 1991 (IN 2006 THIS IS 1990+ IN THE RELEASED FISH)

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE		1994 RELEASE		1993 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED	RELESED	RECOVERED
1993	54																					26	0
1994	593																			3135	0		0
1995	9502																	21528	1		1		0
1996	19604															25683	6		8		1		0
1997	30952													7129	3		19		21		2		0
1998	12459											6002	0		2		6		8		1		0
1999	14968												6		4		14		7		0		0
2000	18461									3802	4		9		1		10		7		2		1
2001	10032										1		1		2		5		3		1		1
2002	8937							5,878	0		10		9		1		1		1		0		0
2003	9522					1243	0		3		4		7		3		7		4		5		0
2004	14288			91	0		2		1		1		1		4		6		1		2		1
2005	6517				1		1		1		0		2		2		2		1		1		1
2006	1489	39	0		0		0		0		0		1		0		1		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1992 year class.

YEARCLASS 1992

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE		1994 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED	RELESED	RECOVERED
1994	6																			970	0
1995	2564																	4101	0		0
1996	8133															8417	0		0		1
1997	33256													8,353	1		9		9		0
1998	20695											22320	11		7		7		0		0
1999	23790												27		9		4		4		0
2000	31430									16798	8		20		7		15		8		0
2001	14668										3		8		0		4		5		4
2002	17305							9995	0		12		23		2		1		5		0
2003	27306					2,829	0		6		11		11		4		9		8		4
2004	28022			212	0		3		10		19		17		2		7		3		1
2005	14667				0		4		2		6		7		0		2		1		0
2006	3976	20	0		0		0		0		0		3		1		0		1		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1993 year class.

YEARCLASS 1993

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE		1995 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED	RELESED	RECOVERED
1995	104																	0	0
1996	595															519	0		0
1997	7838													976	0		0		0
1998	8102											2015	3		0		0		0
1999	8046												3		0		0		0
2000	9099									2673	2		3		0		0		0
2001	3994										1		0		0		2		0
2002	5577							2832	0		4		2		5		1		0
2003	6612					1020	0		0		11		5		1		4		1
2004	7315			109	0		4		5		6		8		2		0		2
2005	4546				0		1		2		3		1		0		0		0
2006	2820	0	0		0		0		0		0		0		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1994 year class.

YEARCLASS 1994

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE		1996 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED	RELESED	RECOVERED
1996	243															3,152	0
1997	3099													1618	0		2
1998	2929											3752	2		1		2
1999	2896												7		1		4
2000	2450									2278	1		1		0		2
2001	1104										0		1		0		1
2002	1588							1143	0		1		2		1		1
2003	2154					442	0		4		3		0		0		0
2004	1933			94	0		3		0		3		3		0		0
2005	1,087				0		0		1		0		1		0		0
2006	1,028	0	0		0		0		0		0		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1995 year class.

YEARCLASS 1995

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE		1997 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED	RELESED	RECOVERED
1997	211													46	0
1998	215											123	0		0
1999	570												1		0
2000	495									505	0		0		0
2001	376										0		0		0
2002	250							197	0		1		2		0
2003	747					263	0		0		2		0		0
2004	829			25	0		0		0		0		1		0
2005	750				1		0		0		2		0		0
2006	290	0	0		0		0		0		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1996 year class.

YEARCLASS 1996

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE		1998 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED
1998	356											0	0
1999	3303												0
2000	9,807									1,084	0		0
2001	6,838										0		0
2002	5,013							3379	0		0		2
2003	7,439					1,130	0		1		0		0
2004	6,903			260	0		0		1		0		0
2005	4,680				0		2		0		0		0
2006	1,562	14	0		0		0		0		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1997 year class.

YEARCLASS 1997

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE		2000 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED	RELESED	RECOVERED
1999	101										
2000	2161									102	0
2001	2402										1
2002	2415							1869	0		0
2003	5420					2086	0		1		0
2004	3678			802	1		0		0		0
2005	4142				2		0		0		0
2006	2092	14	0		0		2		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1998 year class.

