The international acoustic survey in the Norwegian Sea in May 2007

R/V DANA Cruise No. 3/2007

Calibration of Echo-sounders

2/5 – 4/5 2007

International Acoustic Monitoring of Herring and Blue whiting

4/5 – 31/5 2007

Cruise participants

Calibration 2 – 4/5

Bo Lundgren	Denmark
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Thyge Dyrnesli	Denmark
Karl-Johan Stæhr	Denmark
Torben Filt Jensen	Denmark
Bjarne Stage	Denmark
Hjalte Partner	Denmark
Bram Couperus	Netherlands

Acoustic monitoring 4/5-14/5

Bram Couperus (cruiseleader) (acoustic)	Netherlands
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Acoustic monitoring 15/5-31/5

Karl Johan Stæhr (Cruise leader) (acoustic)	Denmark
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Background of the survey

The Norwegian spring spawning or Atlanto-Scandian herring stock is highly migratory and straddling, carrying out extensive migrations in the NE Atlantic. After a major stock collapse in the late 1960's the stock has recovered and biomass has varied from approximately 5 to 10 million tonnes during the 1990's.
After spawning from February to March, mainly in the Norwegian Fjord between 62°N to 64°N, the Norwegian spring spawning herring migrate northeast towards feeding grounds in the Norwegian Sea. In general, the main feeding takes place along the polar front from the island of Jan Mayen and northeast in the direction of Bear Island. During the latter half of the 1990's this migration gradually shifted north and eastwards. In the period 2002 - 2004 this development seemed to have stopped as herring had a more southerly distribution at the end of the feeding season than in 2001. After feeding, the herring have concentrated in August in the northern parts of the Norwegian Sea prior to the southern migration towards the Vestfjord wintering area (68°N, 15°E). Since the winter of 2002-2003, part of the stock seems to winter in the Norwegian Sea off Lofoten. In January the southerly spawning migrations begin again.

Besides herring, abundant stocks of blue whiting and mackerel exploit the Norwegian Sea as an important feeding area. Blue whiting is currently is supporting the largest fishery of the Northeast Atlantic. The main spawning areas are located along banks and the shelf edge west of the British Isles. The eggs and larvae can drift both north or southwards, depending on spawning site and oceanographic conditions. The northward drift spreads juvenile blue whiting to all warmer parts of the Norwegian Sea and adjacent areas from Iceland to the Barents Sea. Adult blue whiting carry out active feeding and spawning migrations in the same area. Blue whiting has consequently an important role in the pelagic ecosystems of the area, both by consuming zooplankton and small fish, and by providing a food resource for larger fish and marine mammals.

Objective of the survey

The main objective of this survey is to map the distribution and migrations of herring and other pelagic fish and to assess their abundance. Other objectives are to monitor hydrographic and plankton conditions of the Norwegian Sea and adjacent waters and describe how feeding and migration of herring and other pelagic fishes are influenced by these conditions.

Calibration

The echo sounders Simrad EK60 were calibrated prior to the survey at the Bornö Island in the Gullmar Fjord, Sweden on 3 May 2007.
The calibration was performed according to the procedures followed in 2003 when the echo sounder equipment was upgraded to EK60 with three frequencies (18, 38 and 120 kHz).

This calibration was the first in 2007; a previous calibration was conducted in June 2006. The calibration of the towed body split-beam transducer at 38 kHz was conducted against a 60 mm copper sphere. Calibration of the three hull-mounted split-beam transducers at 18, 38, and 120 kHz were carried out against 63mm, 60 mm, and 23 mm copper spheres respectively.
The results of the calibration for all three frequencies were similar to the previous calibrations in 2006. The calibration parameters used during the survey (and for abundance estimates) are shown in the text table.

EK 60 calibration parameters May 2007		
	EK 38 kHz Hull	**EK 38 kHz Paravane**
Transducer name	ES38B	ES 38BP
Max Power	2000.0	2000.0
2 way beam angle	-20.50	-20.50
Gain (pulse dur. 1024)	24.91	25.53
Sa correction	-0.50	-0.59
Angle sensitivity - alongship	21.90	21.90
Angle sensitivity - athwartship	21.90	21.90
3dB beam width - alongship	6.87	6.80
3dB beam width – athwartship	6.74	6.86
Angle offset – alongship	-0.05	0.03
Angle offset – athwartship	0.09	-0.02

Materials and methods

Acoustic data

The survey is coordinated by ICES and includes EU countries, Norway Iceland, Russia and Faeroe Islands. The EU contribution this year consisted of the Netherlands, Denmark, Ireland, Sweden, England and Germany. The Danish research vessel “Dana” conducted the EU survey part. The acoustic survey tracks of Dana are shown in figure 1.
Acoustic data was collected with EK60 using a 38 kHz splitbeam transducer, mounted in a towed body (paravane). During trawling, acoustic data was collected by the EK60 using the hull mounted 38 kHz transducer: the recordings during trawling were only used for scrutiny of the echograms. Echo integration was conducted for 24 hours per day.

Acoustic monitoring was limited to the first 750m from the surface for all frequencies. Scrutinization was confined to the top 500m.

As the maximum depth during the survey has been fixed on the EK60 for all frequencies at 750 m all depth information’s stored in the SIS data base can not be used for data on total depth during the survey

For the first half of the survey the data was scrutinized regularly during the survey by use of the Simrad BI500 software. At the beginning of the second half of the survey, 18 May, the BI500 broke down and the Database structure was damaged. Data for the remaining part of the survey were stored raw files on the EK60 system. This data has been replayed to a BI500 system ashore for scrutinized. Due to the brake down of the BI 500 system acoustic data from 68º 35N, 3º 58W until 68º 35N, 0º 41E were damaged and could not be scrutinized.

Hydrographical and zooplankton data

Plankton sampling took place at 60nm intervals using a WP2 net in vertical hauls from 200m to the surface. Breaking with the standard operating procedure outlined in the survey manual, two WP2 hauls were conducted at each station in the 2007 survey. The complete contents of the first WP2 net sample were fractioned using the standard sieves, dried and frozen for weighing. The second WP2 sample was separated into halves using a plankton splitter. While the first half was fixed in a 4% formaldehyde-sea water solution for species identification in Norway, while the second was fixed in Alcohol for special studies at DIFRES.

