21 Shallow Pelagic *Sebastes mentella*

21.1 Stock description and management unit

This section addresses the fishery for shallow pelagic *S. mentella* in the Irminger Sea and adjacent areas (parts of Division 5a, subareas 12 and 14; eastern parts of NAFO divisions 1F, 2H and 2J) at depths shallower than 500 m. No information was available on number of vessels participating in the fishery in 2017–2020.

21.2 Summary of the development of the fishery

The historic development of the fishery can be found in the Stock Annex. The clear changes in the spatial pattern of the fishery can be seen in Figure 21.2.1, based on logbook data from the Faroe Islands, Greenland, Iceland and Norway. A summary of the catches by ICES Divisions/NAFO regulatory area as estimated by the Working Group is given in Table 21.2.1 and Figure 21.2.2. The estimated catch for 2020 is 6152 t compared to 3184 t caught in 2019 (Tables 21.2.1 and 21.2.2).

There are no CPUE data for 2017-2020. The standardized CPUE index trend for the period 1994–2006 is shown in Figure 21.2.3. This standardized CPUE series includes data from Faroe Islands, Iceland, Germany, Greenland, and Norway, and it is estimated with a GLM model including the factors year, ship, month, and towing time. The model residuals are in Figure 21.2.4.

21.3 Biological information

There are no new data. The length distributions for the period 1989–2006 of biological stocks based on Icelandic data are shown in Figure 21.3.1. The length of the largest proportion of caught fish oscillates around 35 cm for the whole period.

21.4 Discards

Redfish form aggregations composed of individuals with a narrow size range, which results in very clean catches. Thus, discards are negligible according to available data from various institutes.

21.5 Illegal Unregulated and Unreported Fishing (IUU)

The Group had again difficulties in obtaining catch estimates from several fleets. Furthermore, there are problems with misreported catches from some nations. The Group requests NEAFC and NAFO to provide ICES in time with all the necessary information.

21.6 Surveys

The last international trawl-acoustic survey for the shallow pelagic stock was carried out in June–August 2021 and it is described in detail in ICES WGRS Report 2021 (ICES, 2021). Only one vessel from Russia participated in the survey. Iceland informed WGIDEEPS in December 2020 that it would not participate, and Germany had to withdraw its participation because of a broken vessel. Russia therefore surveyed the German part and were able to cover Subareas A, B, and E

(Figures 21.6.5 and Figures 21.6.6). The coverage of the shallow pelagic stock was considered adequate and most of the distribution area covered, except in the western and southern part (Figure 21.6.1).

21.6.1 Survey acoustic data

Since 1994, the results of the acoustic survey show a drastic decreasing trend from 2.2 million t to 600 000 t in 1999 and fluctuated with decreasing trend between 700 000 t–90 000 t in 2001–2013 (Table 21.6.1). The 2003 estimate, however, was inconsistent with the time series due to a shift in the timing of the survey.

The most recent trawl-acoustic survey on pelagic redfish (*S. mentella*) in the Irminger Sea and adjacent waters that covers the whole distribution of the stock was carried out by Iceland, Germany, and Russia in June/July 2013. Approximately 341 000 NM² were covered. Figures 20.6.1 and 20.6.2 show the biomass estimates for depth shallower than the DSL (Depth Scattering Layer). A total biomass of 91 000 t was estimated acoustically in the layer shallower than the DSL (Table 21.6.1 and Figure 21.6.4). The results showed a substantial biomass decline in subarea B compared to 2011 but in other areas the biomass was similar as in 2011 (Table 21.6.2 and Figure 21.6.5 for area definition).

The survey in 2021 (ICES, 2021) covered Subareas A, B and E (Figures 21.6.5 and 21.6.6) and 242 000 NM² was covered compared to only 103 000 NM² in 2018 (when only Subarea A was covered) and 341 000 NM² in 2013 (Table 21.6.1). An estimate of 490 000 t was measured acoustically in the layer shallower than the DSL which is the highest value observed since 2005 (Table 21.6.2). This is a substantial increase in biomass estimates compared to previous surveys. The biomass estimates in Subarea A is the highest since 1996 and in Subarea B the highest since 2001, while the biomass estimates in Subarea E is among the highest value observed in the time series (Table 21.6.2). It is likely that the whole distribution area of the stock was not covered by the survey, that is, areas south and west of Subarea E. Biological samples from the acoustic estimate above the DSL a mean length of 34.3 cm in all areas which is 1.7 cm smaller fish than caught in 2013.

21.6.2 Survey trawl estimates

In addition to the acoustic measurements, redfish biomass was estimated by correlating catches and acoustic values at depths shallower than 500 m at 352 000 t, the highest value since 2001 (Table 21.6.1 and Figure 21.6.4). Figure 21.6.3 shows the distribution of the redfish catches within the DSL and shallower than 500 m.

The trawl biomass estimates in Subarea A in 2021 was 221 000 t which is the highest value observed in this subarea since the beginning of the time series in 2001 (Table 21.6.3). In Subarea E, the trawl biomass was 91 000 t, the highest in the time series, but in Subarea B, only 40 000 t were estimated which is among the lowest values.

The obtained correlation was used to convert the trawl data at greater depths to acoustic values and from there to abundance. For that purpose, standardized trawl hauls were carried out at depth 350–500 m, evenly distributed over the survey area (Figure 21.6.3). For the time being, the correlation between the catch and acoustic values is based on few data points only and it is highly variable. It is also assumed that the catchability of the trawl is the same, regardless of the trawling depth, thus the abundance estimate obtained is questionable and must only be considered as a rough attempt to measure the abundance within the DSL. Evaluation on the consistency of the method must wait until more data points are available.

Biological samples from the trawls within the DSL and shallower than 500 m showed a mean length of 34.4 cm, which is about 1 cm smaller fish than caught in 2015, but larger than in 2018. Figure 21.6.3 shows the spatial distribution of samples used in the survey and Figure 21.6.7 shows the corresponding length distribution.

The 2021 survey, therefore, indicates a decrease in the average total length in Shallow Pelagic *S. mentella* in the area observed. Despite no indication of young juvenile redfish on the Greenlandic or Icelandic shelf in the last 5–10 years (ICES, 2018) this may give an indication of recruitment of juvenile fish into the adult population of Shallow Pelagic *S. mentella* in the Irminger Sea.

21.7 Methods

The assessment of pelagic redfish in the Irminger Sea and adjacent waters is based on survey indices, catches, CPUE and biological data. See Stock Annex and Section 21.6 for details.

21.8 Reference points

For pelagic redfish in the Irminger Sea and adjacent waters, no analytical assessment is carried out due to data uncertainties and the lack of reliable age data. Thus, no reference points can be derived.

21.9 State of the stock

21.9.1 Short term forecast

For pelagic redfish in the Irminger Sea and adjacent waters, no analytical assessment is carried out due to data uncertainties and the lack of reliable age data. Thus, no short-term forecasts can be derived.

21.9.2 Uncertainties in assessment and forecast

21.9.2.1 Data considerations

Preliminary official landings data were provided by the ICES Secretariat, NEAFC and NAFO, and various national data were reported to the Group. The Group, however, repeatedly faces problems to obtain reliable catch data due to unreported catches of pelagic redfish and lack of catch data disaggregated by depth from some countries. There are indications that reported effort (and consequently landings) could represent only around 80% of the real effort in certain years (see Section 20.3.3 in the 2008 NWWG report, ICES, 2008). No new data in IUU have been available since 2008.

