

MEGRIM

Lepidorhombus whiffiagonis

GENERAL INFORMATION

Megrim is a demersal species on a sandy or muddy substrate, occurring at depths ranging from 40-400 m, but is most common at 100-200 m. Its distribution is confined to the relatively warm waters south and west of Iceland. In Icelandic waters the females can reach 70 cm in length, but males about 60 cm. Size at sexual maturity differs between the sexes. At the length of 32 cm about half the males have reached maturity, but half the females have reached maturity at 42 cm.

THE FISHERY

Main fishing grounds for megrim are in the southeast, south, and southwest of Iceland (Figure 1). There is no target fishery for megrim in Iceland and it is taken as bycatch in other fisheries. Spatial distribution of the Icelandic megrim fishery is relatively stable, with around 90% caught off the south coast. In recent years, reported catches have increased as megrim was inadequately reported in logbooks before 2009 (Figure 2).

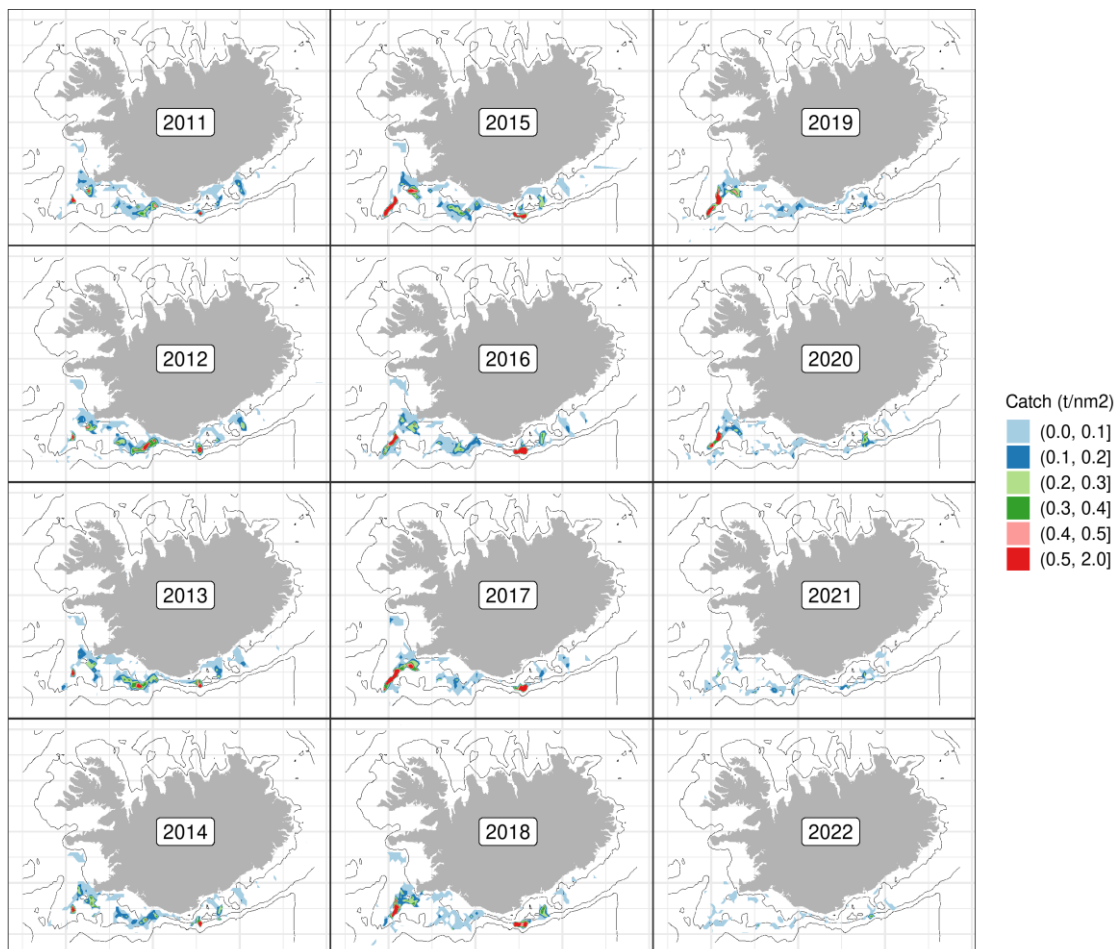


Figure 1. Megrim. Geographical distribution of the Icelandic fishery since 2011. Reported catch from logbooks.

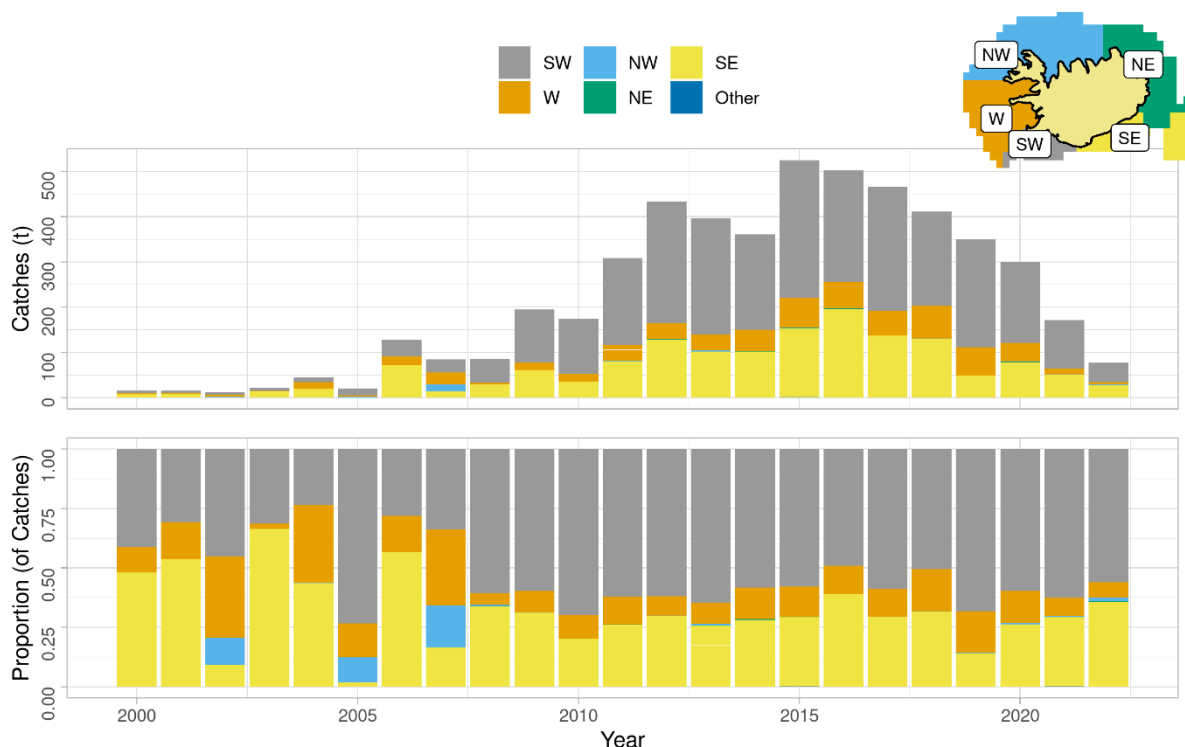


Figure 2. Megrim. Spatial distribution of the Icelandic fishery by fishing area since 2000 according to logbooks. All gears combined.

Megrim is caught in relatively deep water for a flatfish species, with most of the catch (50-80%) taken at depths of 100-250 meters (Figure 3), until recently. In 2022, almost half of the catches were caught deeper than 250 m (Figure 3) parallel to a large reduction in catches (Figure 2-4).

Megrim in Icelandic fishing grounds is mainly caught as bycatch in demersal seine, *Nephrops* trawls, and bottom trawls (Figure 4, Table 1). Catches in demersal seine have been decreasing in the past decade. Catches in *Nephrops* trawl and bottom trawl started increasing in 2009 but catches in *Nephrops* trawl decreased again since then and were close to zero in 2022 due to a ban on *Nephrops* fisheries. In 2022, approximately 85% of landed megrim was fished in bottom trawl. In recent years numbers of seiners landing over 1000 kg of megrim has decreased significantly with only three seiners in 2022 landing one tonne or more. This decrease also applies to *Nephrops* trawlers, first with area closures on certain *Nephrops* fishing grounds, and then the fishing ban that resulted in zero *Nephrops* trawlers landing one tonne or more in 2022 (Table 1).