Each plankton haul was preceded by a CTD cast to a maximum depth of 1000m or 5m above the seabed using the Seabird CTD unit connected to a rosette water sampler. Altogether Dana carried out 47 combined CTD and WP2 stations (Figure 1). Water samples were taken at maximum depth as well as at 20m in order to calibrate the conductivity sensors of the CTD unit

Water surface conditions (temperature and salinity) and weather conditions (e.g. wind direction, wind speed etc.) were continuously monitored during the survey using R/V Dana's hydrographic and meteorological analysis system.

Biological data

The acoustic recordings were verified by fishing with a 2000 mesh pelagic Fotö midwater trawl. Fishing was carried out when there was doubt about the species composition of the marks observed on the echo sounder, and to obtain biological samples of herring and blue whiting. In general, after it was decided to make a tow, the vessel turned and fished back on its track line. Trawls took place at a range of depths from the surface to 450m depending on the layer of interest at the time. In total 35 trawls were made during the survey, covering all transects but with bias towards those sections where high fish densities were observed on the echo sounder (Figure 1). Details on trawl hauls and catches are given in Table 1 and 2.

For each trawl the total weight and weight of each species was recorded. Length measurements were taken for all species, for herring to the lowest ½ cm and for all others to the lowest 1 cm. With bulk catches of herring and blue whiting, or very numerous amounts of small mesopelagic fish, catches were split into sub-samples. For herring and blue whiting sub-samples, 50 fish were retained for ageing, length, weight and maturity stage while a further 200 were length measured only. Ageing tissue for herring was scales while for blue

whiting otoliths were taken. In all 16 hauls contained herring while 13 contained blue whiting with the majority of these being too small to subsample. For herring and blue whiting subsamples of 50 fish were taken. Ageing material is to be delivered to Norway for reading.

Trawl data were entered into the Babelfisk database and all data were checked. Data will also be put into the PGNAPES formats and sent to IMR, Bergen at the end of the survey.

Biomass estimation

Data collected during this cruise will be included in an overall dataset containing data from all other participating vessels in the International Acoustic Survey in the Norwegian Sea. The final estimate methodology will be presented at the PGNAPES meeting in August 2007 and included in the PGNAPES report.

Itinerary of the survey

R/V Dana left Hirtshals, Denmark on Wednesday 2nd of May at 08:00. On the 2nd of May the calibration site "Bornö" near Lysekil in Sweden was reached. Calibration took place on the 3rd of May. The next morning Dana returned to Hirtshals for a crew change and to take delivery of a commercial trawl to be used in the survey. Problems with the trawl specification delayed departure from Hirtshals until 13:00hrs on the 5th May. On the 6th May Bergen was visited to collect trawl doors from IMR. Echo integration started on transect at 11.45 on the 7th of May and continued until 10.45 on the 14th of May when Dana broke off track for a crew change in Bodö, Norway. The cruise track and echo integration was resumed again 20.30 on the 15th of May and completed on the 27th of May at 21.30. Dana headed south towards Hirtshals and arrived at 31 May at 06:00 hours thereby finishing the survey.

Results

Acoustic data

Herring schools were more scattered than last year. And for large areas no tracies of herring were identified. The distributions of identified herring are shown in Figure 2 and 4.

Blue whiting was this year only identified in the northern part of the survey area by DANA. The distributions of identified blue whiting are shown in Figure 3 and 5.

Acoustic data has been delivered to the survey coordinator in PGNAPES format.

Fisheries data

Details on trawl haul conditions and catches are given in Table 1 and 2. Length distributions for herring and blue whiting per station are shown in Table 3 and 4.

All fisheries information has been delivered to the survey coordinator in PGNAPES format.

Hydrographic conditions and zooplankton biomass

Information's on temperature and salinity by 10 meter intervals for all CTD stations has been delivered to the survey coordinator in PGNAPES format.

Data for plankton biomass for all WP2 stations has been delivered to the survey coordinator in PGNAPES format.

Discussion

Trawling

In the 2004 to 2006 Dana surveys, it was questionable if the trawl samples when fishing on schools were representative of the composition of the recorded schools. Trawl results were thought only to be representative when fishing took place on layers or many small schools. Targeting schools when they were comparatively large and separated from other schools was never successful. For most trawls there seemed to be no relationship between the size of the echoes and the size of the catch. Whether fishing on a layer of blue whiting echoes or on no echo at all at the same depth, the catch was always a few baskets. The same applied to herring in the upper layer, but that may have been caused by herring swimming above the transducer.
The circumference of the trawl opening in the Fotø trawl is about the same as for the Åkra trawl, which is routinely used by the Norwegian vessels in pelagic surveys (Fotø trawl 397m vs. Åkra trawl 384m). GO Sars is able to veer the trawl lines much quicker, which is an advantage for fishing in midwater. However, that may still not be enough to catch samples representative of schools recorded by the echosounder. For example, during an inter-ship calibration in March 2006 between GO Sars and the Dutch research vessel Tridens, the total GO Sars catch of blue whiting was smaller than the catch of Tridens. More importantly the length profile of the GO Sars fish were smaller. Tridens used a commercial trawl of 1040m circumference. According to observers on commercial trawlers, with trawls of this size, it is possible to hunt dense school of herring and blue whiting in midwater. Therefore it was in 2006 recommended to use a larger commercial trawl for future Dana blue whiting and herring surveys.
A commercial trawl, Gloria Helix with an opening of **XX** m. was tested at the beginning of this year's survey. Unfortunately, there were problems in tests with twisting bridles, which could not be solved, and it was decided to use the normal Fotø trawl for the rest of the survey. It is recommended that the search for a larger midwater trawl for use in next years survey be continued.

Maturity

The most important aspect of scoring maturity is to distinguish between juvenile and adult fish, stages 8 and 2 respectively. The herring maturity scale adopted by PGNAPES does not include sufficient detail to accurately guide the cruise biologists. To overcome this, the eight scale maturity stage endorsed by PGHERS was adopted as the scale reference for herring maturity as it is quite explicit in describing all stages of maturity for both male and female, and states quite clearly the continuity between stages eight and three which is all important in distinguishing between spawners and pre-spawners. It is strongly recommended that the PGHERS eight stage maturity scale be adopted by PGNAPES and used in all future Norwegian Sea international acoustic surveys.

Scrutinization

In the light of the problems that occurred with the scrutinization of the echo recordings during second half of this year survey due to the breakdown of the BI500 system, there is a need to switch to another scrutinization system for future surveys.