As in previous years, detailed descriptions on the horizontal, vertical, and seasonal distribution of the fisheries were given.

The need for and importance of having catch and biological data disaggregated by depth from all nations taking part in the fishery cannot be stressed strongly enough, and the Group urges all nations involved on supplying better data. With this need in mind, ICES sent a data call to all EU countries participating in the redfish fishery, encouraging stockholders to deliver detailed catch data before the WG would meet, but the response was very limited.

21.9.2.2 Assessment quality

The results of the international trawl-acoustic survey are given in section 21.6. Given the high variability in the correlation between trawl and acoustic estimates as well as the assumptions that need to be made about constant catchability across depth and areas, the uncertainty of these estimates is considered high.

The survey carried out in 2021 covered most of the geographical distribution of the shallow pelagic stock. A decreasing trend in the relative biomass indices in the acoustic layer was observed 1991–2013. In 2021, there was a sharp increase in the biomass of the shallow pelagic stock, both in the acoustic and DLS layers.

It is not known to what extent CPUE reflects changes in the stock status of pelagic *S. mentella*, since the fishery focuses on aggregations. Therefore, stable or increasing CPUE series might not indicate or reflect actual trends in stock size, although decreasing CPUE indices are likely to reflect a decreasing stock. The new data available to the NWWG were insufficient to estimate the CPUE since 2013.

NEAFC set for 2015–2021 a 0 TAC for Shallow Pelagic *S. mentella*. However, the Russian Federation decided on a unilateral annual quota of 27 300 t in 2015 and 2016 and 24 900 in 2017–2020. This quota was taken from both Shallow and Deep pelagic stocks since the Russian Federation does not agree on the division of the *S. mentella* management units and stock structure.

21.9.3 Comparison with previous assessment and forecast

The data available for evaluating the stock status are similar as in 2013.

21.9.4 Management considerations

The Group needs more and better data and requests that NEAFC and NAFO provide ICES with all information leading to more reliable catch statistics.

The main feature of the fishery since 1998 is a clear distinction between two widely separated fishing grounds with pelagic redfish fished at different seasons and different depths. Since 2000, the southwestern fishing grounds extended also into the NAFO Convention Area. Biological data, however, suggest that the aggregations in the NAFO Convention Area do not constitute a separate stock. The NAFO Scientific Council agreed with this conclusion (NAFO, 2005). The Group concludes that currently there are not enough scientific bases available to propose an appropriate split of the total TAC among the two fisheries/areas.

21.9.5 Ecosystem considerations

The fisheries on pelagic redfish in the Irminger Sea and adjacent waters are generally regarded as having negligible impact on the habitat and other fish or invertebrate species due to very low bycatch and discard rates, characteristic of fisheries using pelagic gear.

21.9.6 Changes in the environment

The hydrography in the June/July 2013 survey show that temperature in the survey area is above average but it was lower than in 2011 in most of the surveyed area, except for the Irminger Current (ICES, 2013).

The increase of water temperature in the Irminger Sea may have an effect on spatial and vertical distribution of *S. mentella* in the feeding area (Pedchenko, 2005). The abundance and distribution

of *S. mentella* in relation to oceanographic conditions were analysed in a special multistage workshop (WKREDOCE1-3). Based on 20 years of survey data, the results reveal the average relation of redfish to their physical habitat in shallow and intermediate waters: The most preferred latitude, longitude, depth, salinity and temperature for *S. mentella* are approximately 58°N, 40°W, 300 m, 34.89 and 4.4°C, respectively. The spatial distribution of S. mentella in the Irminger Sea mainly in waters <500 m (and thus mainly relating to the "shallow" stock) appears strongly influenced by the Irminger Current Water (ICW) temperature changes, linked to the Subpolar Gyre (SPG) circulation and the North Atlantic Oscillation (NAO). The fish avoid waters mainly associated with the ICW (>4.5°C and >34.94) in the north-eastern Irminger Sea, which may cause displacing towards the southwest, where fresher and colder water occurs (ICES, 2012b).

Results based on international redfish survey data suggest that the interannual distribution of fish above 500 m will shift in a southwest/northeast direction depending on integrated oceanographic conditions (ICES, 2012b).

21.10   References

ICES. 2008. Report of the North Western Working Group (NWWG). ICES CM 2008/ACOM:03.

ICES. 2009a. Report of the Workshop on Redfish Stock Structure (WKREDS). ICES CM 2009/ACOM:37.

ICES. 2009b. Report of the Planning Group on Redfish Surveys (PGRS). ICES CM 2009/RMC:01.

ICES. 2012a. Report of the Benchmark Workshop on Redfish (WKRED 2012), 1–8 February 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:48. 291 pp.

ICES. 2012b. Report of the Third Workshop on Redfish and Oceanographic Conditions (WKREDOCE3), 16-17 August 2012, Johann Heinrich von Thünen Institute, Hamburg, Germany. ICES CM 2012/ACOM:25. 70 pp.

ICES. 2013. Report of the Working Group on Redfish Surveys (WGRS), 6-8 August 2013, Hamburg, Germany. ICES CM 2013/SSGESST:14. 56 pp.

ICES. 2014. Report of the Workshop on Redfish Management Plan Evaluation (WKREDMP) ICES CM 2014/ACOM: 52.

ICES. 2015. Third Interim Report of the Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS), 4-6 August 2015, Marine Research Institute, Reykjavík (Iceland). ICES CM 2015/SSGIEOM:03. 49 pp.

ICES. 2018. Report of the Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS). 6-8 August 2018. Bremerhaven, Germany. ICES CM 2018/EOSG:40. 50 pp.

ICES. 2021. Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS). ICES Scientific Reports. 3:43. 32pp. https://doi.org/10.17895/ices.pub.8056

NAFO 2005. Scientific Council Reports 2004, 306 pp

Pedchenko, A. P. 2000. Specification of oceanographic conditions of the Irminger Sea and their influence on the distribution of feeding redfish in 1999. ICES North-Western Working Group 2000, Working Document 22, 13 pp.

Pedchenko, A. P. 2005. The role of interannual environmental variations in the geographic range of spawning and feeding concentrations of redfish *Sebastes mentella* in the Irminger Sea. ICES Journal of Marine Science 62: 1501-1510.

Table 21.2.1 Shallow Pelagic *S. mentella* (stock unit <500 m). Catches (in tonnes) by area as used by the Working Group.

Year	5.a	12	14	NAFO 1F	NAFO 2J	NAFO 2H	Total
1982	0	39 783	20 798	0	0	0	60 581
1983	0	60 079	155	0	0	0	60 234
1984	0	60 643	4189	0	0	0	64 832
1985	0	17 300	54 371	0	0	0	71 671
1986	0	24 131	80 976	0	0	0	105 107
1987	0	2 948	88 221	0	0	0	91 169
1988	0	9 772	81 647	0	0	0	91 419
1989	0	17 233	21 551	0	0	0	38 784
1990	0	7 039	24 477	385	0	0	31 901
1991	0	9 684	17 037	458	0	0	27 179
1992	106	22 969	39 488	0	0	0	62 564
1993	0	66 461	34 310	0	0	0	100 771
1994	665	77 211	18 992	0	0	0	96 869
1995	77	78 898	21 160	0	0	0	100 136
1996	16	22 544	19 210	0	0	0	41 770
1997	321	18 211	9 213	0	0	0	27 746
1998	284	22 002	1 864	0	0	0	24 150
1999	165	23 713	1 101	534	0	0	25 512
2000	3 375	17 491	1 298	11 052	0	0	33 216
2001	228	32 164	2 383	5 290	1 751	8	41 825
2002	10	24 025	336	15 702	3 143	0	43 216
2003	49	24 211	132	26 594	5 377	325	56 688
2004	10	7 669	1 158	20 336	4 778	0	33 951
2005	0	6 784	281	16 260	4 899	5	28 229
2006	0	2 094	94	12 692	593	260	15 734
2007	71	378	98	2 843	2 561	175	6 126
2008	32	25	422	1 580	0	0	2 059
2009	0	210	2 170	0	0	0	2 380
2010	15	686	423	1 074	0	0	2 198
2011	0	0	234	0	0	0	234
2012	28	0	0	3 113	32	0	3 173
2013	32	13	40	1 443	1	0	1 529
2014	153	5 068	489	713	0	0	6 423
2015	161	2 281	0	3 119	34	0	5 595
2016	235	1 671	0	61	0	0	1 967
2017	81	10	10	0	0	0	101