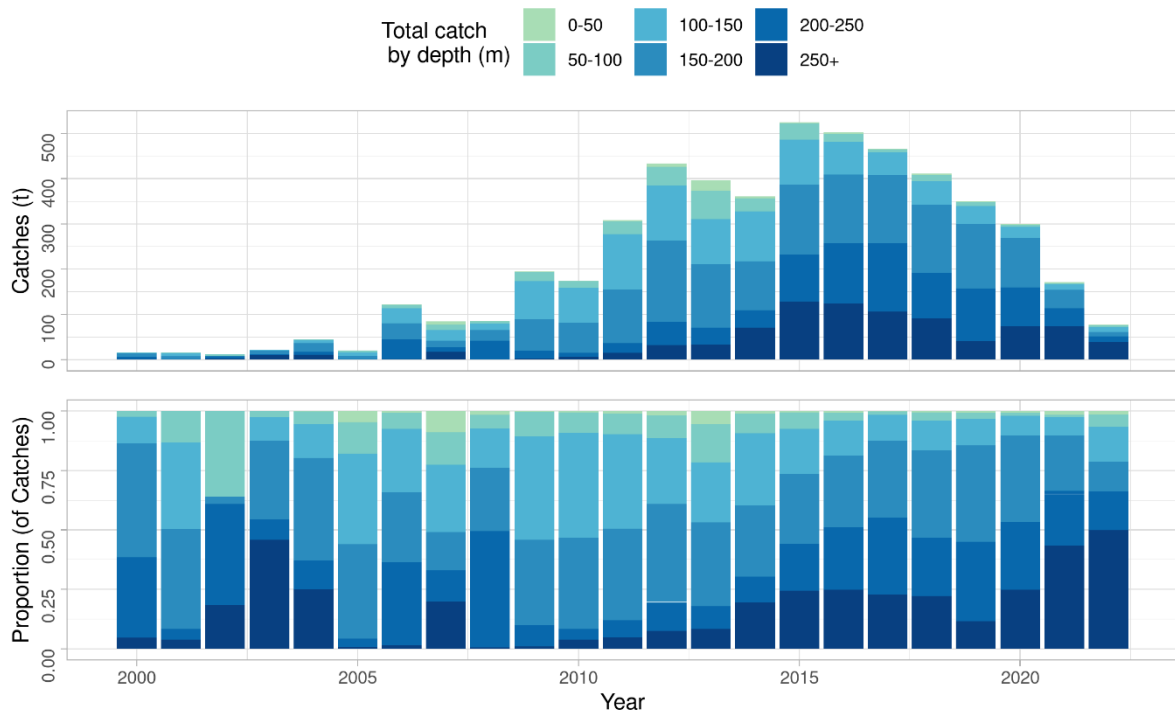
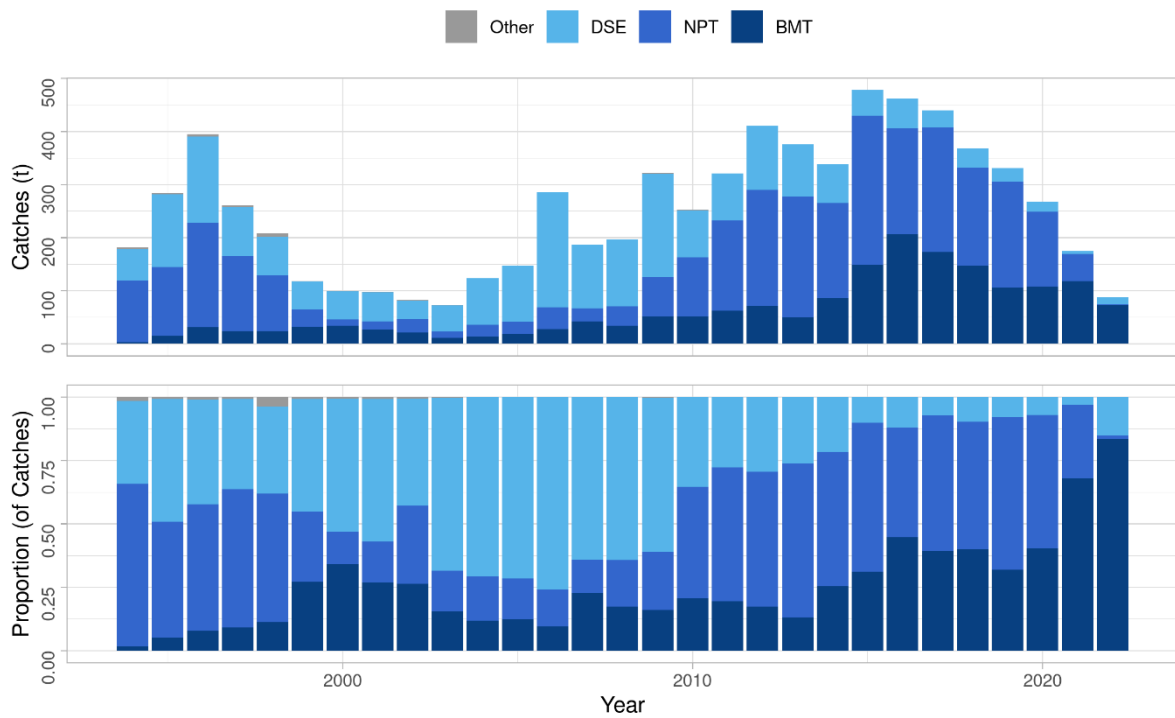


Figure 3. Megrim. Depth distribution catches according to logbooks since 2000.



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Figure 4. Megrim. Total catch (landings) by fishing gear since 1994, according to statistics from the Directorate of Fisheries. DSE = demersal seine, NPT = *Nephrops* trawl, BMT = Bottom trawl.

Table 1. Megrim. Number of Icelandic vessels landing catch of 1000 kg or more of megrim, and all landed catch divided by gear type.

YEAR	NUMBER OF VESSELS			CATCHES (TONNES)			
	<i>Seiners</i>	<i>Nephrops Trawlers</i>	<i>Other</i>	<i>Demersal seine</i>	<i>Nephrops trawl</i>	<i>Other</i>	<i>Sum</i>
2000	8	4	7	53	12	31	96
2001	12	6	7	56	15	26	97
2002	7	9	6	33	23	20	76
2003	10	4	3	50	7	11	68
2004	13	4	4	85	21	14	120
2005	15	5	8	106	22	18	146
2006	17	9	7	216	40	28	284
2007	13	5	9	119	23	45	187
2008	19	7	8	126	36	34	196
2009	23	7	10	191	72	53	316
2010	17	11	12	89	110	52	251
2011	12	14	10	89	169	62	320
2012	17	14	9	134	171	104	409
2013	12	13	8	98	228	50	376
2014	9	14	10	74	171	82	327
2015	8	12	14	48	279	152	479
2016	11	10	17	55	190	215	460
2017	15	8	7	32	235	173	440
2018	8	9	13	36	185	147	368
2019	8	7	13	26	199	106	331
2020	5	7	14	19	141	108	268
2021	2	4	17	5	51	119	175
2022	3	0	13	13	1	73	87

The number of vessels accounting for 95% of the annual catches of megrim in Icelandic waters increased with increased catches in 1992-1996 from about 9-65 vessels (Figure 5). From 1996-2005, a drop in the number of vessels coincided with reduced catches. 2017-2022, less than 20 vessels have accounted for 95% of annual catches (Figure 5).