The scrutiny procedure currently in use by the Norwegian and the European vessel is heavily based on changing the threshold in order to distinct herring, blue whiting and mesopelagic fish from zooplankton. It is not possible to copy this procedure easy in Echoview, because every separate species-composition needs to be saved as a class.

Therefore is recommended that PGNAPES look into this matter during their meeting in August 2007. Methodology for the use of EchoView as a system for scrutinization should be carefully described in a revised manual for the survey before next year survey.

Furthermore, it is recommended that PGNAPES organize a scrutinization workshop for the countries participating in the International acoustic survey in the Norwegian Sea. Such workshops have been conducted for the Acoustic survey in North Sea organized by PGHERS and have resulted in improved quality of scrutinization by each of the participating countries.

Plankton

In the procedure for the handling of plankton samples described in the manual for the survey samples are divided into two equal halves. During last years survey it was found that the plankton splitter was unable to divide the sample into equal halves.
To overcome this two samples with the WP2 net were taken at each station during the 2007 survey. The first WP2 net sample was filtered in the standard way and dried and frozen for weighing. The second WP2 sample was split in two halves by the plankton sampler with the first half fixed in 4% formaldehyde and seawater for species identification in Norway while the other half was fixed in Alcohol for special studies at DIFRES.

Revision of the manual for the Acoustic survey in Norwegian Sea

During the survey the *Manual for Acoustic surveys on Norwegian Spring Spawning Herring in the Norwegian Sea and Acoustic Surveys on Blue Whiting in Eastern Atlantic*, Version 1.0, September 2006 were studied and discussed.
For the maturity it was found that that the tables for maturity stating were incorrect and misleading (see section *Maturity* above). Furthermore it was recognized that species codes for to be used for data export to PGNAPES database were insufficient and incorrect.
It is recommended that the Manual for this survey should be merged with the manual made by PGHERS for the herring survey in the North Sea.
A more detailed list of comments and ideas for the existing manual was made by one of the participants, Frans van Beek and will be send to PGNAPES for discussion on the next meeting in August 2007. This list is attached to this report as an appendix.

Table 1. Trawl hauls Acoustic in Norwegian Sea, Cruise 03/2007 7 May to 27 May 2007

Date dd-mm-yy	Haul no.	Time UTC	ICES Square	Position Latitude	Longitude	Trawling depth m	Total catch kg	Trawling duratin min,	Main Species	Trawl Direction deg.	Trawling speed Kn	Wind speed m/s	Sea state
07-05-07	6	18:58	54F2	64 47.179 N	002 56.526 E	200	16.3	30	**Peralside, Krill**	19	3.6	9.3	4
08-05-07	9	02:07	54F4	62 56.974 N	004 27.486 E	30-70	7.2	30	Mackerel , Krill	44	3.0	6.5	3
09-05-07	18	06:50	55F0	63 33.258 N	000 23.354 E	40	27.4	61	Herring	169	3.7	11.5	5
09-05-07	19	12:57	56F0	64 02.892 N	000 20.502 E	30-40	48.3	60	Mackerel, Herring	177	3.0	9.0	6
11-05-07	32	06:55	59F4	65 04.596 N	004 51.425 E		51.5	60	Krill	262	3.6	3.7	1
11-05-07	35	14:55	59F2	65 06.701 N	002 53.017 E	150	10.8	60	Krill	319	3.5	3.2	1
13-05-07	46	05:55	61F3	66 20.051 N	003 37.259 E	0-40	28.8	60	Herring	276	4.1	5.9	2
13-05-07	49	17:37	61F7	66 20.022 N	007 08.517 E	surface	21.7	60	Salmon, Lumpsucker	273	3.6	7.4	2
16-05-07	57	09:03	64F7	67 40.965 N	007 36.102 E	350-425	5.3	78	Krill, Isprikfisk	93	3.5	9.9	5
16-05-07	60	22:57	64F4	67 39.033 N	004 03.989 E	15-50	121.7	60	Herring	107	3.7	9.4	5
17-05-07	65	15:20	64E9	67 40.790 N	000 24.310 W	200-250	7.5	60	Blue Whiting	87	3.6	6.9	3
18-05-07	68	02:20	64E6	67 40.007 N	003 35.505 W	surface	11.2	60	Herring, Lumpsucker	288	3.5	5.6	3
18-05-07	71	13:14	65E4	68 25.586 N	005 01.829 W	320-340	44.1	65	Herring	190	3.5	13.8	5
19-05-07	76	10:03	66F0	68 35.032 N	000 33.003 E	525	5.5	60	Isprikfisk, Blue Whitting, Krill	269	3.6	5.4	3
19-05-07	79	18:56	66F2	68 35.271 N	002 27.697 E	300-375	19.9	60	Herrring, Blue Whiting	275	3.4	6.1	2
20-05-07	84	09:49	66F6	68 35.767 N	006 52.682 E	400-445	6.2	60	Blue Whiting, Krill, Isprikfisk	276	3.5	3.7	2
20-05-07	85	14:19	66F7	68 34.757 N	007 49.707 E	10-50	440.0	60	Herring	271	3.6	6.5	3
20-05-07	86	17:20	66F7	68 35.048 N	008 03.974 E	290-325	3.3	60	Isprikfisk	271	3.9	7.5	3
21-05-07	89	02:10	66F9	68 56.544 N	009 51.265 E	surface	4.0	60	Lumpsucker, Herring	251	3.6	7.1	4
21-05-07	92	16:59	68G0	69 32.832 N	010 29.355 E	15-35	835.0	64	Herring	88	4.1	8.4	3
21-05-07	95	23:47	68F8	69 32.239 N	008 59.378 E	surface	280.0	60	Herring	90	3.8	2.1	2
22-05-07	98	08:53	68F6	69 32.929 N	006 21.378 E	20-40	2.5	60	Lumpsucker	75	3.6	11.0	4
22-05-07	101	23:00	68F1	69 35.404 N	001 56.273 E	325-360	92.4	60	Herring	14	3.4	6.3	4
23-05-07	105	06:07	68F0	69 32.503 N	000 42.722 E	250-300	4.7	42	Blue Whiting	94	3.7	3.9	1
23-05-07	106	11:02	68E9	69 31.921 N	000 22.866 W	400	7.1	109	Herring, Blue Whiting	109	3.3	1.8	2
23-05-07	107	14:52	68E9	69 32.213 N	000 33.291 W	6-28	1.7	60	Lumpsucker	264	3.5	7.0	3
23-05-07	110	20:55	68E7	69 32.378 N	002 07.753 W	400	8.8	60	Krill, Blue Whiting	271	3.9	5.9	3
24-05-07	111	02:23	68E6	69 35.258 N	003 45.532 W	350	2.4	60	Herring	95	3.2	5.6	3
24-05-07	118	23:27	70E6	70 44.887 N	003 03.263 W	80-100	3.2	61	Invertebrates	270	4.1	12.4	
25-05-07	121	09:36	70E9	70 44.266 N	000.26.051 W	400	2.8	60	Herring, Blue Whiting	266	4.4	14.1	
26-05-07	126	05:59	70F5	70 44.240 N	005 32.247 E	410	8.2	65	Herring, Blue Whiting	273	4.2	9.3	3
26-05-07	127	09:35	70F5	70 44.857 N	005 43.921 E	10-30	4.2	60	Lumpsucker	263	4.3	14.5	6
26-05-07	128	13:48	70F6	70 44.220 N	006 14.005 E	280-320	1.5	60	Blue Whiting	279	3.6	14.1	6
27-05-07	131	07:22	70G0	70 42.872 N	010 32.497 E	325-400	8.5	62	Blue Whiting,Readfish, Saith	229	3.9	11.1	5
25-05-07	134	16:25	70G2	70 45.058 N	012 21.185 E	20-40	2.3	60	Lumpsucker	268	4.2	11.6	4