Year	5.a	12	14	NAFO 1F	NAFO 2J	NAFO 2H	Total
2018	0	2 203	0	2 396	0	0	4 599
2019	0	1 799	0	1 385	0	0	3 184
2020	0	2 532	0	3 620	0	0	6 152

1982–1991 All pelagic catches assumed to be of the shallow pelagic stock

1992–1996 Guesstimates based on different sources (see text)

1997–2020 Catches from calculations based on jointed catch database and total landings

Table 21.2.2 Shallow pelagic *S. mentella* catches (in tonnes) in ICES Div. 5a, subareas 12, 14 and NAFO Div. 1F, 2H and 2J by countries used by the Working Group. * Prior to 1991, the figures for Russia included Estonian, Latvian and Lithuanian catches.

Year	Bulgaria	Canada	Estonia	Faroes	France	Germany	Green-land	Iceland	Japan	Latvia	Lithuania	Nether-lands	Norway	Poland	Portugal	Russia*	Spain	UK	Ukraine	Total
1982														581		60 000				60 581
1983						155										60 079				60 234
1984	2 961					989								239		60 643				64 832
1985	5 825					5 438								135		60 273				71 671
1986	11 385			5		8 574								149		84 994				105 107
1987	12 270			382		7 023								25		71 469				91 169
1988	8 455			1 090		16 848										65 026				91 419
1989	4 546			226		6 797	567	3 816						112		22 720				38 784
1990	2 690					7 957		4 537					7 085			9 632				31 901
1991			2 195	115		201		8 724					6 197			9 747				27 179
1992	628		1 810	3 765	2	6 447	9	12 080		780	6 656		14 654			15 733				62 564
1993	3 216		6 365	6 812		16 677	710	10 167		6 803	7 899		14 112			25 229			2 782	100 771
1994	3 600		17 875	2 896	606	15 133		5 897		13 205	7 404		6 834		1510	16 349			5 561	96 869
1995	2 660	421	11 798	3 667	158	10 714	277	8 733	841	3 502	16 025	9	4 288		2170	28 314	4 327		2 230	100 136
1996	1 846	343	3 741	2 523		5 696	1866	5 760	219	572	5 618		1 681		476	9 348	1 671	137	273	41 770
1997		102	3 405	3 510		9 276		4 446	28				330	776	367	3 693	1 812			27 746
1998			3 892	2 990		9 679	1161	1 983	30		1 734		701	12	60	89	1 819			24 150
1999			2 055	1 190		8 271	998	3 662					2 098	6	62	6 538	447	183		25 512
2000			4 218	486		5 672	956	3 766			430		2 124		37	14 373	1 154			33 216
2001			9	4 364		4 755	1083	14 745			8 269		947		256	5 964	1 433			41 825
2002			719	5 354			657	5 229		1 841	12 052		1 094	428	878	13 958	1 005			43 216
2003			1 955	3 579			1047	4 274		1 269	21 629		3 214	917	1926	15 418	1 461			56 688

Year	Bulgaria	Canada	Estonia	Faroes	France	Germany	Green-land	Iceland	Japan	Latvia	Lithuania	Nether-lands	Norway	Poland	Portugal	Russia*	Spain	UK	Ukraine	Total
2004				777		1 126	750	5 728		1 114	3 698		2 721	1018	2133	13 208	1 679			33 951
2005				210		1 152		3 086		919	1 169		624	1170	2780	15 562	1 557			28 229
2006				334		994		1 293		1 803	466		280	663	1372	4 953	3 576			15 734
2007			209	98		0		71		186	467			189	529	4 037	339			6 126
2008				319				63			8					1 597	73			2 059
2009				93				5		59	138					649	1 438			2 380
2010				653				22			551		12		377	567	16			2 198
2011				162				72												234
2012								28								3 145				3 173
2013								72								1 457				1 529
2014								355			287					5 781				6 423
2015								161								5 434				5 595
2016								235								1 732				1 967
2017								91								10				101
2018																4 599				4 599
2019																3 184				3 184
2020																6 152				6 152

Table 21.6.1 Shallow Pelagic *S. mentella*. Results for the acoustic survey indices 1991–2021 from shallower than the scattering layer, trawl estimates within the deep scattering layer and shallower than 500 m, and area coverage of the survey in the Irminger Sea and adjacent waters. No estimates are available for 2015 and only Subarea A (Figure 21.6.5) was surveyed in 2018.

Year	Area covered (1,000 NM²)	Acoustic estimates (1,000 t)	Trawl estimates (1,000 t)
1991	105	2,235	
1992	190	2,165	
1993	121	2,556	
1994	190	2,190	
1995	168	2,481	
1996	253	1,576	
1997	158	1,225	
1999	296	614	
2001	420	716	565
2003*	405	89*	92*
2005	386	552	392
2007	349	372	283
2009	360	108	331
2011	343	123	361
2013	340	91	200
2015**	-	-	69**
2018***	103***	82****	171***
2021	242	490	352

* The 2003 biomass estimate is considered as inconsistent as the survey was carried out about one month earlier than usual, and a marked seasonal effect was observed.

** The 2015 biomass estimate is considered partial as only Subareas A and B were surveyed (Figure 21.6.5).

***** The 2018 biomass estimate is considered partial as only Subareas A was surveyed (Figure 21.6.5).**

Table 21.6.2. Results (acoustic biomass in ´000 t) for the international surveys conducted since 1994, for redfish shallower than the DSL for each subarea (see Figure 21.6.5 for area definition) and the total biomass. No total biomass estimate was available in 2015 (no data) and in 2018 only Subarea A was surveyed.

Year	Subarea						Total
	A	B	C	D	E	F	
1994	673	1,228	-	63	226		2,190
1996	639	749	-	33	155		1,576
1999	72	317	16	42	167		614
2001	88	220	30	267	103	7	716
2003*	32	46	1	2	10	0	89
2005	121	123	0	87	204	17	552
2007	80	95	0	53	142	3	372
2009	39	48	4	1	15	1	108
2011	5	74	0	3	40	1	123
2013	9	33	2	5	42	0	91
2015	-	-	-	-	-	-	-
2018	82	-	-	-	-	-	82
2021	144	150	-	-	196	-	490

* The 2003 biomass estimate is considered as inconsistent as the survey was carried out about one month earlier than usual, and a marked seasonal effect was observed.

Table 21.6.3. Biomass estimates (trawl biomass in ´000 t) within the DSL layer and shallower than 500 m by Subarea (see Figure 26.6.5 for area definition) from the international redfish surveys in the Irminger Sea and adjacent waters. No biomass estimates are available for 2005 and 2007.