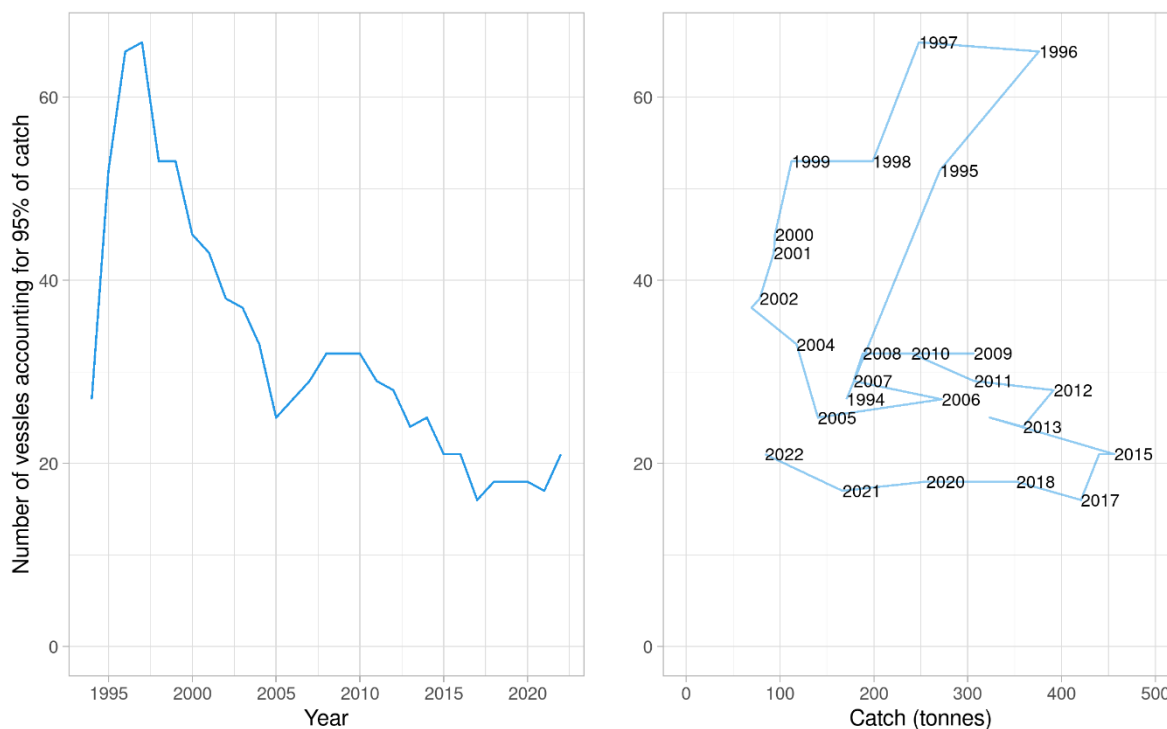


Figure 5. Megrim. Number of vessels (all gear types) accounting for 95% of the total catch annually since 1994. Left: Plotted against year. Right: Plotted against total catch. Data from the Directorate of Fisheries.

CATCH PER UNIT OF EFFORT (CPUE) AND EFFORT

CPUE estimates of megrim in Icelandic waters are not considered representative of stock abundance as changes in fleet composition, technical improvements, and differences in gear setup among other things have not been accounted for when estimating CPUE.

CPUE of demersal trawl and *Nephrops* trawl (kg/hour), in hauls where megrim is caught, gradually increased in 2007-2021 (Figure 6).

CPUE in demersal seine (kg/set) is calculated as the total weight in sets in which megrim was caught. CPUE gradually decreased from 125 kg/set in 2013-2016 to about 50 kg/set in 2022 (Figure 6).

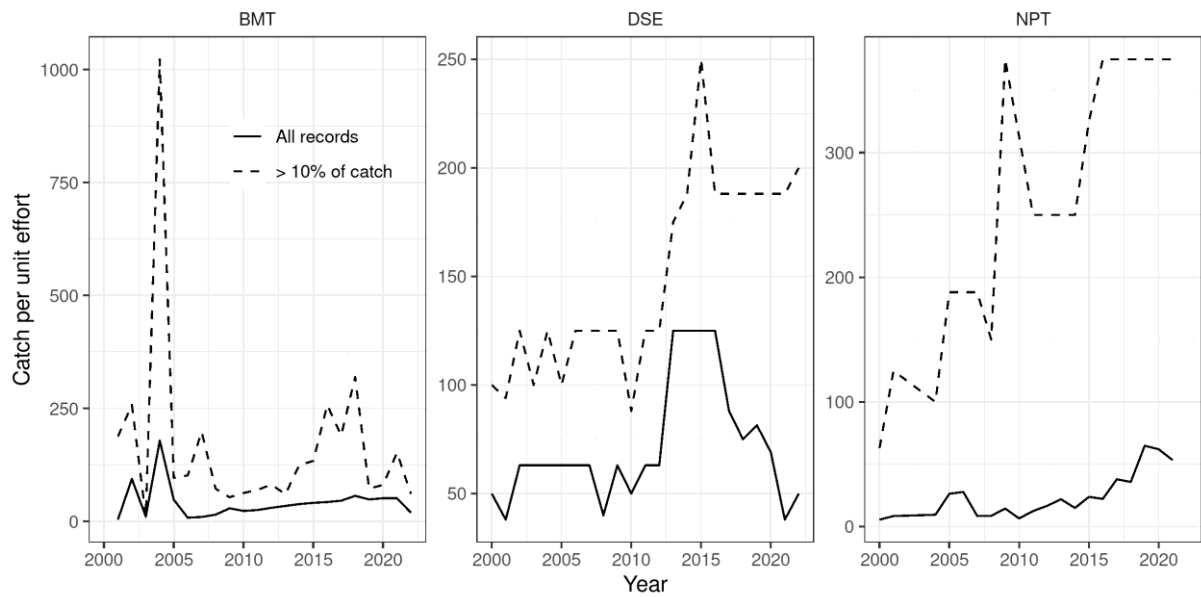


Figure 6. Megrim. Non-standardized CPUE from bottom trawl (left, (kg/hour or towhours), demersal seine (middle, (kg/set or nr. of sets, green)) and *Nephrops* trawl (right, (kg/hour or towhours) .

AGE DISTRIBUTION OF LANDED MEGRIM

Systematic age reading from the commercial catch started in 1996. Table 1 shows number of otoliths sampled from the commercial catch. Usually, 90-97% of the otoliths sampled are age read. During this period, total numbers of otoliths sampled has decreased considerably and in the last two years only 50 otoliths were collected from landed catch. The sampling coverage in 2022 is shown in Figure 8. The landings according to the most recent age readings are mostly 6-12 years old fish, with 7-9 years olds amounting to over 70% of the numbers in most recent years (Figure 7).

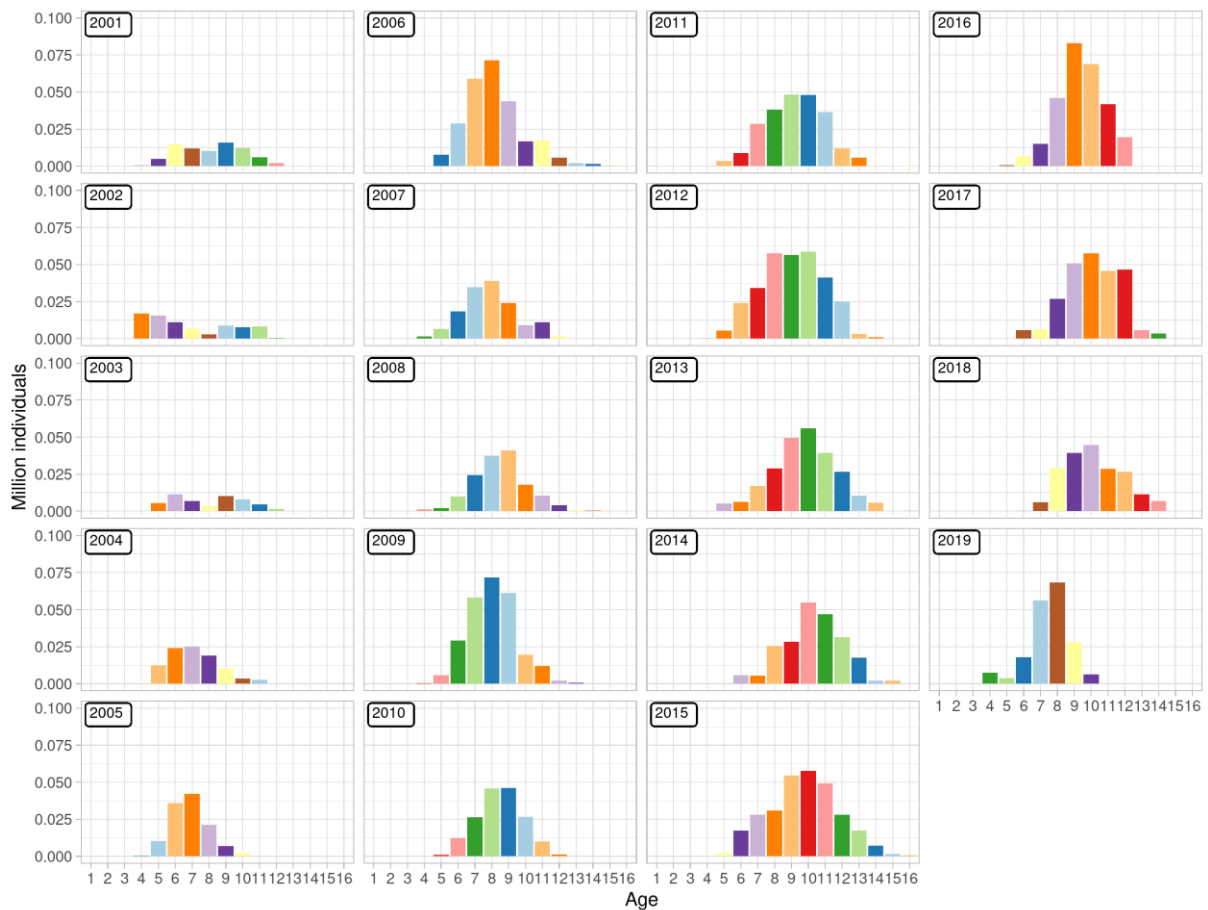


Figure 7. Megrim. Estimated age distribution of landed catch based on otoliths collected from landed catch. Data from 2020-2022 was not available.