Table 2. Species composition per trawl haul

	Station no.	6	9	18	19	32	35	46	49	57	60	65	68	71	76
	Trawling Depth, m	200	30-70	40	30-40		150	0-40	surface	350-425	15-50	200-250	surface	320-340	525
Common English	Total catch, kg	16.305	7.2	27.408	48.269	51.500	10.800	28.846	21.739	5.302	121.718	7.458	11.172	44.100	5.484
Saithe	Pollachius virens	2.666													
"Jellyfish"sp.	Scyphozoa	0.198													
Snake pipefish	Entelurus aequoreus	0.046	0.36	0.652	0.262	0.086	0.149	0.058		0.068	0.070	0.002			0.003
Pearlside	Maurolicus muelleri	8.037	0.591			4.946				0.020					0.001
Krill	Euphausiaceae	5.368	2.009			46.468	9.541	0.530		2.672					0.918
Mackerel	Scomber scombrus		3.388	1.604	24.375										
Herring	Clupea harengus			25.152	21.440			22.500			112.100	0.206	6.322	44.100	
Lumpsucker	Cyclopterus lumptus		0.852		2.192			2.800	8.804		9.500		4.770		1.160
Salmon	Salmo salar							2.958	12.935						
Squid sp.	Cephalopod sp.										0.048		0.080		0.010
Blue whiting	Micromesistius poutassou									0.700		7.248			1.090
Lanternfish	Benthosema glaciale						0.547			1.694					1.892
Deepwater redfish	Sebastes mentella														
Shrimp sp.	Decapod						0.547								
Invertebrates sp.															
Hatchetfish	Argyropelecus hemigymnus														
Northern barracudina	Paralepis coregonoides						0.018			0.168					
Risso's barracudina	Arctozenus rissoi														0.410

Table 2. continued

	Station no.	79	84	85	86	89	92	95	98	101	105	106	107	110	111
	Trawling Depth, m	300-375	400-445	10-50	290-325	surface	15-35	surface	20-40	325-360	250-300	400	6-28	400	350
Common English	Total catch, kg	19.986	6.194	440.000	3.252	3.986	835.000	280.000	2.515	92.362	4.722	7.148	1.770	8.771	2.404
Saithe	Pollachius virens														
"Jellyfish"sp.	Scyphozoa														
Snake pipefish	Entelurus aequoreus	0.020	0.004	0.080	0.024	0.014	0.024		0.025		0.014	0.002			0.014
Pearlside	Maurolicus muelleri		0.001		0.020									0.001	
Krill	Euphausiaceae	0.422	1.749									0.424	0.032	3.422	0.368
Mackerel	Scomber scombrus														
Herring	Clupea harengus	13.030		439.258		0.770	834.976	275.922		91.000		4.308			1.722
Lumpsucker	Cyclopterus lumptus			0.662		3.202		4.078	2.164			0.518	1.670		
Salmon	Salmo salar														
Squid sp.	Cephalopod sp.								0.326		0.038	0.200	0.062	0.240	0,088
Blue whiting	Micromesistius poutassou	5.658	3.472							0.620	4.134	1.484		3.590	0.152
Lanternfish	Benthosema glaciale	0.178	0.939		2.057						0.008	0.076	0.006	0.068	0.060
Deepwater redfish	Sebastes mentella	0.548								0.742					
Shrimp sp.	Decapod	0.014			0.995										
Invertebrates sp.											0.496				
Hatchetfish	Argyropelecus hemigymnus		0.001												
Northern barracudina	Paralepis coregonoides														
Risso's barracudina	Arctozenus rissoi	0.116	0.028		0.156						0.032	0.136		1.450	

Table 2. continued

	Station no.	118	121	126	127	128	131	134
	Trawling Depth, m	80-100	400	410	10-30	280-320	325-400	20-40
Common English	Total catch, kg	3.200	2.830	8.238	4.238	1.502	8.503	2.278
Saithe	Pollachius virens						3.216	
"Jellyfish"sp.	Scyphozoa							
Snake pipefish	Entelurus aequoreus							0.016
Pearlside	Maurolicus muelleri						0.001	
Krill	Euphausiaceae		0.442	0.290			0.398	
Mackerel	Scomber scombrus							
Herring	Clupea harengus		0.670	5.126			0.122	
Lumpsucker	Cyclopterus lumptus				3.962	0.370		2.262
Salmon	Salmo salar							
Squid sp.	Cephalopod sp.		0.286	0.186	0.276	0.026		
Blue whiting	Micromesistius poutassou		0.568	1.870		1.002	2.340	
Lanternfish	Benthosema glaciale		0.084	0.766			0.130	
Deepwater redfish	Sebastes mentella		0.722				2.262	
Shrimp sp.	Decapod							
Invertebrates sp.		3.200				0.094		
Hatchetfish	Argyropelecus hemigymnus							
Northern barracudina	Paralepis coregonoides							
Risso's barracudina	Arctozenus rissoi		0.058			0.010	0.034	