Year	Subarea						Total
	A	B	C	D	E	F	
2001	23	40	45	399	54	5	565
2003*	25	46	3	4	14	0	92
2005	55	66	1	45	114	2	283
2007	69	117	1	27	110	8	332
2009	136	68	0	25	48	0	278
2011	69	185	1	30	76	0	309
2013	71	94	0	9	26	1	201
2015**	31	38	-	-	-	-	69
2018***	171	-	-	-	-	-	171
2021	221	40	-	-	91	-	352

* The 2003 biomass estimate is considered as inconsistent as the survey was carried out about one month earlier than usual, and a marked seasonal effect was observed.

** The 2015 biomass estimate is considered partial as only Subareas A and B were surveyed (Figure 21.6.5).

*** The 2018 biomass estimate is considered partial as only Subareas A was surveyed (Figure 21.6.5).
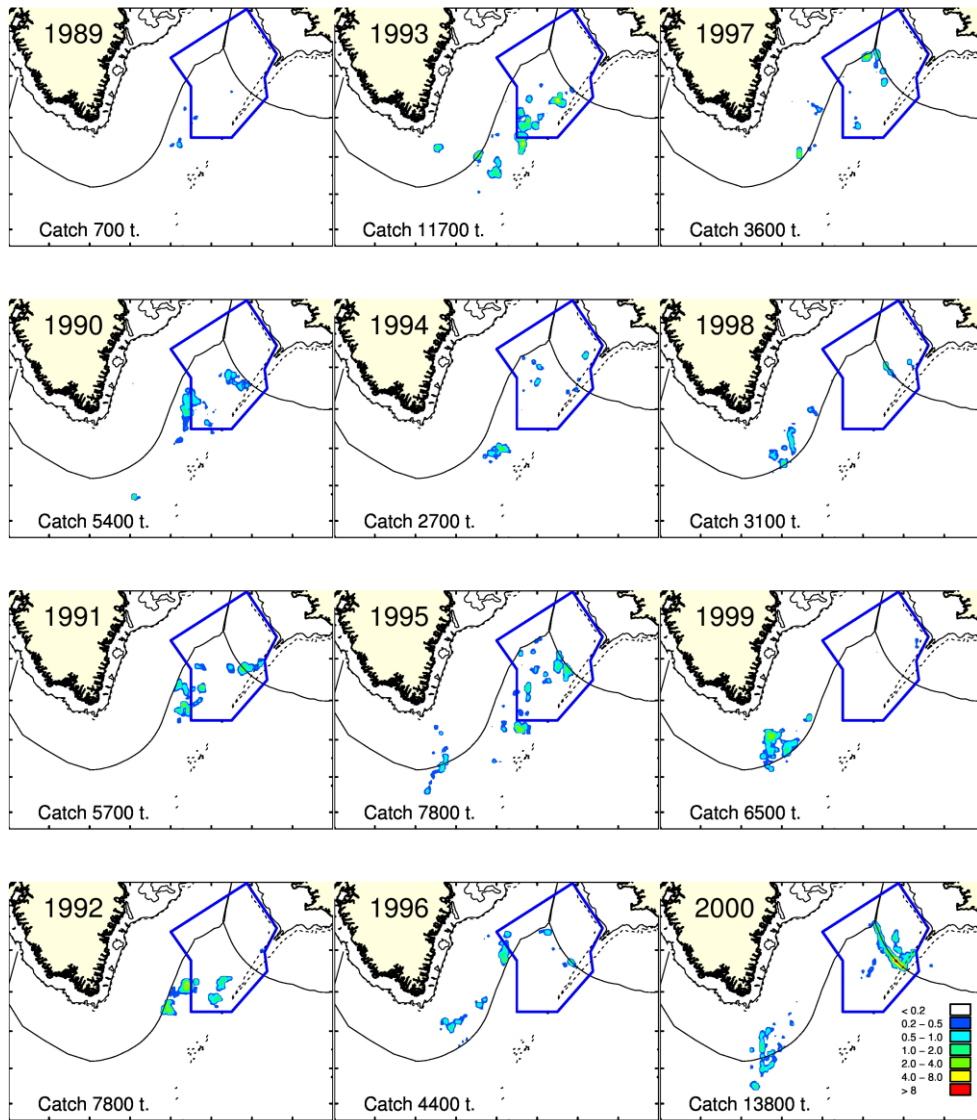
Figure 21.2.1 Fishing areas and total catch of pelagic redfish (*S. mentella*) in the Irminger Sea and adjacent waters 1989–2012. Data are from the Faroe Islands (1995–2012), Iceland (1989–2012) and Norway (1992–2003). The catches in the legend are given as tonnes per square nautical mile. The blue box represents the management unit for the northern fishing area.
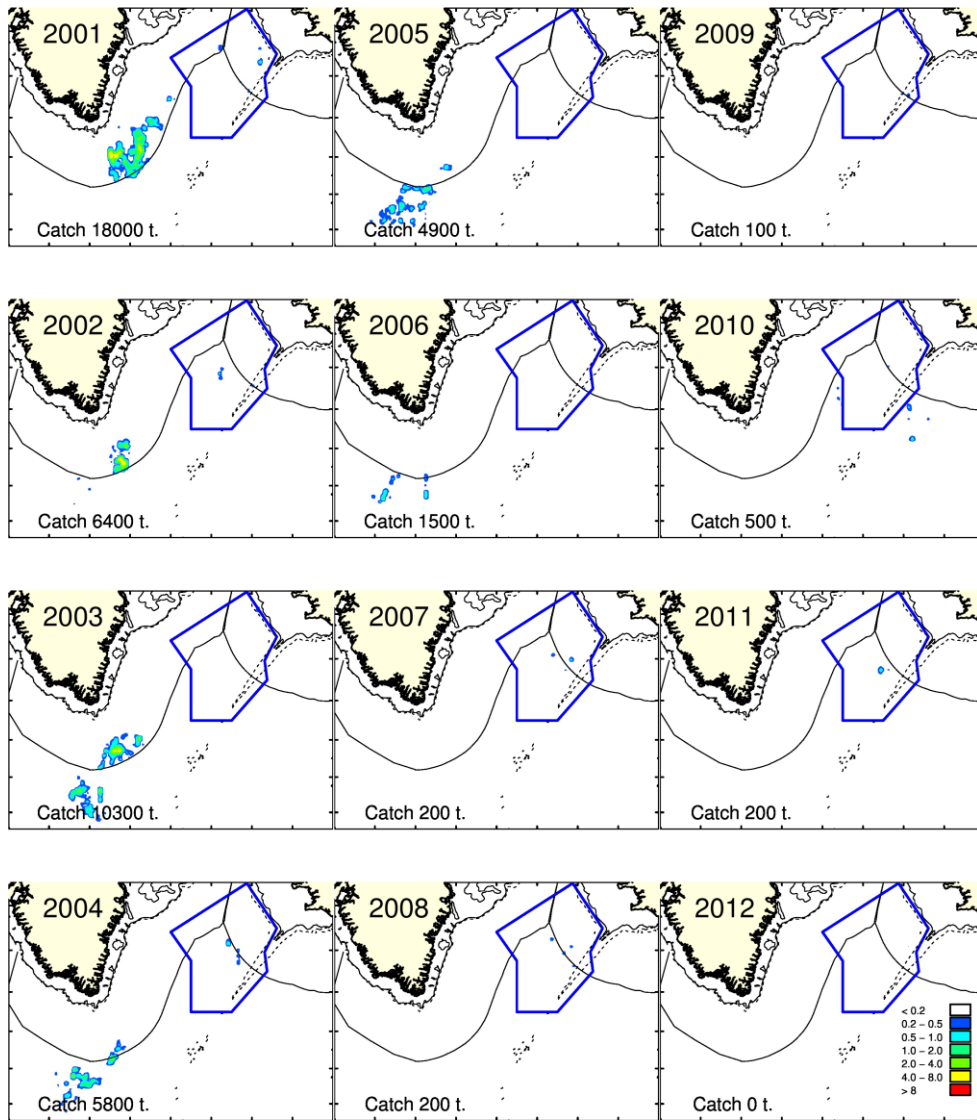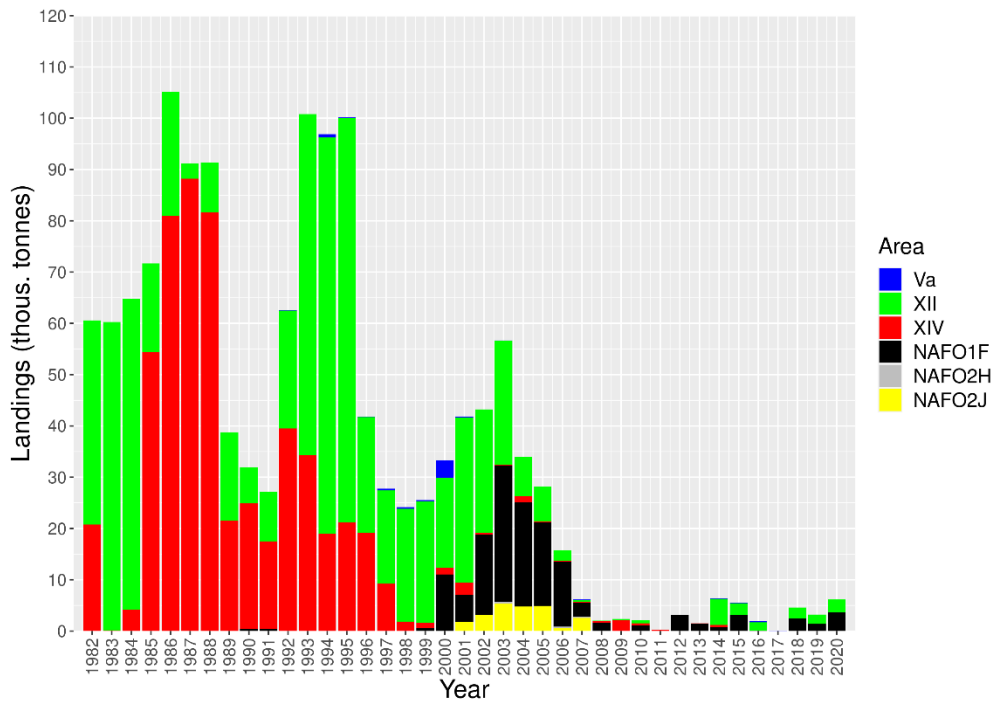
Figure 21.2.1 (Cont.) Fishing areas and total catch of pelagic redfish (*S. mentella*) in the Irminger Sea and adjacent waters 1989–2012. Data are from the Faroe Islands (1995–2012), Iceland (1989–2012) and Norway (1992–2003). The catches in the legend are given as tonnes per square nautical mile. The blue box represents the management unit for the northern fishing area.