Table 2. Megrim. Number of samples and extracted otoliths from landed catch.

Year	<i>Demersal seine</i>		<i>Nephrops trawl</i>		<i>Bottom trawl</i>	
	Samples	Otoliths	Samples	Otoliths	Samples	Otoliths
2010	9	225	8	200	0	0
2011	8	200	15	401	0	0
2012	12	299	19	475	2	50
2013	11	275	12	300	4	100
2014	4	100	4	95	0	0
2015	5	124	9	225	1	25
2016	3	75	5	125	1	25
2017	2	50	7	175	0	0
2018	2	50	3	75	1	25
2019	2	50	5	125	0	0
2020	0	0	1	25	1	25
2021	0	0	1	25	1	25
2022	2	40	0	0	3	60



Figure 8. Megrim. Fishing grounds in 2022 as reported in logbooks (colours) and positions of samples taken from demersal trawl landings (asterisks).

LENGTH DISTRIBUTION OF LANDED MEGRIM

Length distribution of landed megrim was relatively stable in 2001-2009, with average length ranging between 47 and 49 cm in most years with exception of 2002 (Figure 8). Since 2010, landings of larger megrim (50 cm and larger) have increased.

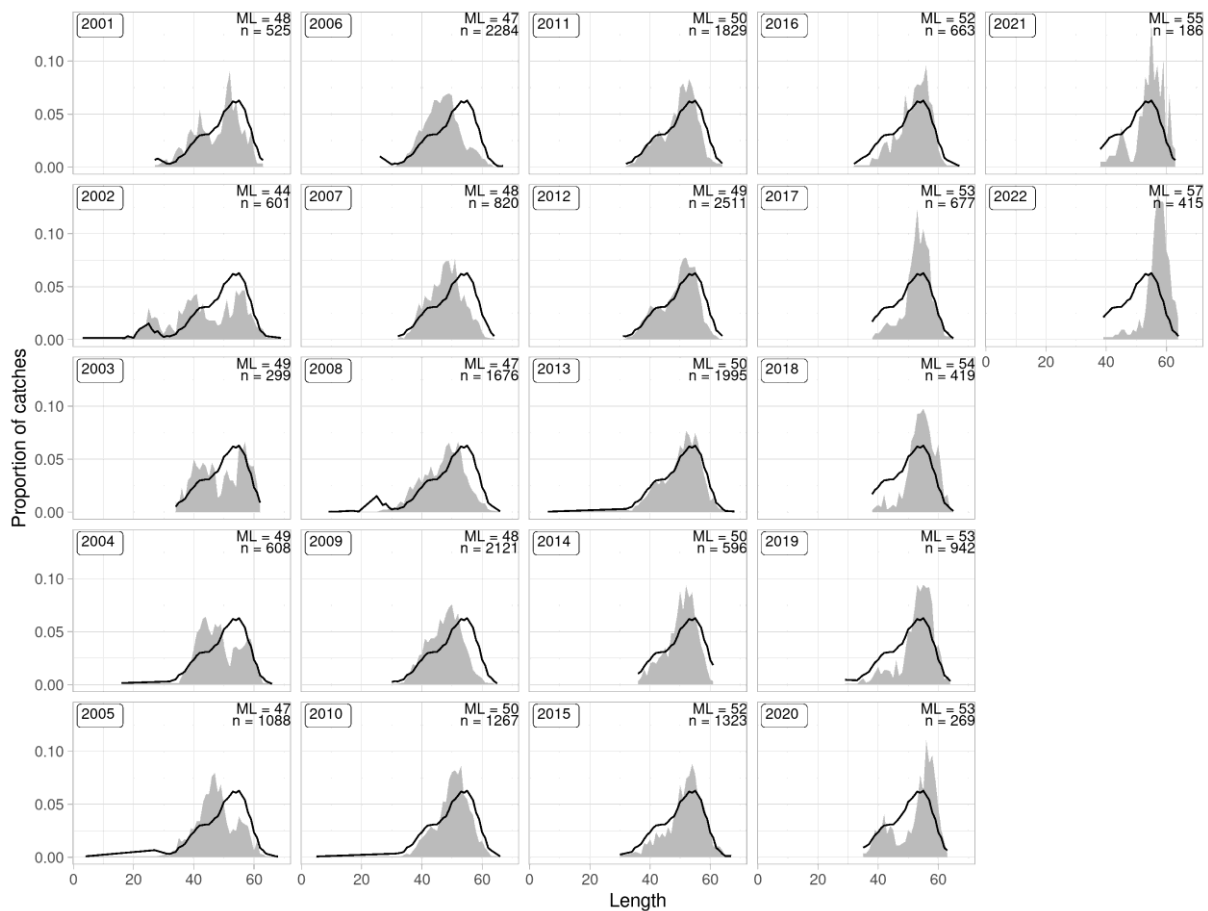


Figure 9. Megrim. Relative length distribution from landed catch. The black line represents the mean length distribution for all years.

SURVEY DATA

The Icelandic spring groundfish survey (hereafter spring survey, IS-SMB), which has been conducted annually in March since 1985, covers the most important distribution area of the megrim fishery. In addition, survey data on megrim is available from the Icelandic autumn groundfish survey (hereafter autumn survey, IS-SMH) since 1996. The autumn survey was not conducted in 2011. The spring survey is considered to measure changes in abundance/biomass better than the autumn survey.

Figure 10 shows trends in various biomass indices and a recruitment index based on abundance of megrim smaller than 20 cm. Survey length disaggregated abundance indices are shown in Figures 11-12, and abundance and changes in spatial distribution in Figures 13-16.

Total biomass index and the biomass index for megrim larger than 40 cm (harvestable part of the stock) increased steadily between 2000 and 2007 and stayed relatively stable until 2018 when the indices decreased and are approaching the lowest levels. The index of megrim larger than 53 cm gradually increased 2000-2018 but has decreased since then. The index of juvenile abundance (<20 cm) has been low for the last eight years. Since 2018, all indices except the juvenile index decreased significantly (Figure 10).