Table 3: Length distribution of herring by haul

	Station																	
Length in cm	18	19	46	60	65	68	71	79	85	89	92	95	101	106	111	121	126	131
20.5			1															
22				3.7														
23									14.9		270.6							
23.5									14.9		116.0							
24			1	7.4						1	425.2							
24.5									29.9		38.7							
25			1	3.7					74.7		154.6							
25.5				3.7					29.9	1	154.6							
26									74.7		193.3							
26.5			3	7.4					59.8		270.6							
27			4						74.7	1	231.9							
27.5	1		4	14.9					134.5		193.3		2.9					
28			4	22.3					224.1	1	270.6		8.7					
28.5			11	29.8				3	283.9		541.2	34.4	5.8					1
29	2		15	44.7			1.4	2	313.8		463.9	43.0	17.4				2	
29.5	3	1	13	63.3		2	7.0	9	254.0		695.8	94.6	32.0				2	
30	5	3	14	108.0		1	12.7	12	239.1		116.0	128.9	46.5	2			1	
30.5	9	4	14	70.8		4	32.4	12	254.0		657.2	206.3	52.3	2			4	
31	17	14	7	96.8	1	7	40.9	14	164.4		347.9	309.5	95.9	1	2	1	5	
31.5	16	13	10	55.9		5	39.5	4	44.8			128.9	43.6	1	2	1	2	
32	15	19	5	14.9		3	25.4	3	14.9		77.3	103.2	49.4				5	
32.5	13	10	1	7.4		4	11.3	2				68.8	29.1	1				
33	10	8	1	3.7		1	5.6	2				51.6	11.6	3	1	1	1	
33.5	7	6	1	11.2			4.2			1		34.4	20.3				1	
34	6	8	1	3.7		1	12.7					17.2	5.8	4				
34.5	1	2	1			1	2.8	1				17.2	5.8	3	1		1	
35	2	2	1				1.4						2.9					
35.5	1						1.4						2.9					
36				3.7										1				
36.5									29.9						1			
37		1		3.7								8.6	2.9					
37.5			1															
38.5									14.9									
Total	108	91	114	580.9	1	29	198.7	64	2345.7	5	5218.7	1246.4	436.1	18	7	3	24	1
Mean Length	31.86	32.21	29.74	30.07	31.00	31.48	31.51	30.57	28.91	27.60	27.87	31.06	31.14	32.81	32.71	31.83	31.17	28.50

Table 4: Length distribution of blue whiting by haul

	Station												
Length in cm	57	65	76	79	84	101	105	106	110	111	126	128	131
23		3		3									
24	2	4		9			2					1	2
25	2	10	3	12	5	2	4	3			1	1	7
26	2	8	3	16	15	3	8	6	2		2	4	5
27	1	17	2	9	8	1	10	1	9		5	2	7
28		12	1	1	1		7	1	9		1	1	1
29		4	1	2	2		1	1	5	1	4		
30					1			1	1				
31							1		1		1		
Total	7	58	10	52	32	6	33	13	27	1	14	9	22
Mean Length	25.29	26.45	26.40	25.58	26.47	25.83	26.73	26.54	27.89	29.00	27.64	26.11	25.91

Figure 1. CTD stations, WP2 stations and trawl stations taken by R/V Dana from 7 May to 27 May 2007.

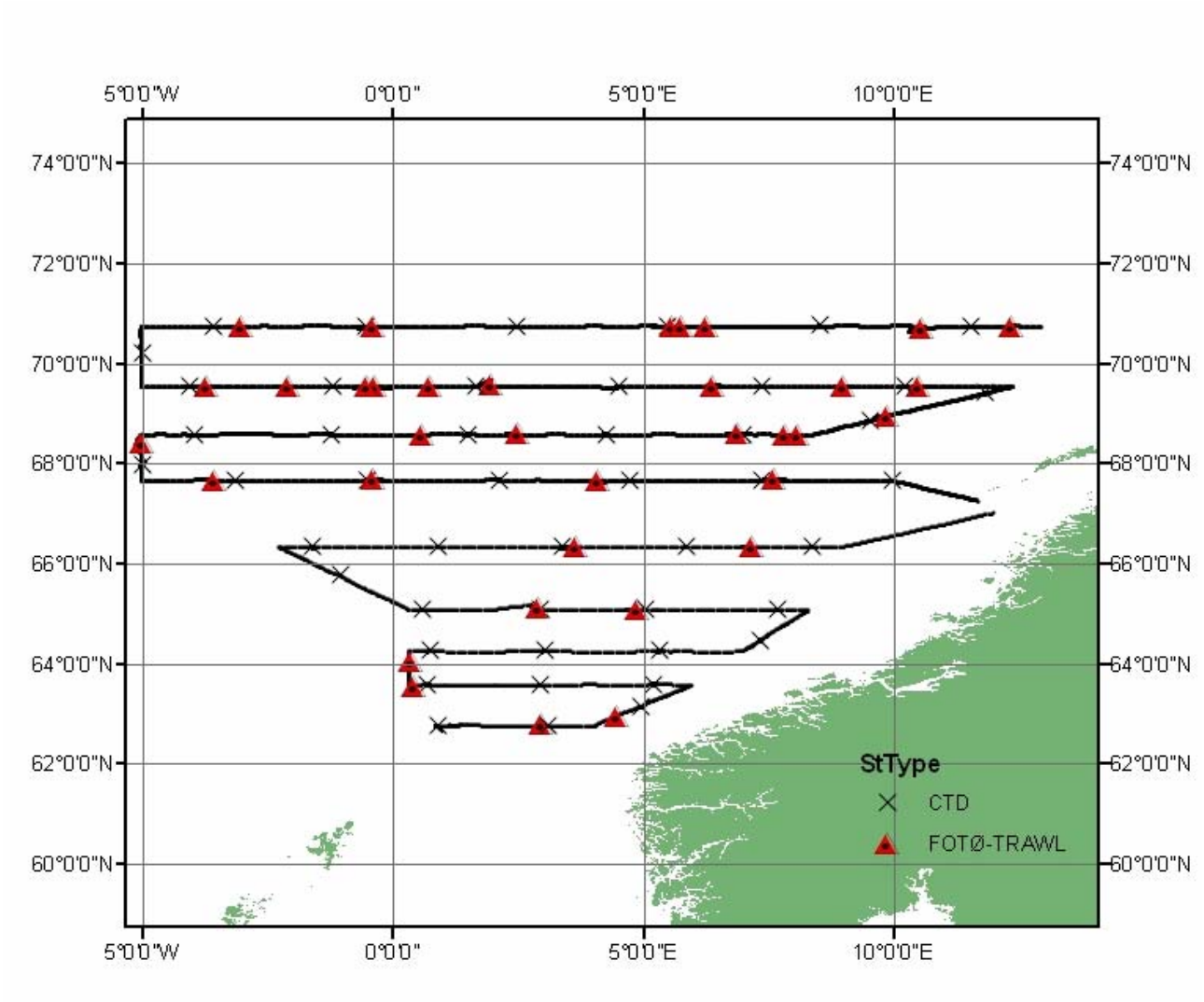


Figure 2. Distribution and area echo abundance (mean NASC per 5 nm) of herring recorded by R/V Dana during 7 May to 27 May 2007.