Yearclass 1998

Year of Recovery	Number Screened	2006 release		2004 release		2003 release		2002 release		2000 release	
		Relesed	Recovered	Relesed	Recovered	Released	Recovered	Released	Recovered	Relesed	Recovered
2000	413									0	0
2001	2104										0
2002	3457							3561	0		0
2003	19623					8530	0		3		0
2004	18332			4699	1		5		1		1
2005	33486				5		9		0		0
2006	17732	278	0		2		4		0		0

*** tagging data for 2002 was considered an outlier and thus not included in the analysis**

Table cont. Norwegian spring spawning herring. Tagging data for the 1999 year class.

YEARCLASS 1999

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED
2001	86								
2002	789							541	0
2003	6,240					2,417	0		1
2004	5,677			14,491	2		4		1
2005	18,097				3		1		0
2006	15,649	272	0		7		3		0

Table cont. Norwegian spring spawning herring. Tagging data for the 2000 year class.

YEARCLASS 2000

YEAR OF RECOVERY	NUMBER SCREENED	2006 RELEASE		2004 RELEASE		2003 RELEASE		2002 RELEASE	
		RELESED	RECOVERED	RELESED	RECOVERED	RELEASED	RECOVERED	RELEASED	RECOVERED
2002	100							31	0
2003	1,124					386	0		0
2004	1,566			5,999	0		0		1
2005	4,298				7		0		0
2006	3,670	234	0		2		0		0

Table cont. Norwegian spring spawning herring. Tagging data for the 2001 year class.

Yearclass 2001

Year of recovery	Number screened	2006 release		2004 release		2003 release	
		Relesed	Recovered	Relesed	Recovered	Released	Recovered
2003	150					286	0
2004	758			193	0		0
2005	1,458				0		0
2006	1,941	426	0		0		0

Table cont. Norwegian spring spawning herring. Tagging data for the 2002 year class.

Yearclass 2002

Year of recovery	Number screened	2006 release		2004 release	
		Relesed	Recovered	Relesed	Recovered
2004	825			3	0
2005	7,244				0
2006	22,798	30,322	12		0

Table cont. Norwegian spring spawning herring. Tagging data for the 2003 year class.

Yearclass 2003

Year of recovery	Number screened	2006 release	
		Relesed	Recovered
2006	982	528	0

Annex 3: Technical Minutes of review group of widely distributed stocks

Copenhagen 1–3 October

Participants

Asgier Aglen	(Norway)	
Jan Horbowy	(Poland) Chair for mackerel management plan	
Bob Mohn	(Canada) (External)	
John Simmonds	(UK) Chair	
Valentin Trujillo	(Spain)	
Working Group Chairs:	Manuela Azevedo (IPIMAR, Portugal)	WGHMM
	Beatriz Roel (CEFAS UK)	WGMHSA
	Morten Vintner(DIFRES Denmark)	WGNPBW
	Frans van Beek (IMARES The Netherlands)	WGNPBW

Blue Whiting

The stock is on observation list.

Assessment accepted.

As in former years several models were used for exploratory assessment: AMCI, ICA, ISVPA/TISVPA, SMS, XSA. Final assessment was performed with SMS following the procedure of previous two years. All assessment models showed similar picture of stock and exploitation development (except one setting of TISVPA). The WG could not repeat this year assessment with the same settings as last year as the Norwegian Spawning Stock Survey was not conducted in the same way in 2007 (in assessment survey information from 2007 is used as representing state of stock in 1 January 2007). Thus, this year first time the International Blue Whiting Spawning Stock survey was used. The series is short (2004–2007) and Norwegian survey from recent years has been included in it. To avoid double use of the Norwegian survey in tuning the later was used till 2003. In addition, for tuning younger ages the International Ecosystem Survey in the Nordic Seas was used (ages 1–2). Final assessment was performed as much as possible in similar way as last year and was accepted by the RG.

The WG dealt with ToR c) (discrepancies in landing statistics), however, clear conclusion of the work was lacking. The co-chair informed the RG that the discrepancies between different sources do not create serious problem for the assessment. It would be helpful to reach a final conclusion on the landings data and then include these just to remove the issue.

All assessment methods indicate serious decline in recruitment in recent years. The WG predicted recruitment using regressions of the assessment model recruitment estimates against indexes from surveys. However, three surveys produced very different estimates of year classes 2005–2006. Following last year procedure, the WG took the average of the two larger values as predicted recruitment. However, the SMS estimate of 2005 year class was much lower than the estimate accepted by the WG, and the RG checked that the SMS estimates of recruitment show correlation with commercial catch at age 1 of similar order as with the best recruitment index. The WG is requested to look deeper into the recruitment prediction. The ICES RCT3 program could be tested for predicting recruitment; the program can accept several recruitment indices and optionally, shrinkage to the mean. In addition, in program calibration regression is available and this recommended for use if independent variable (recruitment index) has higher error than dependent variable (predicted recruitment). The WG should investigate and choose a standard procedure for estimating recruitment. This should then be followed unless the WG finds a better supported approach.