Figure 21.2.2 Landings of shallow pelagic _S. mentella_ (Working Group estimates, see Table 21.2.1).
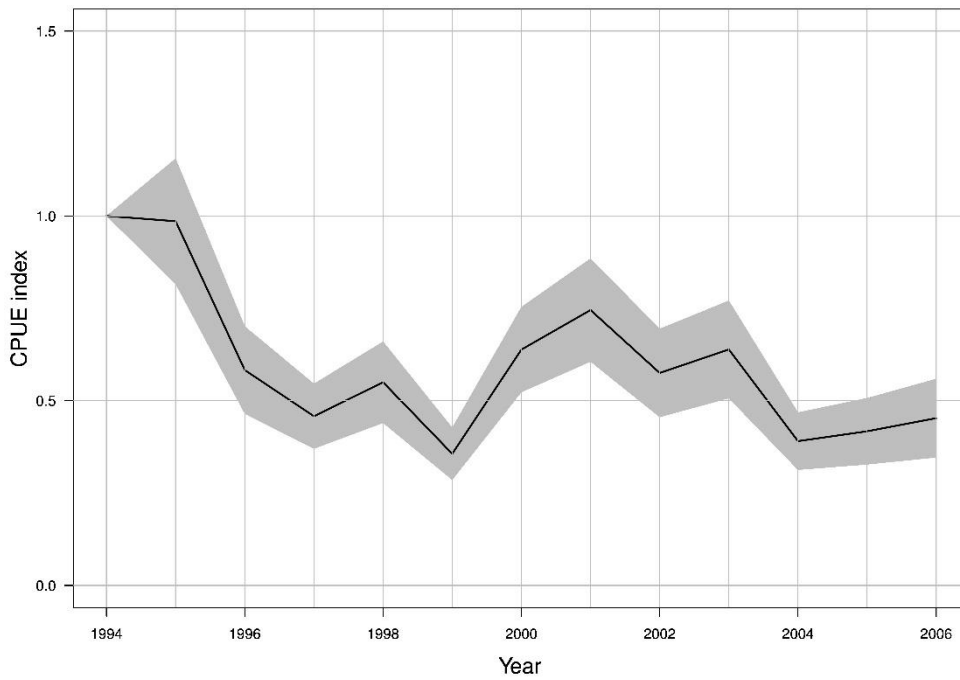
Figure 21.2.3 Trends in standardized CPUE of the shallow pelagic _S. mentella_ fishery in the Irminger Sea and adjacent waters, based on log-book data from Faroes, Iceland, Norway, and Greenland.
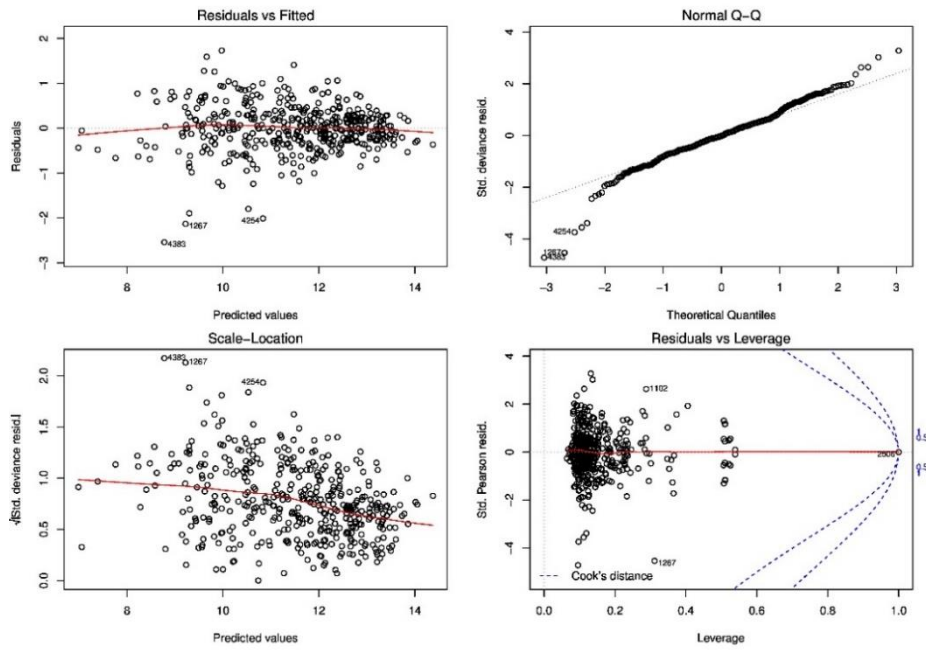
Figure 21.2.4 Residuals from the GLM model used to standardize CPUE, based on log-book data from Faroe Islands, Iceland, Greenland and Norway.
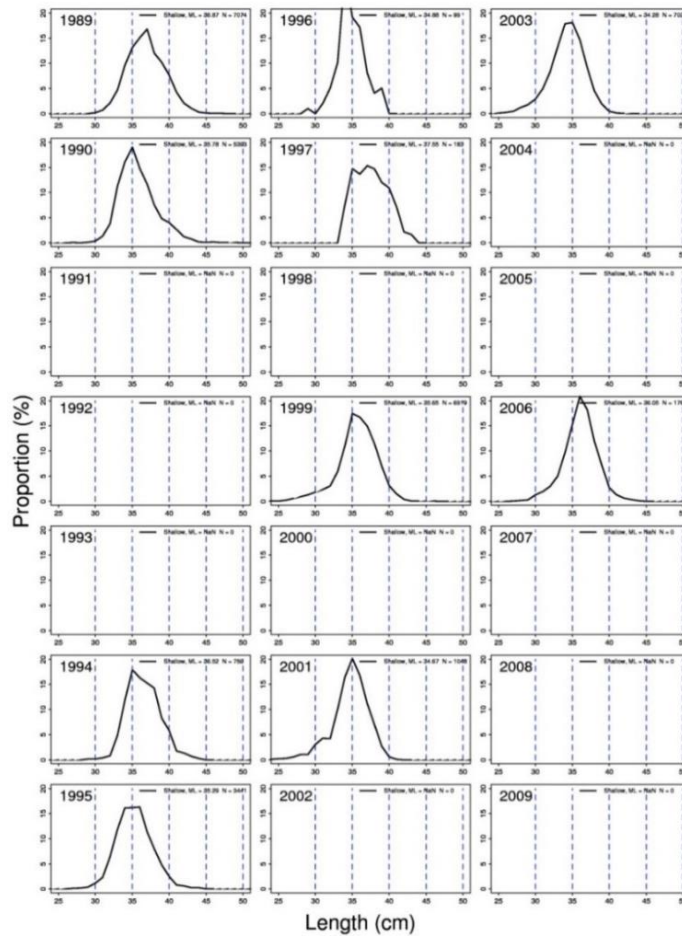