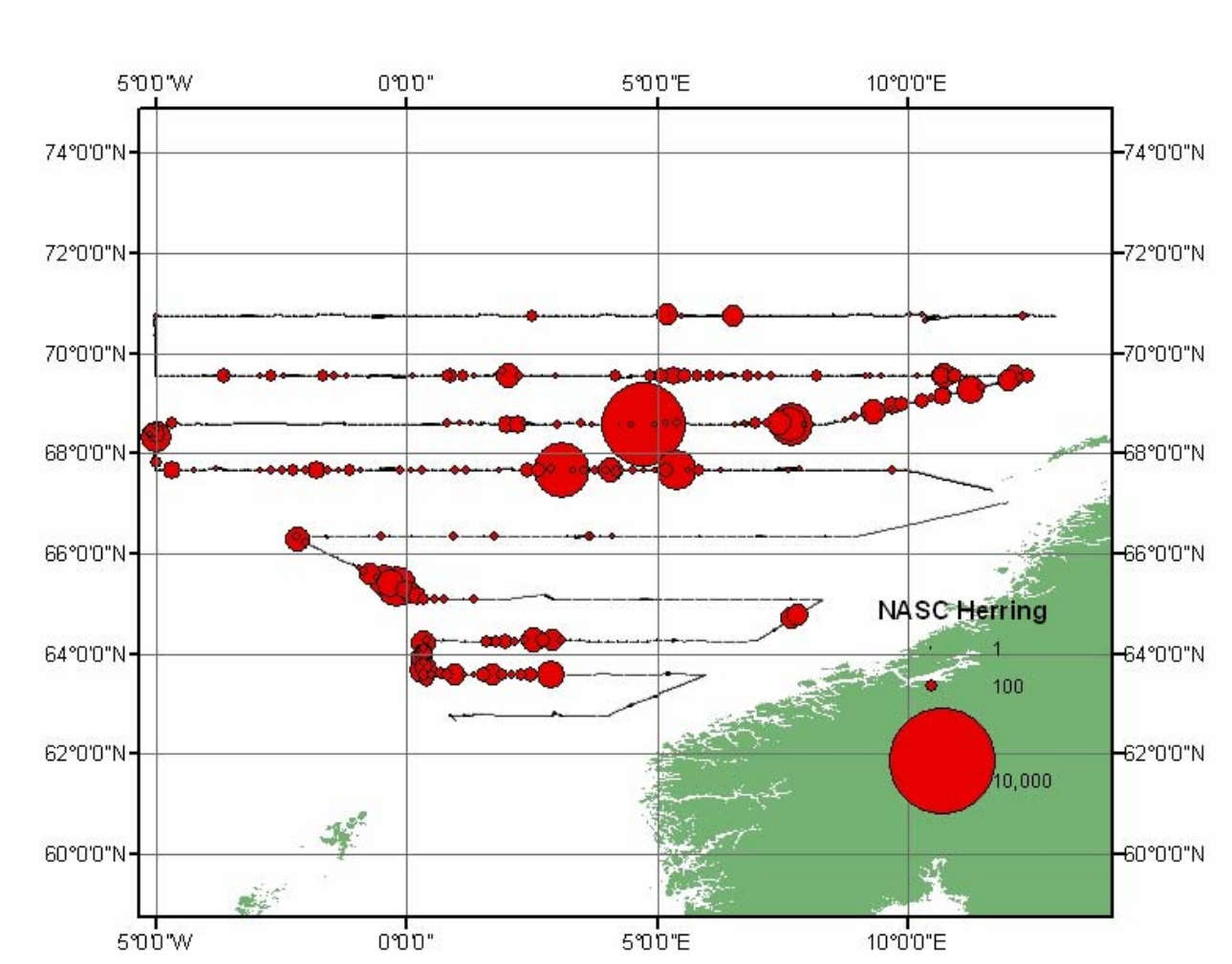


Figure 3. Distribution and area echo abundance (mean NASC per 5 nm) blue whiting recorded by R/V Dana during 7 May to 21 May 2007.

