

Working document of  
**Planning group on Northeast Atlantic Pelagic Ecosystem Surveys (PGNAPES)**  
 Hirtshals, Denmark, 19-22 August 2008  
 and  
**Working Group on Widely distributed Stocks (WGWIDE)**  
 ICES, Copenhagen, 2–11 September 2008

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**Report on Survey A6-2008 – R/V Arni Friðriksson, TFNA (Iceland)**

**Pelagic fish off W- S- and SE-Iceland and the western Norwegian Sea  
 29 April - 22 May**

*Part of the joint Northeast Atlantic Pelagic Ecosystem Surveys in 2008  
 (see ICES PGNAPES report, August 2008)*

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***The objectives***

The survey is a part of an annual international survey in the NE-Atlantic with the objectives to explore: (1) through acoustical measurements, the distribution and quantity of Norwegian spring-spawning herring, blue whiting and mackerel; and (2) hydrographical- and zooplankton communities' conditions. The abundance estimates are used in the fish stock assessment of Norwegian spring spawning herring and blue whiting in ICES Working Group on Widely distributed Stocks (WGWIDE).

***Participants in the Survey onboard R/V Árne Friðriksson***

<b>29 April - 12 May</b>	<b>12 – 22 May</b>
<b>Scientific staff:</b>	
Þorsteinn Sigurðsson, cruise leader, acoustics	Guðmundur J. Óskarsson, cruise leader, acoustics
Friðrik Guðmundsson, acoustics, technology	Friðrik Guðmundsson, acoustics, technology
Leifur Adalsteinsson, biological trawl samples	Leifur Adalsteinsson, biological trawl samples
Jóhann Gíslason, biological trawl samples	Agnar M. Sigurðsson, plankton
Gerður Palsdóttir, plankton	Gerður Palsdóttir, plankton
Aðalbjörg Jónsdóttir, plankton	Ragnhildur Ólafsdóttir, biological trawl samples, aging of herring
	Haraldur Einarsson, acoustics, capturing pelagic trawl fishery on film
	Einar Hreinsson, acoustics, capturing pelagic trawl fishery on film
<b>Captain:</b>	
Kristján Finnsson	Guðmundur Bjarnason

## ***Survey description***

In order to assess blue whiting concentrations west and south of Iceland, the survey began on 29 April at the shelf edge west of Iceland, just south of the Dohrn Bank and from there continued south at and on either side of the shelf break to the Reykjanes Ridge.

South of the Reykjanes promontory (SW-Iceland) the general course was eastwards, running along and just off and in over the outer shelf. From SE-Iceland the area between Iceland and Faroe Island was covered or the area from 62°N to 64°N, between approximately 09°W and 13°W, i.e. blue whiting concentrations inside the Icelandic and the western Faroese EEZs. A short intermission from the blue whiting part was taken on 5 May, when the vessel sailed to Torshavn in the Faeroe Island to take on fuel. After six hours stop in Torshavn, the survey continued and during the following days continued northwards along E/W transects spaced at about 30 n.m. intervals, starting from 63°05' N.

On 12 May, the vessel ceased the measurements on the transect 66°10' N and sailed to a harbour off east Iceland, Norðfjörður, for substitute some of the crew and scientist members onboard. The survey continued then following a 12 hrs stop.

The next day was used for filming a fish sorting grid embedded to a pelagic trawl as the vessel sailed towards the transect at 66°10' N to complete it. The following days, the survey continued northwards along E/W transects spaced at about 30 n.m. intervals but 40 n.m. intervals north of 66°50' N. The western boundary was generally about 12°W, i.e. the survey went well into the cold waters of the East Icelandic Current. The eastern limits were generally around 09°W but increased gradually to 02°W between 65 and 69°30' N.

During the latter part of the survey (from 12 May), performance of two different sorting grids in front of codend and one pelagic trawl, as well as the behaviour of pelagic fish against it, were captured on a film. This work did not interrupt the acoustic measurements during the survey but elongated the survey about one and a half days. The results of this project are neither given nor discussed in this report.