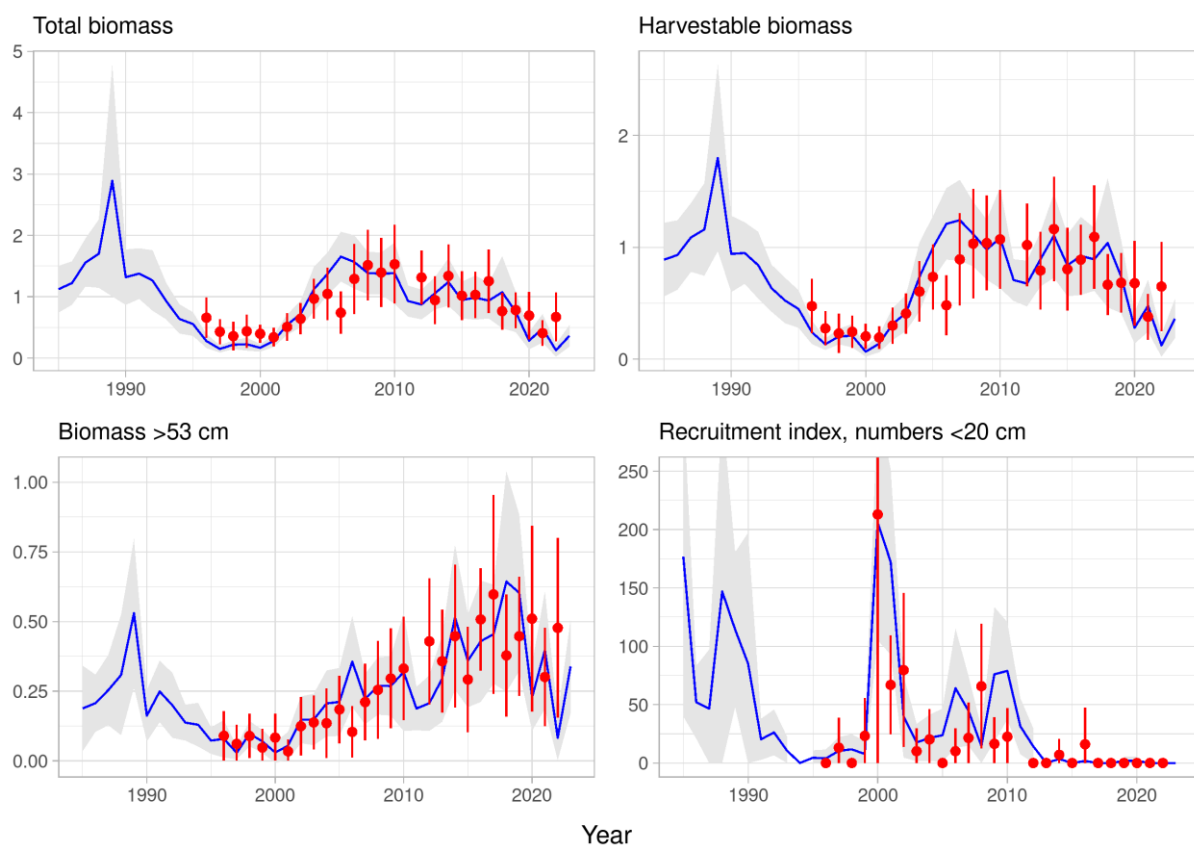


Figure 10. Megrim. Total biomass indices (upper left) and harvestable biomass indices (≥ 40 cm) (upper, right), biomass indices of larger ind. (≥ 53 cm) (lower left) and juvenile abundance indices (≤ 20 cm) (lower right) from the spring survey (blue) from 1985 and autumn survey (red) from 1996, along with the standard deviation.

From the onset of the spring survey in 1985 until 1993 there were little changes in the general length distribution of megrim and the average length ranged between 36 and 38 cm (Figure 11). In 1994-1999 there was relatively more larger fish, increasing the average length to 44 cm in 1998. In the survey of 2000, there was a sudden change in the length distribution of megrim with relatively high number of small individuals and the average length decreased to 26.5 cm. This is seen as a sudden increase in recruitment in 2000 (Figure 10). Although recruitment continued to be high in the following years, the length distribution gradually shifted towards larger fish with average length reaching over 50 cm in 2018. Comparable changes in length distribution of megrim are also seen in the autumn survey (Figure 12).

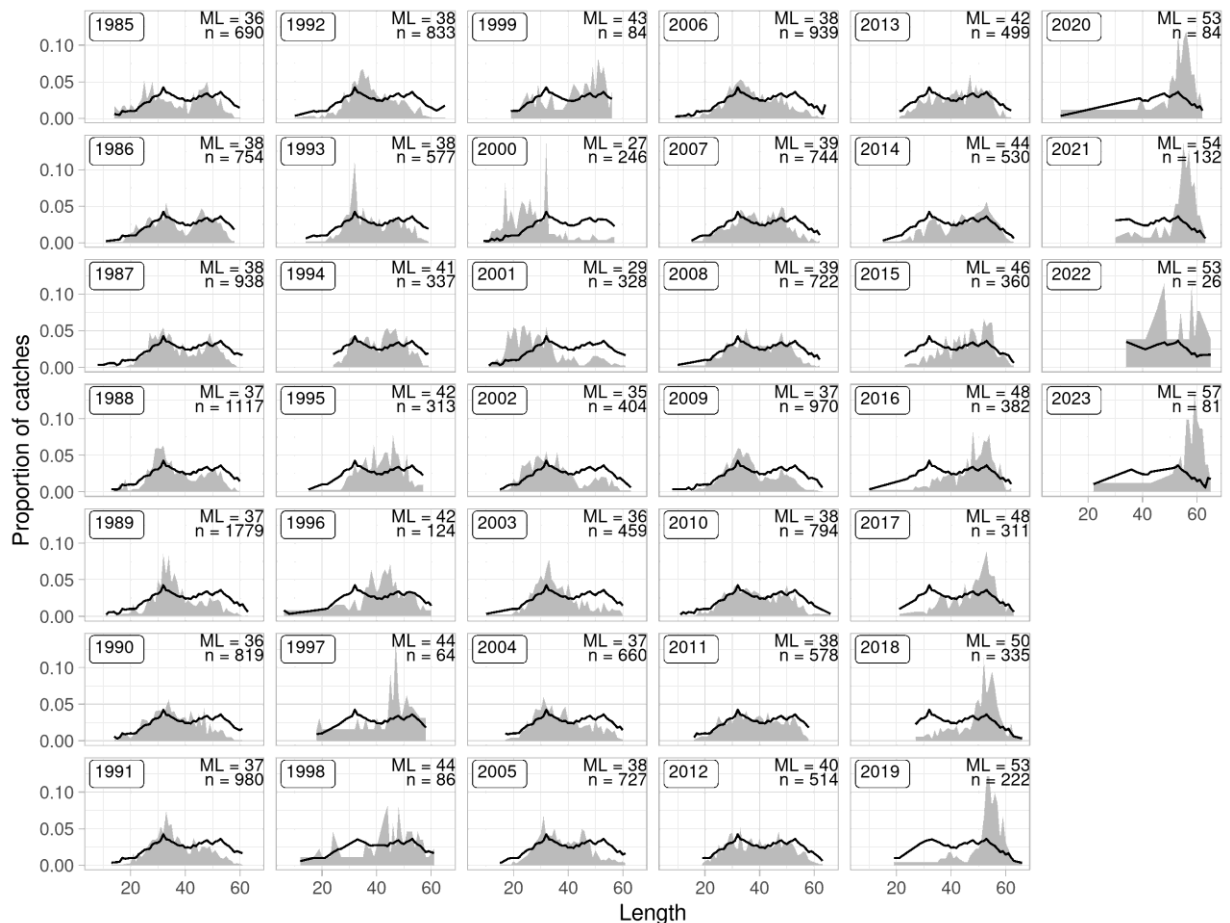


Figure 11. Megrim. Relative length-disaggregated abundance indices from the spring survey. The black line shows the mean for all years.