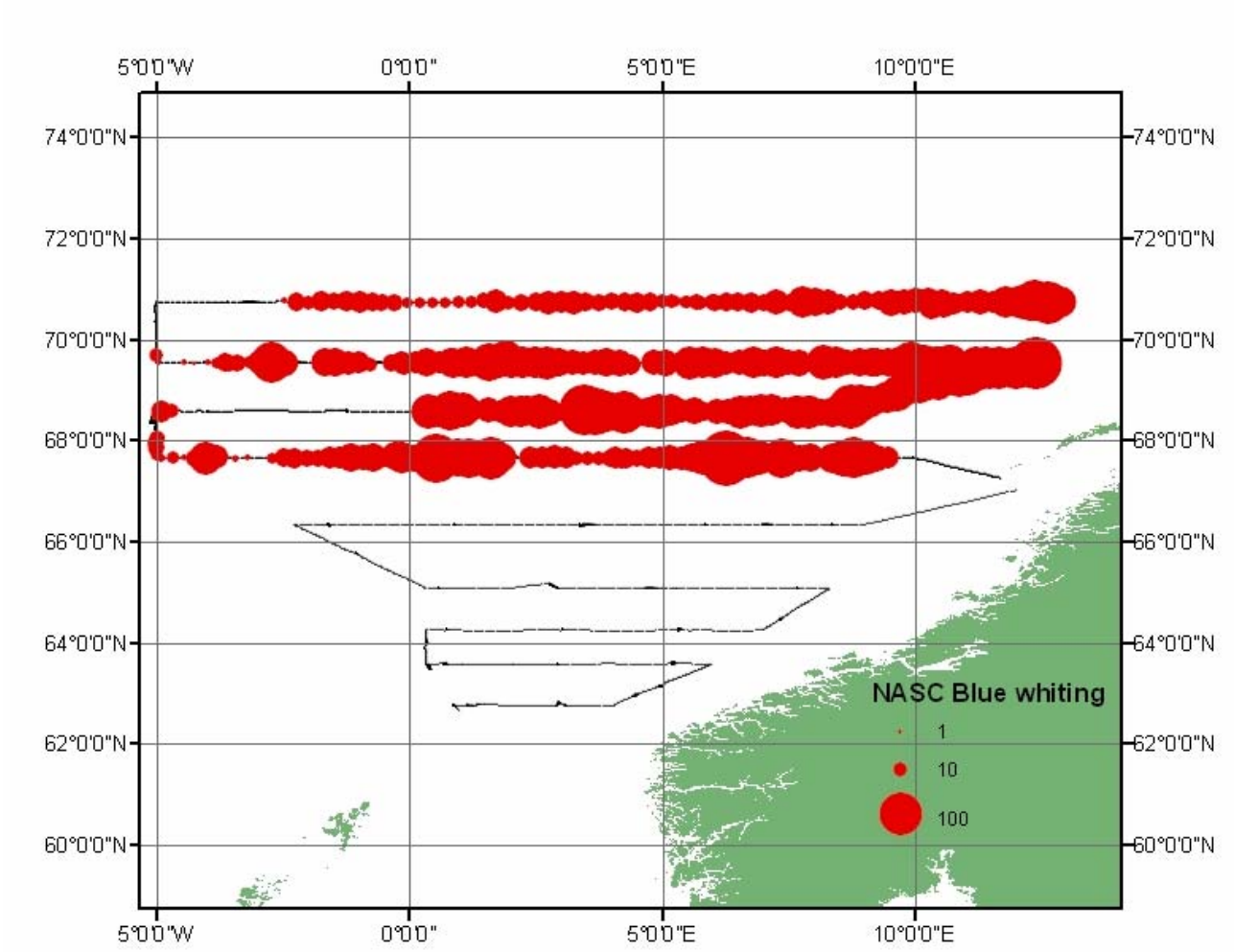


Figure 4. Mean area echo abundance (NASC's) of herring by grid cells recorded by R/V Dana during 7 May to 27 May 2007. Map made with BI500 software.

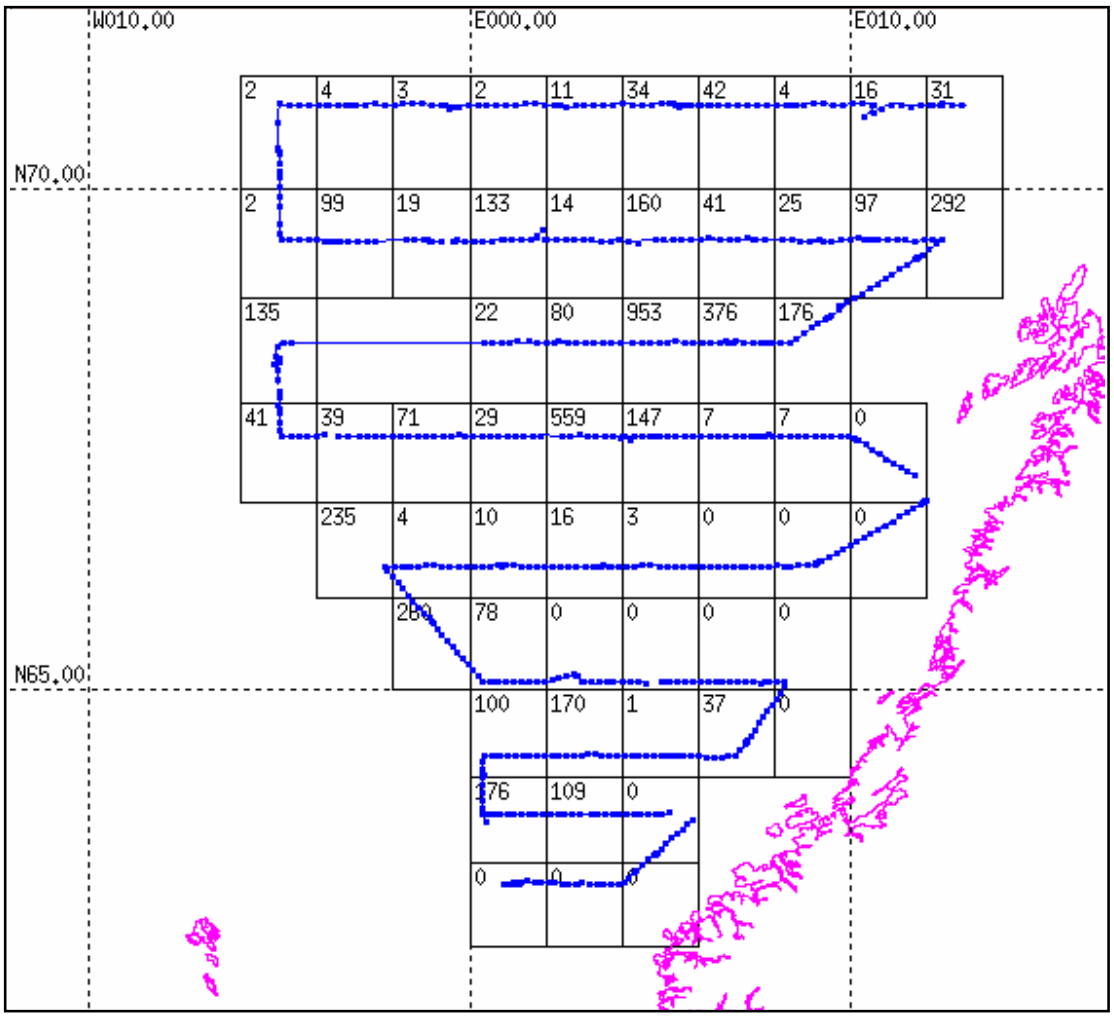
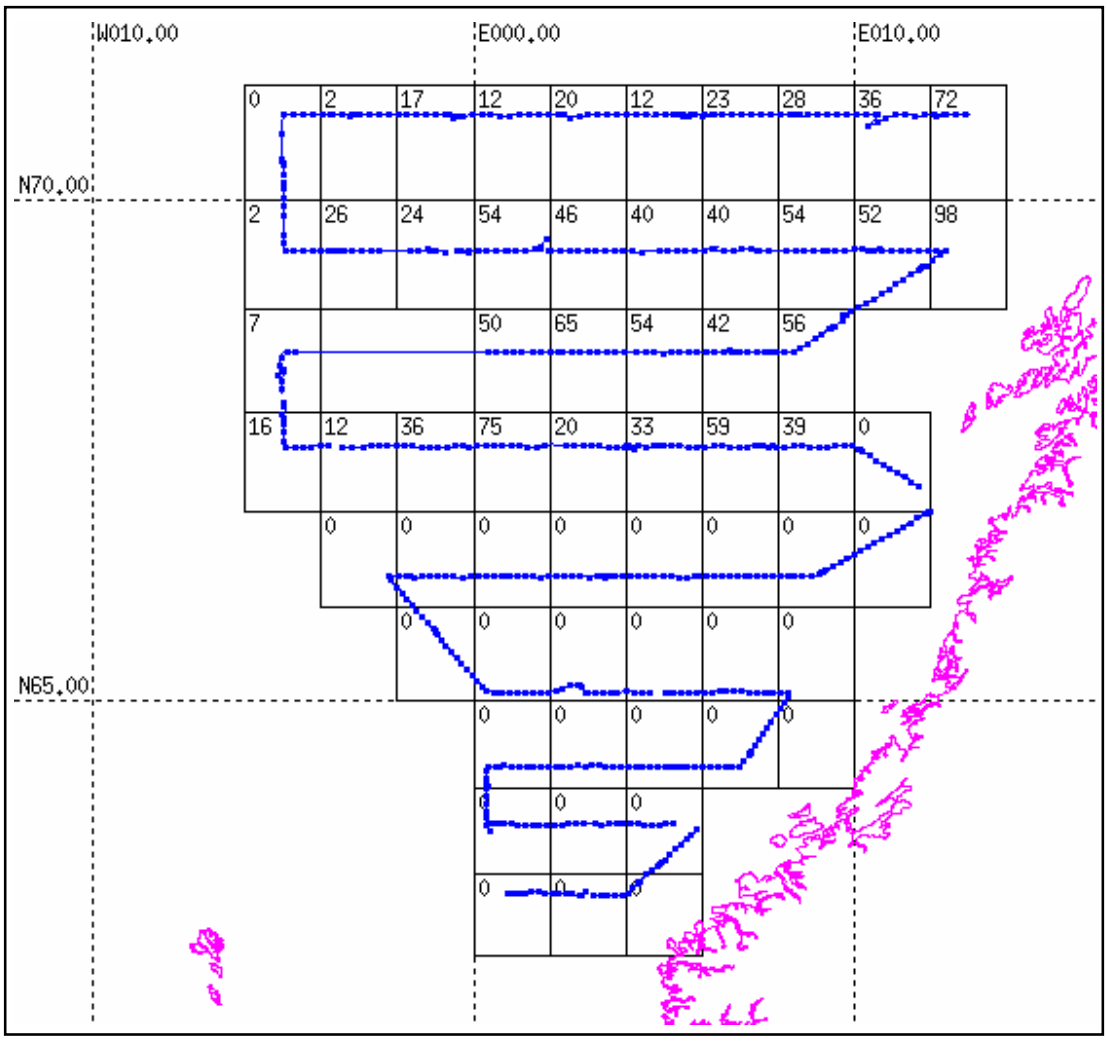