The final CTD and WP-2 station was taken on 20 May at 69°22' N and 10°50' W, where the vessel headed then towards Bakkafjörður off northeast Iceland, where it was on 22 May.

## ***Materials and methods***

### Survey design

The survey design was of two types. First, when assessing blue whiting west and south of Iceland, a zig-zag course was adopted as in these waters the target fish almost always occur in a narrow strip near the shelf edge. By running diagonally in and out of the recordings this type of survey setup gives a longer time among blue whiting recordings and thus better coverage in addition to be less time consuming. When coming east to the southwestern Norwegian Sea the survey design was changed to parallel E/W courses spaced at about 30 n.m. but was increased to 40 n.m. as the quantity of herring diminished. This was according to the predetermined plan and is a better way of surveying an open ocean where fish distribution can be assumed to be random rather than following any predetermined course.

### Equipment and sampling

Acoustic scatters were recorded continuously by a Simrad EK500 echo sounder and post-processed using a BI 500 integrator with a plankton sieve threshold of -70dB. The remaining echoes were then stored in their respective categories (mainly herring and blue whiting) as 1 mile averages and averaged again over every 5 miles. In order to get an idea of how well herring densities were represented by the echo sounder, Kaijo Denki low and high frequency sonar were run continuously throughout the survey. However, formal school counts were not made. Acoustic instruments and settings on RV Árni Friðriksson were the same as in the summer 2007 survey and are described in details in Table 1.

Sea temperature and salinity were measured from surface to bottom using a SeaBird CTD. At bottom depths greater than 1000 m, recordings were stopped at that depth. Inter-station distance was generally in the range of 30-50 n.m. A total of 55 CTD stations were carried out during the cruise (Table 3).

A WP2 net was used to quantify zooplankton volume at each CTD location, with three exceptions. Two vertical hauls were made at each station, i.e. from 50 m and 200 m to the surface at total 52 stations (Table 3). On every third station, an additional 50 m haul was made.

Acoustic records were sampled fairly regularly by a pelagic trawl, Gloria 1024 (Table 2). As usual, the decision to collect samples was taken on the basis of observations of the echo recordings, where length of time elapsed since the last haul effected also the decisions. A total of 27 hauls were taken, which were aimed for collection of fish samples and two additional for filming the fishing gear (Table 3). The fishing gear worked well and there were few empty hauls.

The total catch per species and the treatment of the samples is given in Table 4.

## **Results**

### Hydrography

Like in the last few years both temperature and salinity were above average in the warm Atlantic water south and west off Iceland (temperature ranging from 6°- 9°C and salinity 35,1 - 35,3) according to the spring survey on RV Bjarni Sæmundsson in May 2008 (MRI, 2008). In the upper water masses off the north coast, the temperature was just below the long-term mean but the salinity was around the mean level. The temperature and the salinity in the East-Iceland Current north-east off the Icelandic shelf was just above and around long-term mean. Finally, the conditions in the upper water masses on the shelf off the east coast were around the long-term mean.

Location of waters of the East Icelandic Current was similar to the last two years or in fairly large areas northeast and east of Iceland and reached south to about 65°30N with an eastern border between about 7° and 08°W (Figure 1). Furthermore, the Atlantic water reached further west north of 68°N or to around 9°W, which is comparable to last year's condition.

The cruise transects are shown on Figure 2 (E off Iceland) and Figure 3 (off W and S Iceland), while the location of CTD and WP2 stations are shown on Figure 1 where they represent the temperature at different depths.

### Zooplankton

The density of zooplankton is shown on Figure 2 as ml of fresh samples. According to the annual spring survey on RV Bjarni Sæmundsson in May 2008, the zooplankton density was near the long-term mean off the west coast, just below mean off the north coast, and around and above mean off the east coast. Off the south coast, the zooplankton density was twice the mean value, especially *Calanus finmarchicus*. Generally, the zooplankton density was higher in all areas than in the year before (2007), except for the northern area (MRI, 2008).