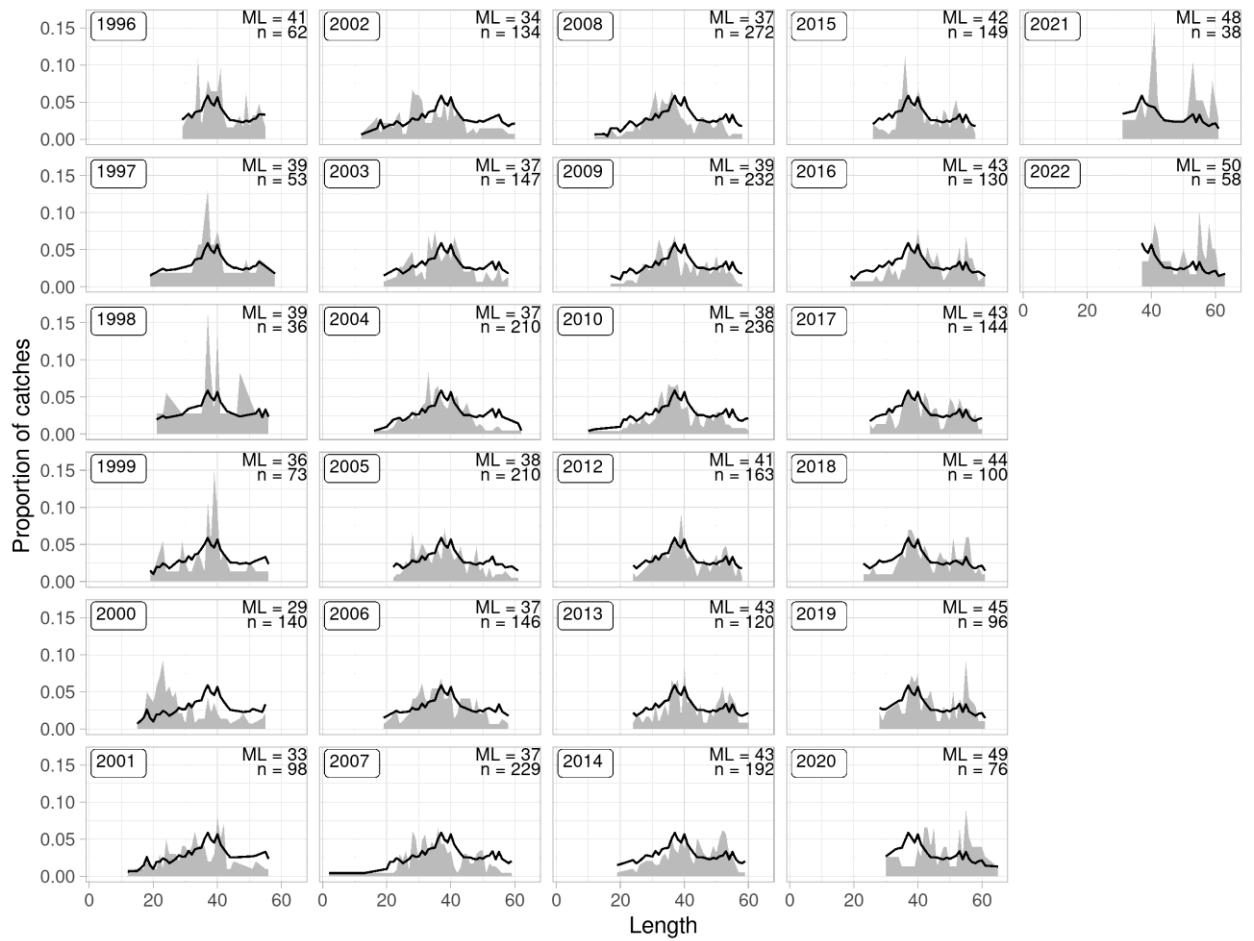


Figure 12. Megrim. Relative length-disaggregated abundance indices from the autumn survey. The black line shows the mean for all years.

Megrim was caught in the southern part of the shelf in the spring survey in 2022, particularly in the SW area around 300 m depth (Figure 13). Spatial distribution of the biomass index of megrim in the spring survey has been relatively stable since 2007, with highest proportion of megrim caught in the SW area (Figure 14).

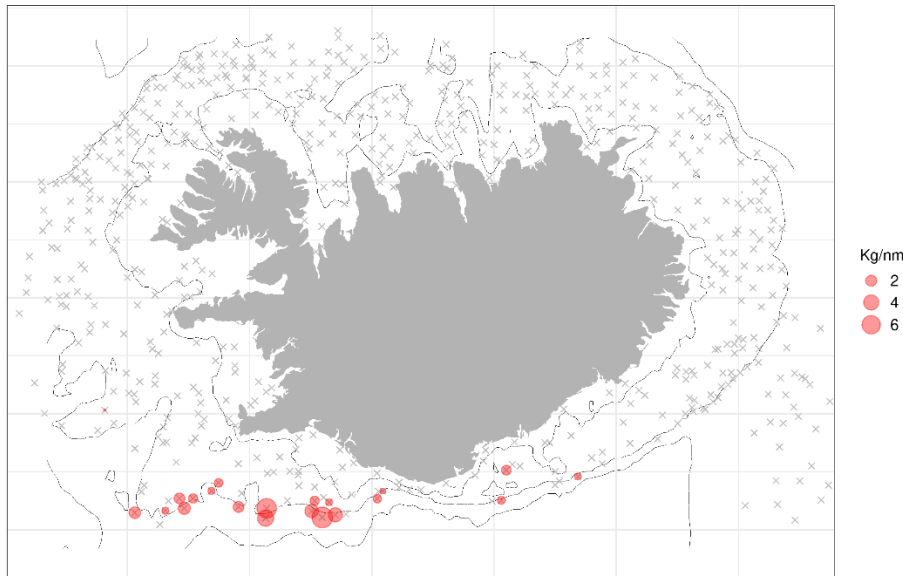


Figure 13. Megrim. Spatial distribution in the spring survey in 2023.

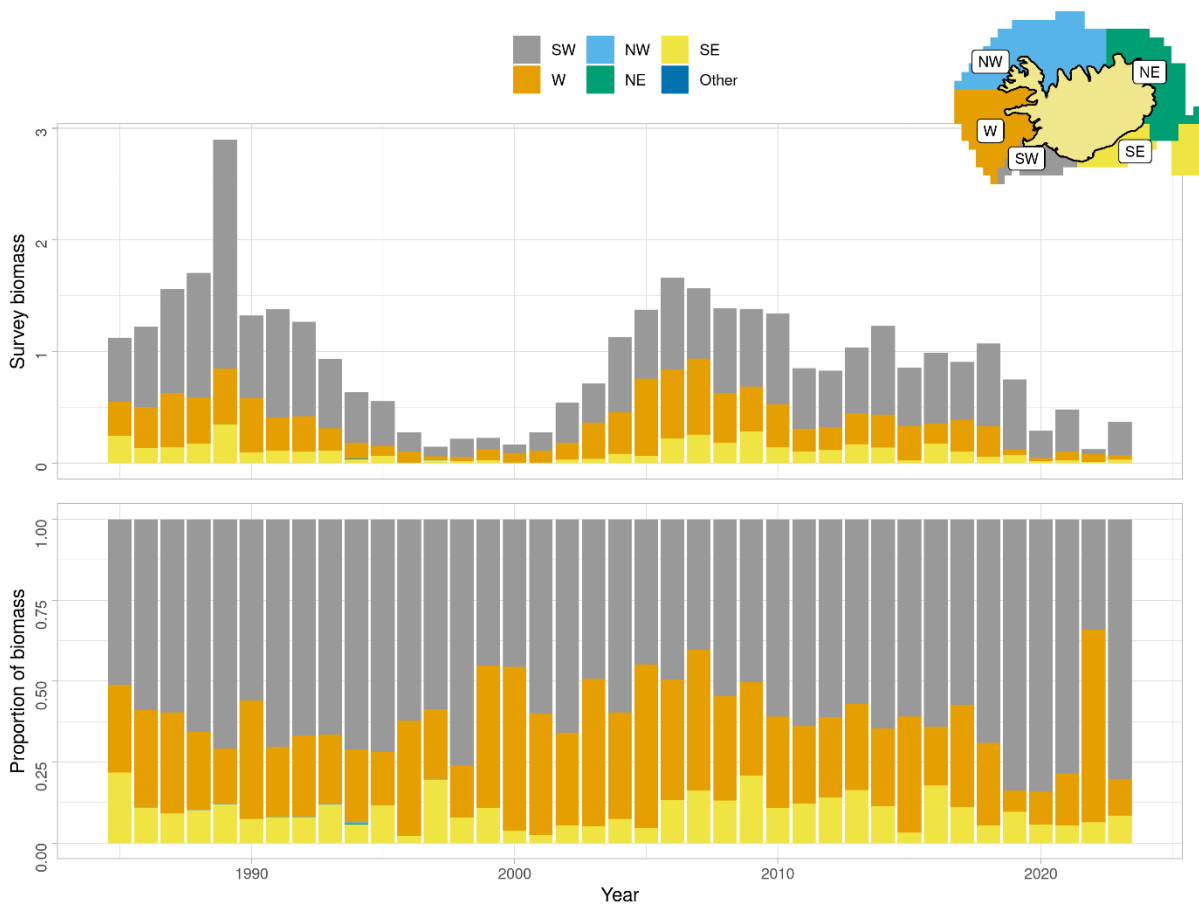


Figure 14. Megrim. Spatial distribution of biomass indices from the spring survey.

In the autumn survey of 2021, the general distribution was similar to the distribution in the spring survey (Figure 15). The same is true for the spatial distribution of megrim in the autumn survey since 1996 (Figure 16), where most of the biomass has been observed in the SW area, followed by the W and SE areas.