Figure 21.3.1 Length distribution from Icelandic landings of shallow pelagic _S. mentella._
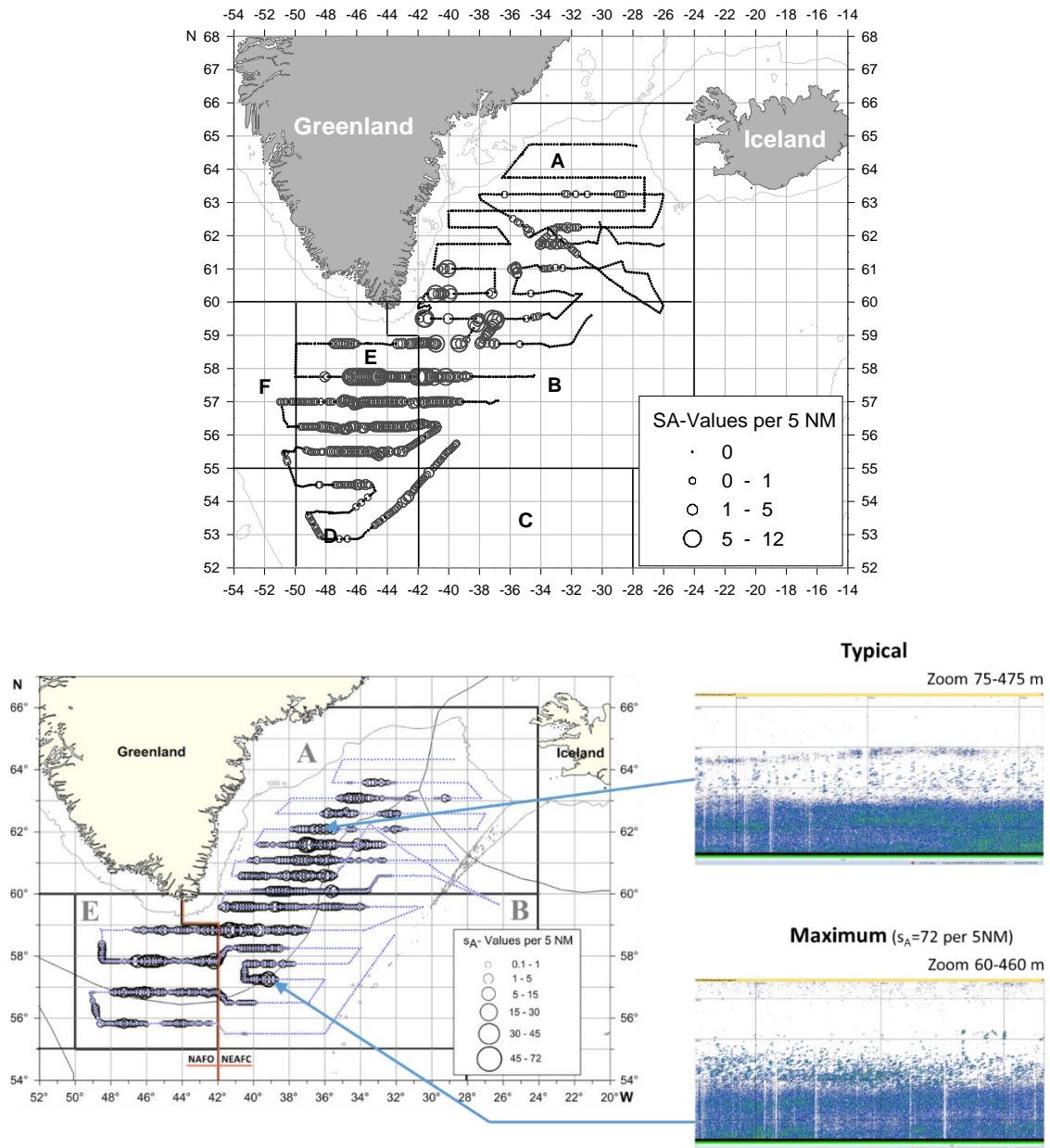
Figure 21.6.1 Pelagic *S. mentella*. Acoustic estimates (average s$_A$ values by 5 NM sailed) shallower than the deep-scattering layer (DSL) from the joint trawl-acoustic survey in June/July 2013 (upper) and 2021 (lower).
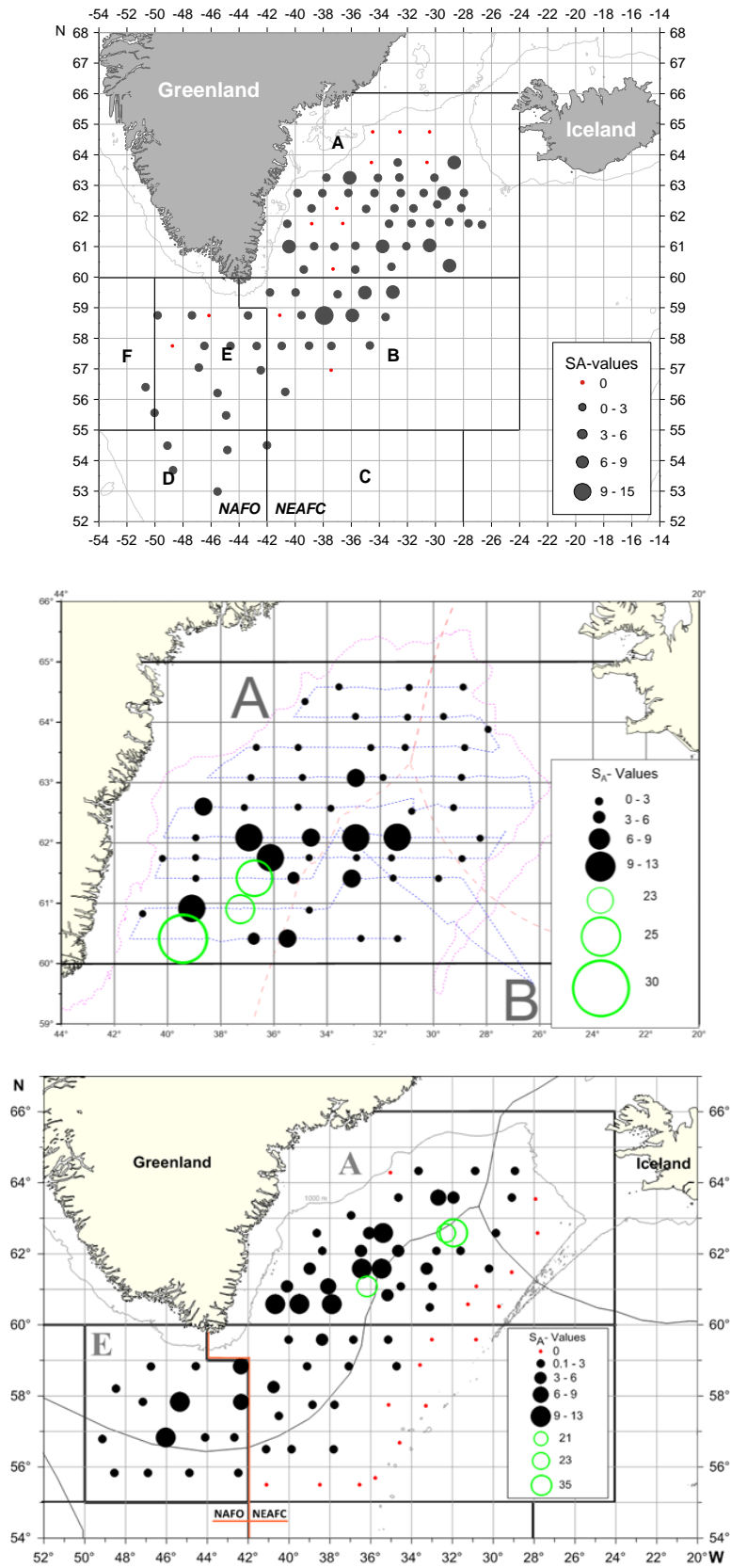
Figure 21.6.2. Redfish acoustic estimates shallower than the DSL (ca. 0–350 m) during the joint international redfish survey in 2013 (upper) and 2021 (lower). The figure shows average s_A values within statistical rectangles.