### Blue whiting

Practically no blue whiting were recorded west off Iceland and very little around the continental edge south off Iceland west of 15°W (Table 5; Fig. 3). East of 15°W between 62°N and 63°N there were some concentrations. Blue whiting was also observed between 63°N and 65°N in small amount and again in a small area SE of Jan Mayen, at around 68°N and 2°W.

South of Iceland and west of 15°W there was a dominance of one year olds (year class 2006; 24% by biomass) as well as three (27%) and four years old (28%) but the total estimated biomass in that area was only around 100 thousands (Tables 5). Further east (E of 15°W and including Faroese waters) there were mainly older fish which in the southernmost part included post spawners migrating north.

### Herring

The distribution of Norwegian spring-spawning herring was similar to the last year distribution or more westerly and southerly than in most recent decades (Figure 4). Herring was observed more or less continuously from around 64°05'N and east of 12°W north to 69°N. North of 67°N, the distribution was more easterly with westerly limits at around 4°W, or near the cold arctic water. The herring was often observed in many, continuous, small schools near the surface at 20 to 50 m depth, but considerable large schools were also observed and then usually deeper. There seems to be limited relation between the density distribution of the herring (Figure 3) and zooplankton (Figure 2).

The total abundance estimate came to about 2.6 million tons, as detailed in Table 6. The weighed mean length was 32.9 cm of the estimated  $1.0 \times 10^{10}$  individuals in the acoustic estimation (Table 7a). Overall, the most numerous year class was the one from 2002 (41%) and those from 1998 and 1999 contributed to 15 and 20%, respectively, of the total number (Table 7b). When limiting the acoustic estimations to Icelandic waters, only 27% belonged to the 2002 year class and 21 and 26% to the 1998 and 1999 year classes, respectively. This difference is because that the herring in the NE part were generally smaller and younger herring than the herring further south.

The herring was in poor condition and the weight at length was lower than in last year's May survey. If that can be explained by the fact that this year survey took place around 10 days earlier than the 2007 survey can not be stated at this point. The herring starts to gain weight as soon as they start to feed on the feeding grounds.

## ***Discussion***

The results from the salinity and the temperature measurements in A8-2007, as well as the results from the annual spring survey aimed to record the hydrographic and environmental conditions in Icelandic waters (May survey on RV Bjarni Sæmundsson; Anon. 2008), indicate that the hydrographic conditions of Icelandic waters in 2007 are fairly mild and close to the long-term mean. Noteworthy, is that the temperature and the salinity off the east coast are though near the long-term-mean.

The distribution of the herring now is similar to the May 2007 distribution, or much more southerly and westerly than in previous years and it needs to go back to the 1960s to find a resemblance. The amount of herring was though less now than in 2007 survey in the Icelandic zone. The reason is considered to be that this year survey is about 10 days earlier than the last year survey. Information from the Faroese survey, that took place east of the Icelandic survey area, indicated that herring was widely distributed further east. Western migration was therefore probably still ongoing.

It is not a surprise that it is mainly older herring that appears in the Icelandic waters as they are generally observed in the front of migrating herring beside that the 1998 and 1999 year classes (now at age 10 and 9) are obviously still numerous in the stock.

Because of the observation of more southerly and westerly feeding migration of the herring stock in the last two years in comparison to the last four decades, it is important to put more capacity and resources than has been in recent years to monitor the stock's migration and distribution. Recording the migration route of the stock within the Icelandic waters should be given higher priority, and should be set as a task for the next year.

The herring was often observed in the upper layer of the ocean, at 20-50m depth, which is the surface layer that was started to warm up according to the hydrography results. Despite this horizontal distribution, there were usually little indications for avoidance to the approaching vessel by comparing sonar and EK 60 records, but a clear avoidance was though observed in some periods, which causes an underestimation in the herring abundance estimate. The degree of underestimation is impossible to judge. The Icelandic assessment was conducted under excellent weather conditions for most of the survey with no retardation.

The almost disappearance of blue whiting west of 15°W, south and west of Iceland, could be something to worry about. Recruiting year classes have often been numbered in that area, and this could indicate that the current recruiting year classes are weak.