Figure 5. Mean area echo abundance (NASC's) of blue whiting by grid cells recorded by R/V Dana during 7 May to 27 May 2007. Map made with BI500 software.



Appendix I

Notes to the improvement of the ASH and BW survey procedures and survey manual

- The survey manual needs an introduction with
  - the aim of the surveys with reference of the DCR
  - overview of survey methods applied
    - acoustics
    - trawl
    - plankton
    - hydrography
  - definition of the survey areas and periods
  - listing the participating countries and how they cooperate
  - a reference to the requirement of an annual cruise plan for each vessel in a separate document. This document should contain:
    - trajectories to be survey
    - stations to be sampled (CTD, Plankton)
    - additional sampling requirements
    - coordination between vessels
    - deadlines for (partial) data results and reports
- This manual contains instructions and descriptions of procedures to be applied by all countries. In addition, request for national manuals describing national procedures during the cruise such as
  - data recording and storage
  - administration
  - back up procedures
  - lists of accessories needed for sampling and identification
- Coordination of the survey (coordinating vessel) and procedures of exchange of information during the survey
- Sampling of the trawl catch
  - weighing of the catch (components)
  - guidelines for subsampling and sorting
  - instructions measurements of length, weight and biological parameters by species
  - species and methods to be aged
  - It is recommended to compile a list of species which are regularly caught
    - scientific names
    - point specific features which discriminate them of other related species
    - photographs
- include instruction to indentiy all species to the exact species name and if this is not possible samples should be taken to indentify later ashore.
- consider the measurement of length composition of (subsamples olf) all species
- The chapter dealing with the maturity stages needs to be checked and updated.
  - There are errors in the herring key.
  - Propose to include color photographs of the different stages.
  - It should be made absolutely clear whether we mean maturation of the fish of maturation of the gonad.

- Expand the plankton section and discriminate between the sampling of the plankton and processing of the plankton catch
- Expand the hydrography section with instructions on how the CTD should be operated, discriminating between operations (speed, depth) and measurements (temperature, salinity, fluorescence and oxygen)
- Chapter on acoustics to be consider by users
    - expand by instructions how to mount towed body
    - distinguish between
        - calibration
        - operation (data collection)
        - interpretation
        - integration
- Include picture with zones on herring where scales should be taken
- Consider to include qualitative recording of stomach contents by haul
    - percentage full, half full or empty
    - diet: fish, plankton, krill
- record sightings of potential predators (whales, cetaceans)
- (not for the manual) The methods of calculation of SSB should be reconsidered by PGNAPES. Do we include fish which mature during the current year but have not spawned yet in the SSB. If so, the SSB cannot be compared to the SSB in the assessment which is at the beginning of the year.
- (not for the manual) consider that the scientific crew should cover all expertises needed. Expertise fields are: acoustic, database, hardware, taxonomy, plankton sampling, otoltih preparation etc.