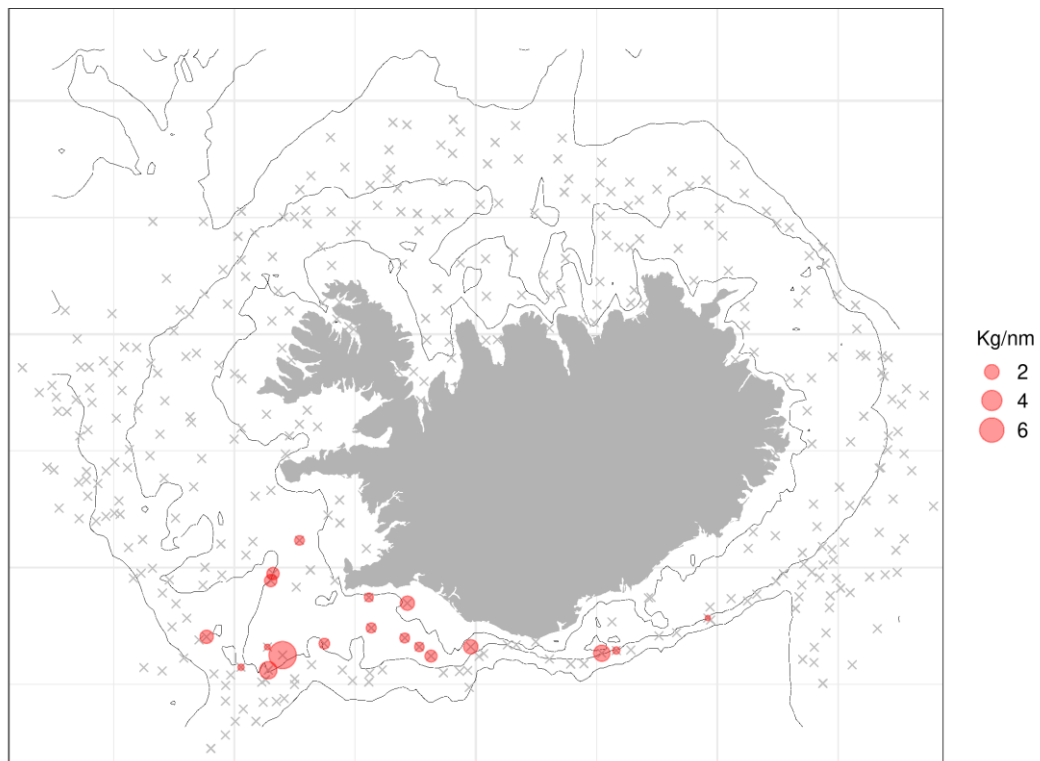


Figure 15. Megrim. Spatial distribution of megrim in the autumn survey in 2021.

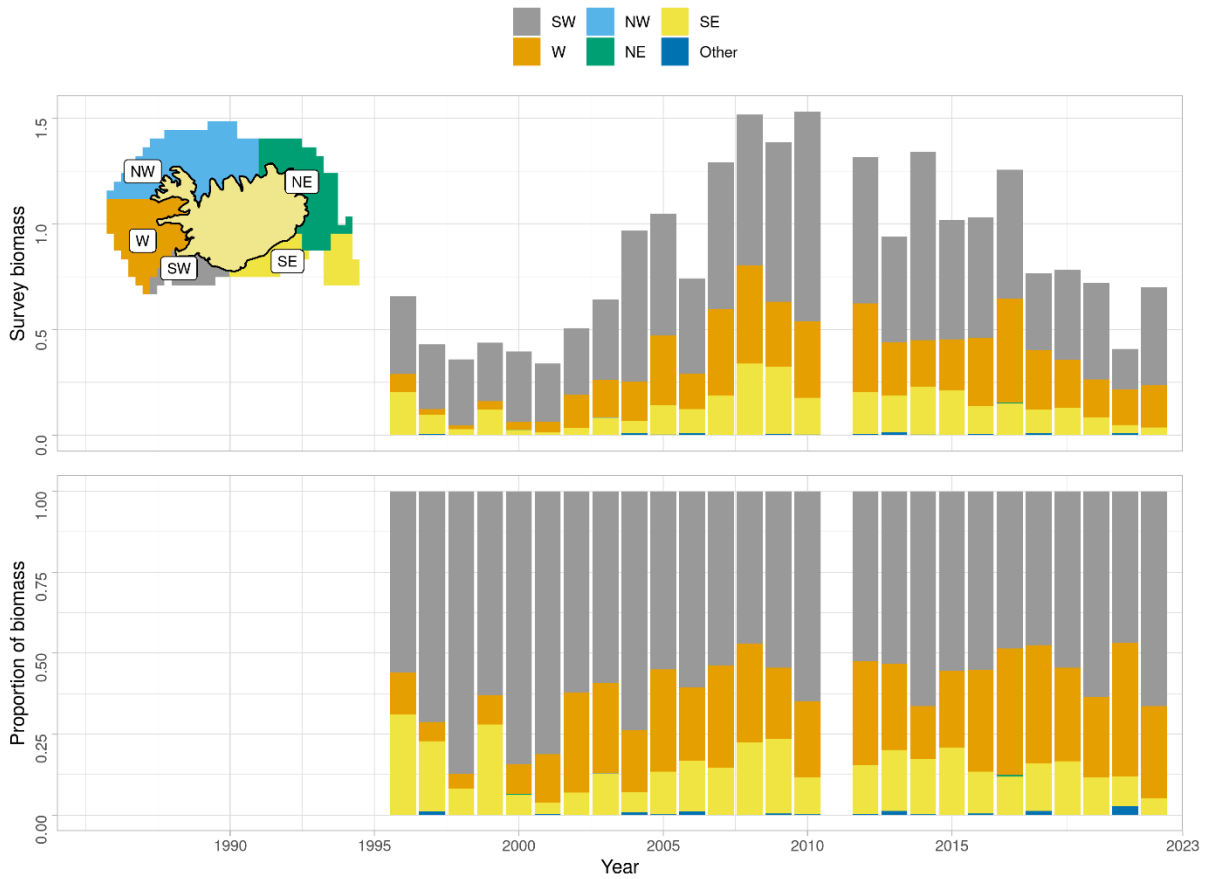


Figure 16. Megrim. Spatial distribution of biomass indices from the autumn survey.

STOCK ASSESSMENT

COMMENTS ON THE ASSESSMENT AND ADVICE

The assessment is for this stock based on ICES *rfb*-rule for data limited stocks for the first time in 2023, where life history traits, exploitation characteristics and other relevant parameters for data-limited stocks are considered (ICES 2021). The *rfb*-rule has the following form:

$$A_{y+1} = A_{y-1} r f b m$$

where A_{y+1} is the advised catch, A_{y-1} is last year's advice, r corresponds to the trend in biomass index (as in the current ICES "2 over 3" rule), f is a proxy for the exploitation (mean catch length divided by an MSY reference length) and b a biomass safeguard (reducing the catch when biomass index drops below a trigger value).

r is the ratio of the mean of the last two survey indices and the mean of the three preceding values or:

$$r = \frac{\sum_{i=y-2}^{y-1} I_1 / 2}{\sum_{i=y-3}^{y-5} I_1 / 3}$$

f is the length-ratio component where:

$$f = \frac{\bar{L}_{y-1}}{L_{F=M}}$$

where \bar{L} is the mean catch length above $L_{F=M}$.

$L_{F=M}$ is calculated as:

$$L_{F=M} = 0.75L_c + 0.25L_\infty$$

where L_c is the length where frequency is half that of the modal value (Figure 20), and L_∞ is von Bertalanffy L_∞ .

b is the biomass safeguard and is used to reduce catch advice when index falls below trigger,

$$b = \min(1, I_y - 1/I_{trigger})$$

where $I_{trigger} = i_{loss\omega}$

m is a multiplier based on stock growth. K for megrim is 0.19 and therefore m is 0.95.