## **References:**

MRI 2008. Environmental conditions in Icelandic waters 2007. Marine Research Institute, Iceland, Fjölrít No. 139: pp. 40.

**Table 1.** Acoustic instruments and settings for the primary frequency (boldface) on RV Árni Friðriksson in the May 2008 survey.

Echo sounder	Simrad EK 500
Frequency (kHz)	<b>38</b> , 18, 120
Primary transducer	ES38B
Transducer installation	Drop keel
Transducer depth (m)	8
Upper integration limit (m)	15
Absorption coeff. (dB/km)	10
Pulse length (ms)	1.027
Band width (kHz)	2.425
Transmitter power (W)	2000
Angle sensitivity (dB)	21.9
2-way beam angle (dB)	-20.9
Sv Transducer gain (dB)	
Ts Transducer gain (dB)	24.64
sA correction (dB)	-0.84
3 dB beam width (dg)	
alongship:	7.31
athw. ship:	6.95
Maximum range (m)	750
Post processing software	Simrad BI500

**Table 2.** The properties of the pelagic trawl used on RV Árni Friðriksson in the May 2008 survey.

	Gloria 1024
Circumference (m)	640
Vertical opening (m)	45-55
Mesh size in codend (mm)	40
Typical towing speed (kn)	3.0-4.0

**Table 3.** Overview of number of the different stations in the different areas in the survey A6-2008.

Station type	Number				Total
	Icelandic waters	Faroese waters	International waters	Jan Mayen waters	
Pelagic trawling	19	4	3	2	28
CTD	36	4	6	9	55
WP-2	33	4	6	9	52
Filming of pelagic trawl	2*	4	1	1	4
Total	88	16	16	21	137 <sup>‡</sup>

\*Both jointly with a biological sampling

<sup>‡</sup>The CTD and WP2 stations share the same station number in the database, thus the total number of stations is actually 88.

**Table 4.** The number of samples in survey A6-2008 for the different fish species and how they were treated onboard.

Species	Counted	N length determined	N aged	N maturation determination	N weighed	Catch (tons)
<b>Blue whiting</b>		713	475	712	475	1.275
<b>Herring</b>		4623	1100	1100	1100	23.150
<b>Mackerel</b>		3	3	3	3	0
Cod		4				
Haddock		1				
Saith		24				0.250
Lumpsucker		1		1		
Deep sea red fish		11				
Skjótta skata ( <i>Raja</i> <i>Amblyraja</i> <i>hyperborea</i> )		1				
Gulllax ( <i>Argentina</i> <i>silus</i> )		1				
Laxsíld ógr. (Myctophidae sp.)		1				
Urrari ( <i>Eutrigla</i> <i>gurnardus</i> )		2				
Álsnípa ( <i>Nemichthys</i> <i>scolopaceus</i> )		1				
Litla geirsili ( <i>Arctozenus rissoi</i> )		46				
<b>Total</b>		<b>4622</b>	<b>1578</b>	<b>1816</b>	<b>1578</b>	<b>24.675</b>

**Table 5.** Length stratified abundance estimates of blue whiting in number and weight off the south coast of Iceland between 20°W and 15°W in May 2008 (no blue whiting was observed west of 20°W).

Length (cm)	Mean weights (g)	Number of length measurements	N (millions)	Biomass (tons)
20	41	2	0.6	25
21				
22				
23				
24				
25	85	1	0.3	26
26	114	7	2.1	244
27	135	7	2.1	289
28	144	15	4.6	660
29	156	23	7.0	1096
30	169	11	3.4	569
31	192	12	3.7	703
32	212	5	1.5	324
33	215	2	0.6	131
34	267	2	0.6	163
<b>Total</b>		<b>87</b>	<b>26.6</b>	<b>4232</b>

**Table 6.** Overview of the acoustic measurements of herring in A6-2008 for different areas.

Area	Herring tow samples	SA-value	N (millions)	Biomass (10 <sup>3</sup> tons)
Icelandic waters	8	6530	5322	1 443
International waters	3	3772	3252	766
Jan Mayen waters	1	1919	1639	389
Total	12	12221	10214	2 598

**Table 7.** The total acoustic estimation of herring in A6-2008 for (a) the different length groups and (b) the different age classes.