Figure 21.6.3 Redfish trawl estimates within the DSL shallower than 500 m during the joint international redfish survey in 2013 (upper), 2018 (middle), and 2021 (lower). s$_A$ values calculated by the trawl method (Section 21.6.2).
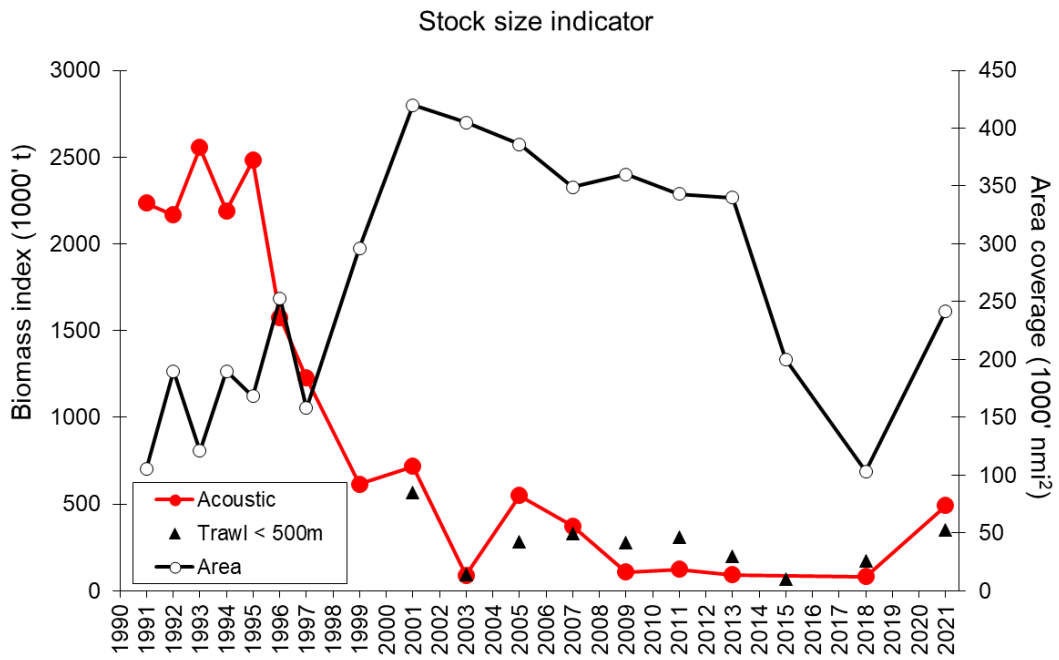
Figure 21.6.4. Overview of acoustic survey indices (thousand tonnes) from above the scattering layer (red filled circle), trawl estimates within the scattering layer and shallower than 500 m (black triangle), and aerial coverage (nmi²) of the survey (black open circle) in the Irminger Sea and adjacent waters.