In the light of uncertainties in recruitment the WG is especially requested to provide standard sensitivity analyses of short-term prediction (catch and biomass).

The recommendation of the WG to investigate the observed changes in weight at age is strongly supported by the RG.

Norwegian Spring Spawning herring

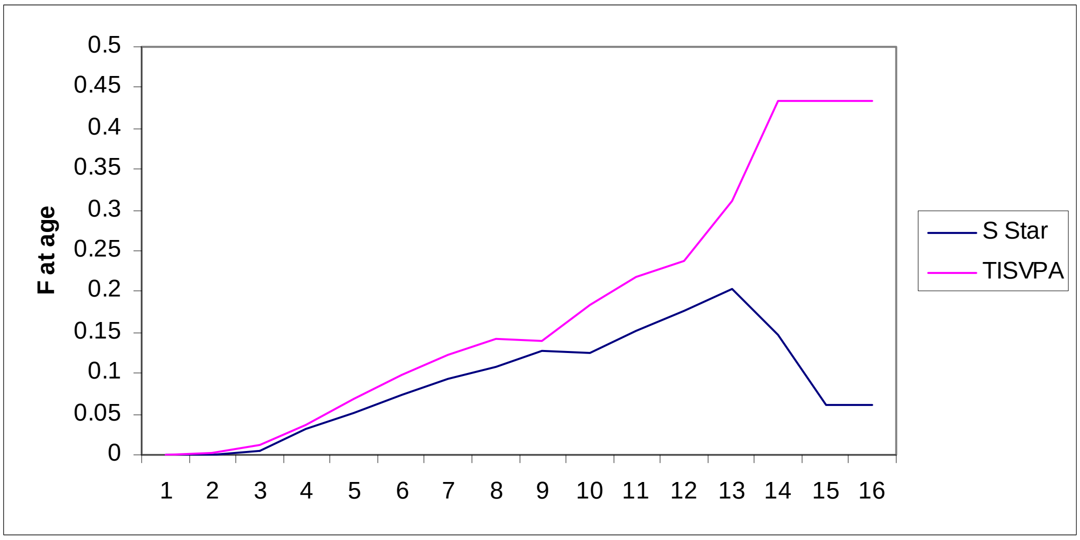
This is an update assessment under the observation list.

The assessment is accepted.

There are a number of issues most of them relatively minor.

Selection at oldest ages

The TISVPA and Seastar have very different selection patterns at oldest ages (14 and older). The basis for this, particularly in Seastar final assessment should be explained. The variability in selection examined and the influence of this on estimates of F0.1 investigated.



Use of surveys in the assessment

A better explanation for the substitution of values of numbers at older ages in some years from surveys would be helpful.

Editorially the report would be helped considerably with clear short consistent titles or nemonics for the surveys. The table of surveys included is inconsistent with survey titles, survey years and ages blocked in black are available in some tables, but it's a little unclear which parts refer to assessment of adults in the main fit and the later evaluation of recruits. Survey 6 years in table 2000 to 2006 but 1990 indicated in the summary table.

Estimates of recruitment for projections

The current procedure seems to be to model recent recruitment in a separate stage. These values are then discarded in favour of values selected from the time series. The WG needs to select an objective procedure for resolving which indices with which weights should be used in what way to derive suitable estimates of recruits for projections. In particular RCT3 package may assist with this task. The current method appears to be an ad hoc rank selection process. Retrospective may help to choose an analytical method to compute recruit values Whether RCT3 or some other method is chosen, the procedure should be agreed, documented and used.

Estimates of selection for projections

The projections presented by the WG use assumptions of stability in selection that are explicitly excluded from the assessment using Seastar. There is a need to harmonise these two aspects so that the choices are explained rationally. The choice of selection pattern for forward projection should be examined and a suitable method chosen that recognises the assumptions in the model and makes the best estimate of selection that can be supported by the information. This may involve averaging over years or projecting selection on cohorts. The different possibilities need to be tested and a well supported method chosen.