<b>a.</b>			<b>b.</b>		
Length (cm)	Total number (millions)	Biomass (10 <sup>3</sup> tons)	Age (years)	Total number (millions)	Biomass (10 <sup>3</sup> tons)
28	55	9.8	4	116	21.8
29	169	29.2	5	785	165.0
30	660	135.1	6	4593	1063.2
31	1679	363.1	7	312	81.0
32	1983	463.5	8	615	167.8
33	1848	472.6	9	1837	517.3
34	1597	445.8	10	1335	384.3
35	1184	343.8	11	159	47.9
36	638	202.4	12	73	23.2
37	289	96.7	13	66	21.3
38	100	31.9	14	88	28.7
39	11	4.0	15	113	36.4
40	0	0.1	16	97	31.7
			17	25	8.4
Total	10214	2598.0	Total	10214	2598.0



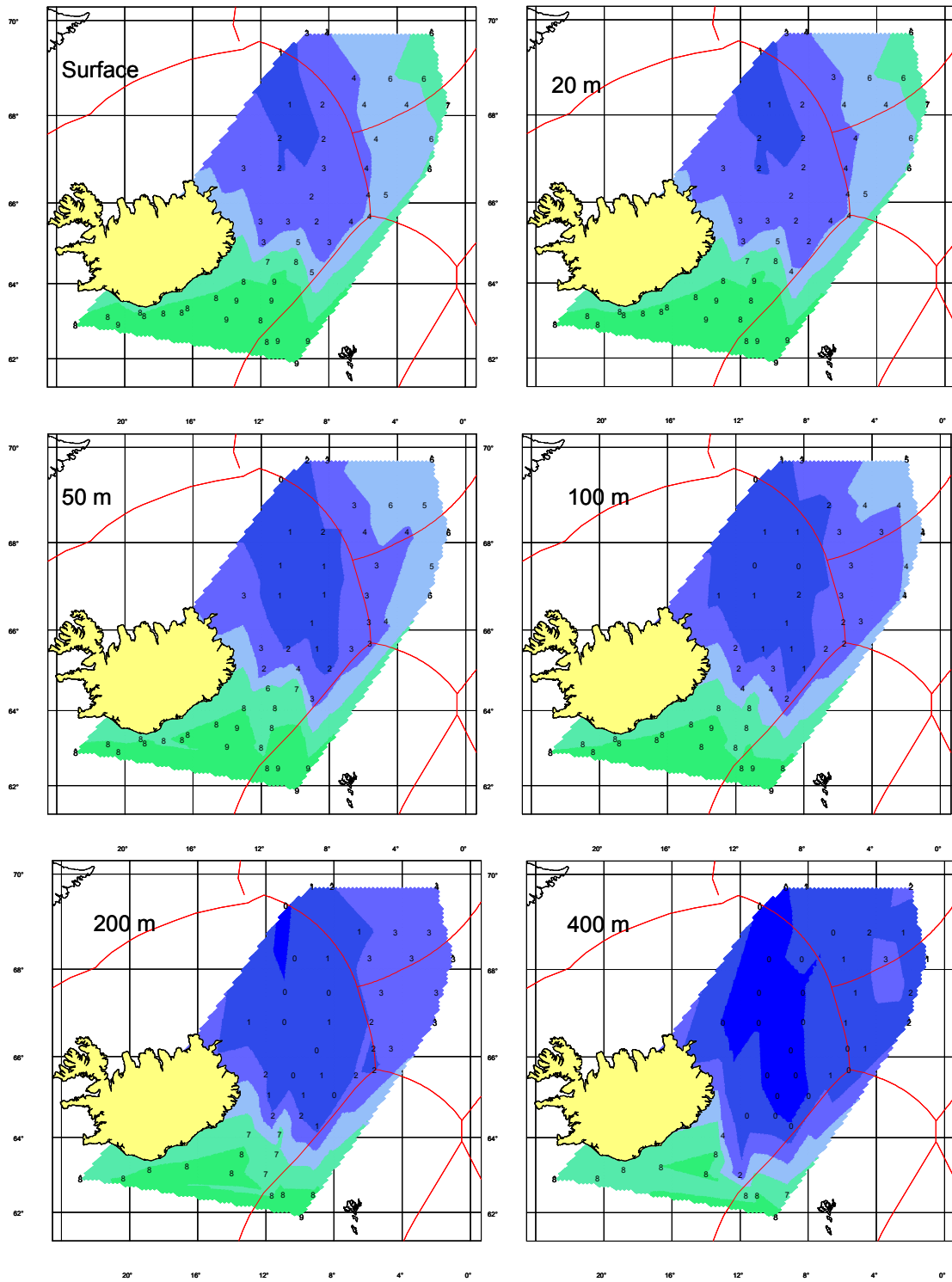


Figure 1. Temperature at surface, 20 m, 50 m, 100 m, 200 m and 400 m as measured in the May survey 2008 (A6-2008).

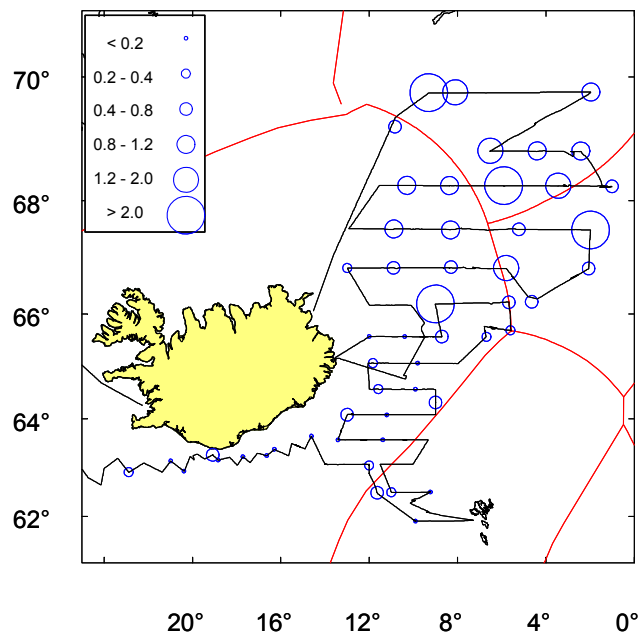


Figure 2. The relative density of zooplankton (fresh zooplankton;  $\text{ml m}^{-3}$ ) in the upper most 50 m as recorded by Arni Fridriksson in May 2008.

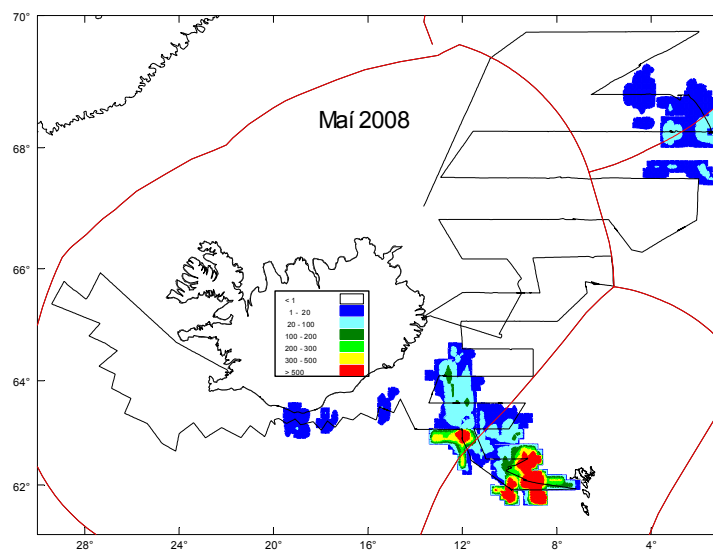


Figure 3. The relative density of blue whiting (Sa values) in the acoustic survey on RV Árne Friðriksson in May 2008.