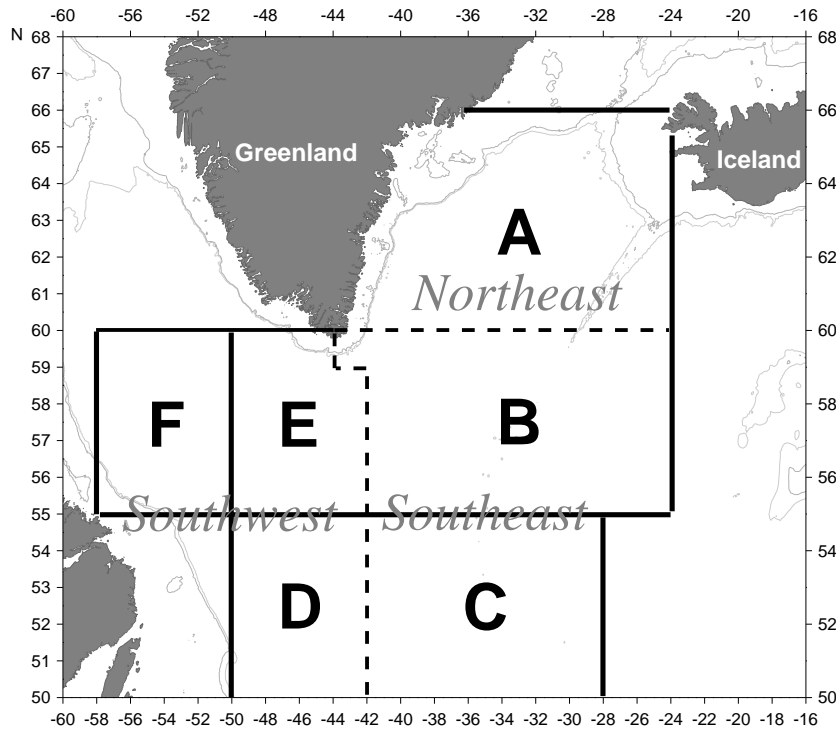
Figure 21.6.5 Subareas A–F used on international surveys for redfish in the Irminger Sea and adjacent waters, and divisions for biological data (Northeast, Southwest and Southeast; boundaries marked by broken lines).
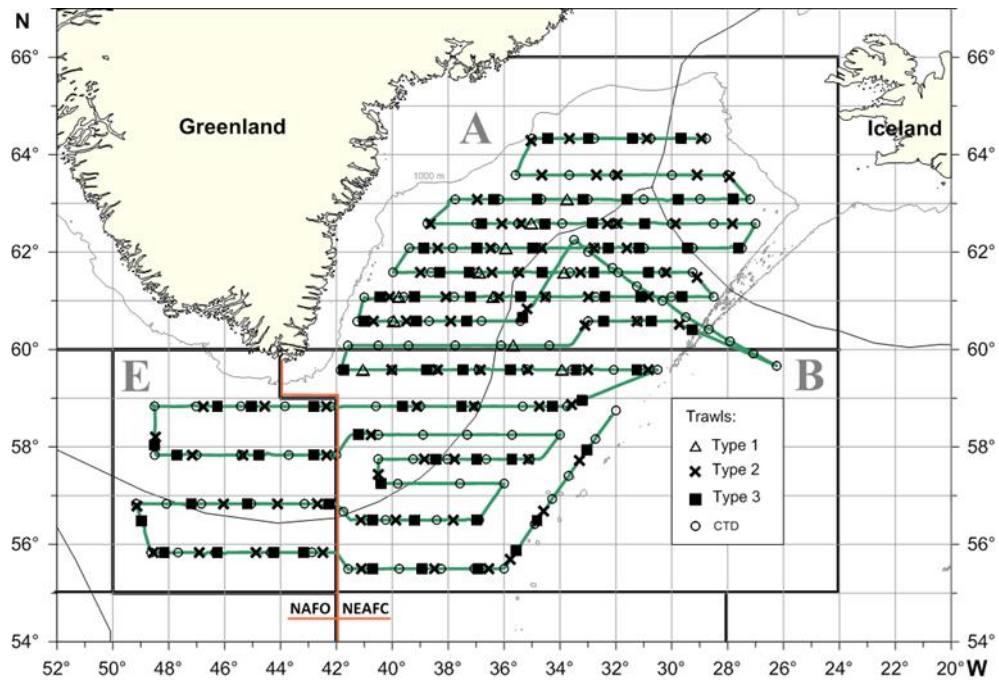
Figure 21.6.6. Cruise tracks and stations taken in the joint international redfish survey in June–August 2021.
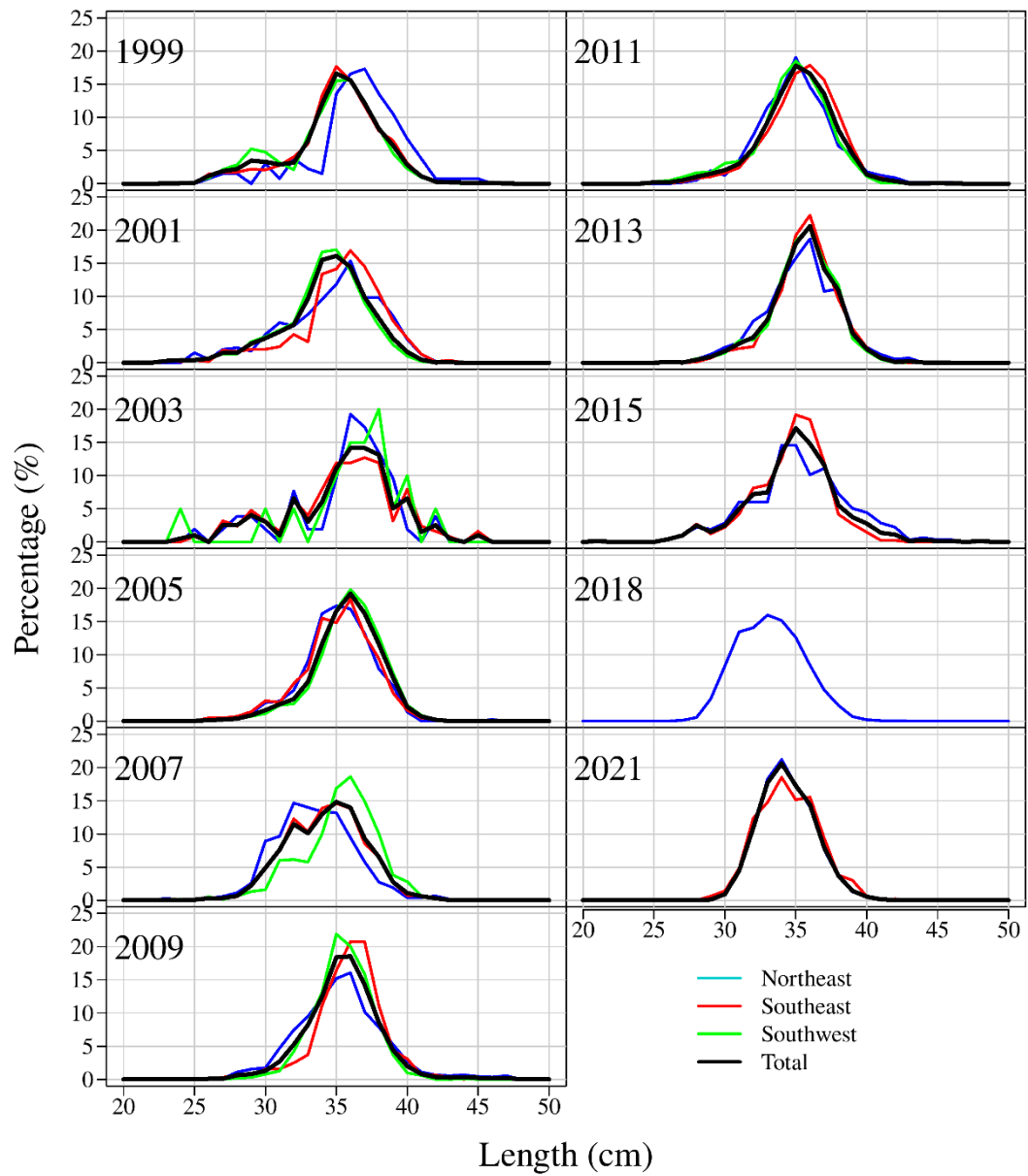
Figure 21.6.7. Length distribution of redfish in the trawls, by geographical areas and the total, from fish caught shallower than 500 m 1999–2021.