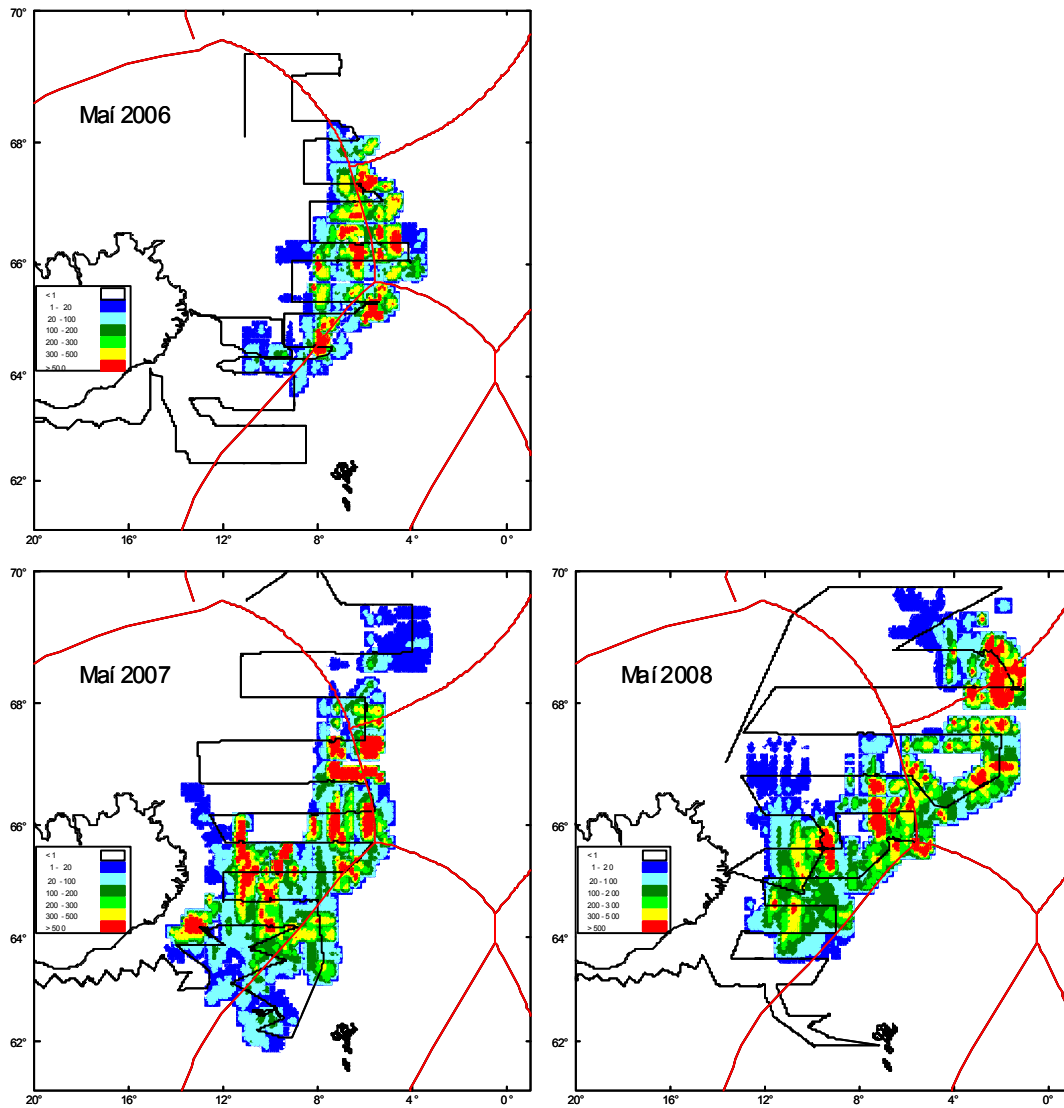


Figure 4. SA-values for Norwegian spring-spawning herring in May survey 2006 (on the top), May survey 2007 (down to left) and now in May 2008 (down to right).