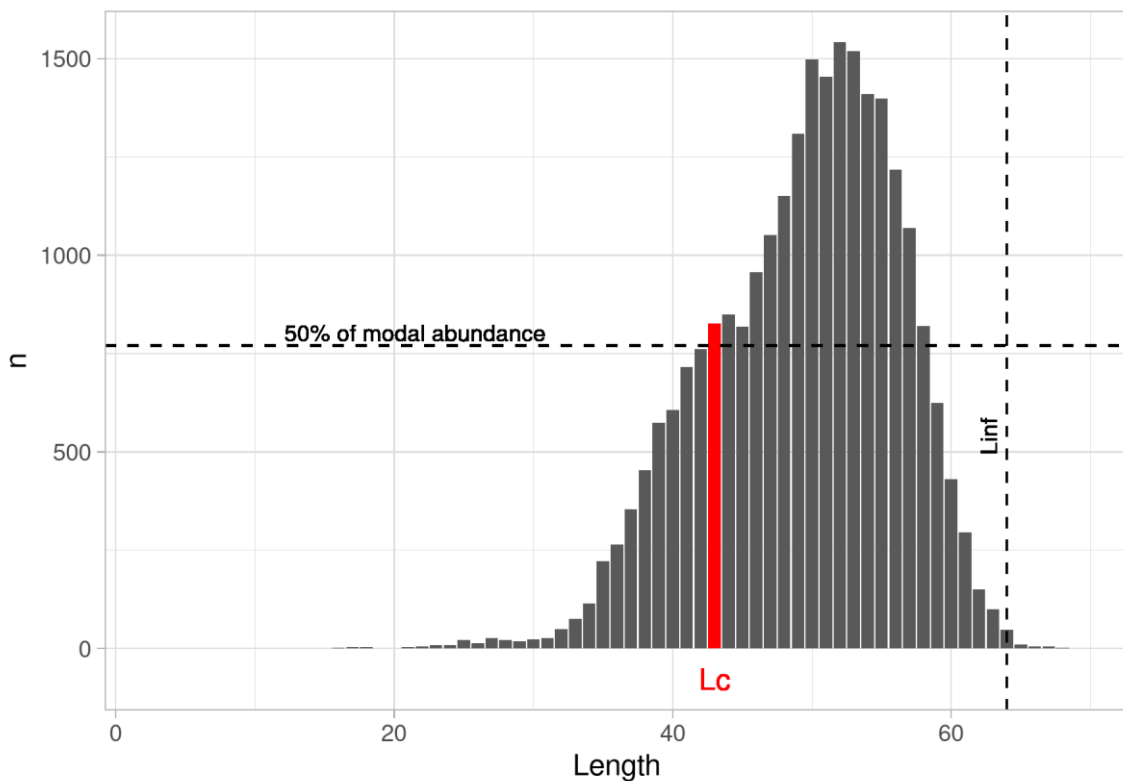


Figure 20. Megrim. Length frequency distribution from catches. Red line is the length at first capture.

ANALYSIS ON THE ASSESSMENT AND ADVICE

The assessment is based on the rfb-rule for ICES category 3 data-limited stocks and is applied for megrim for the first time this year and is applied for the next two fishing years (2023/2024 and 2024/2025). The Icelandic spring trawl survey (IS-SMB) was used as the index for the stock development. The advice is according to $A_{y+1} = A_{y-1} r f b m$ or $132 \text{ t} * 0.48 * 1.19 * 1 * 0.95$ which results in advice for 2023/2024 that is more than 30% lower than the previous advice. Applying the stability clause results in advice of 92 t (-30% reduction from last year’s advice) (Table 3). In 2019-2021, the advice was based on the ICES framework for data limited stocks (Category 3.2) where the ratio of the mean of the last two survey

indices (Index A) to the mean of the three preceding values (Index B) is multiplied by the last year's advice. This method is no longer considered precautionary and hence, the new rule.

Table 3. Megrim. Comparison between the *r*fb-rule and the “2 over 3” rule.

	<i>r</i> fb-rule	Old 2-over-3 rule
Previous advice	132	132
Index A	244	244
Index B	507	507
Ratio (A/B)	0.48	0.48
Length ratio	1.19	-
Biomass safeguard	1	-
Multiplier	0.95	-
Initial advice	72	63
Stability clause applied	-30%	-20%
Precautionary buffer*	-	-
Final advice	92	106
Advice change	-30%	-20%

*Last applied in 2022.

APPLICATION OF THE RFB-RULE

- *r* is calculated as the average of last two years values, divided by average of three preceding years values which results in $r=0.929$ (Figure 21, Table 3)

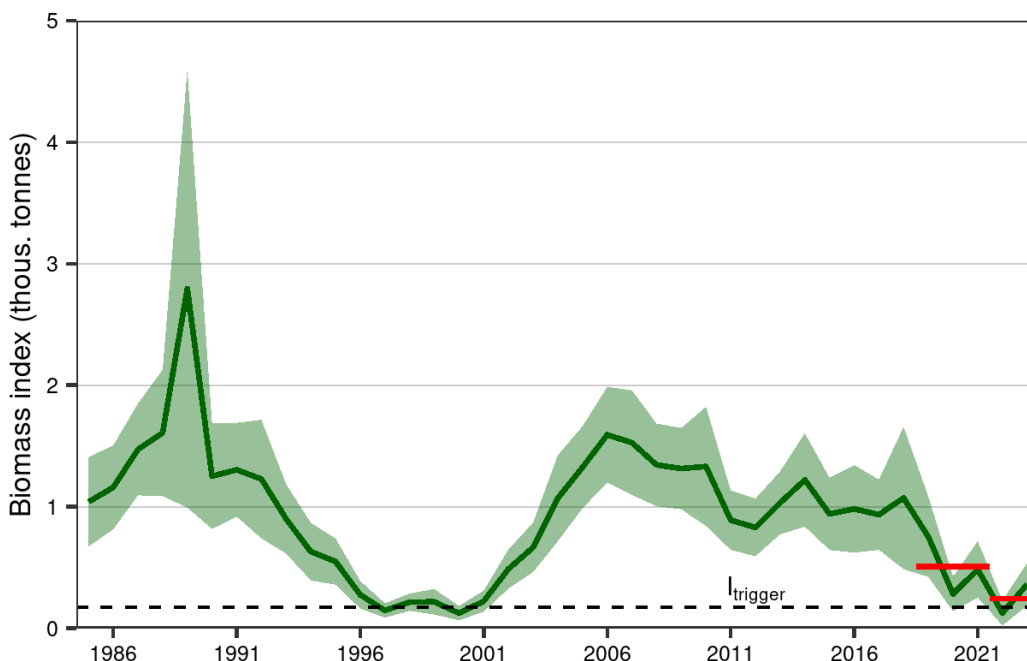


Figure 21. Megrim. IS-SMB biomass index since 1985. The red lines show the average of the last two years values and the three preceding years used to calculate *r*.

- *f* is the length-ratio component. The mean length from catches 2022, the last year that length was measured from catches, was 57 cm and the target reference length (L_C , the length where frequency is half that of the modal value $* 0.75 + L_{\infty} * 0.25$) is **48** (Figure 22).

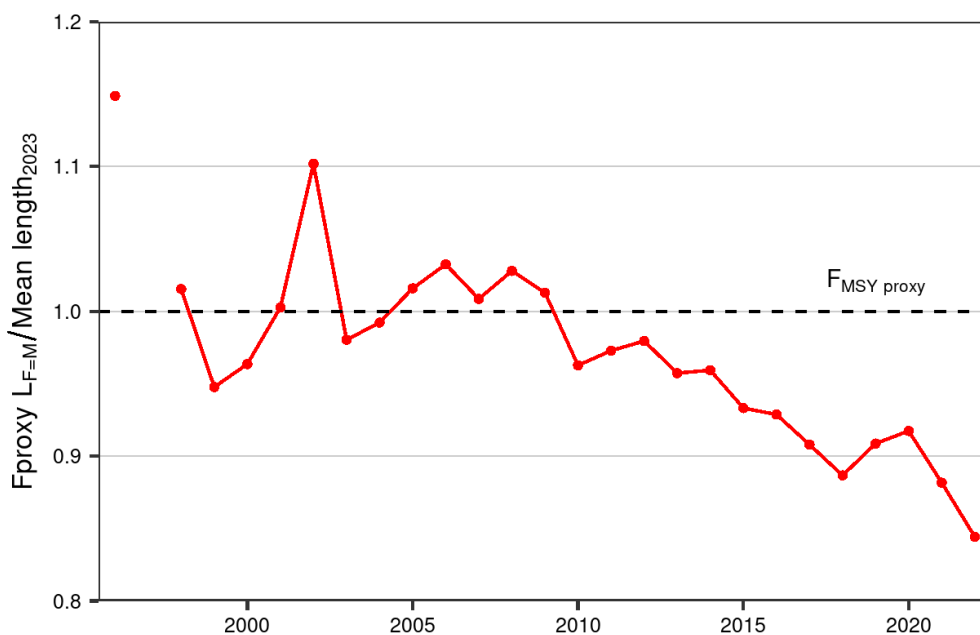


Figure 22. Megrim. Annual Fproxy for years for which sufficient data was available.

- b is the biomass safeguard and is used to reduce catch advice when index falls below trigger. I_{loss} for megrim is 124 and was based on the lowest biomass index. $I_{trigger}$ is $I_{loss} * 1.4$ or 174 (Figure 21). The biomass index this year is 362, which is above $I_{trigger}$ and hence, b is 1.
- m is the tuning parameter and for slow growing species (with von Bertalanffy $K < 0.2$), m equals 0.95.

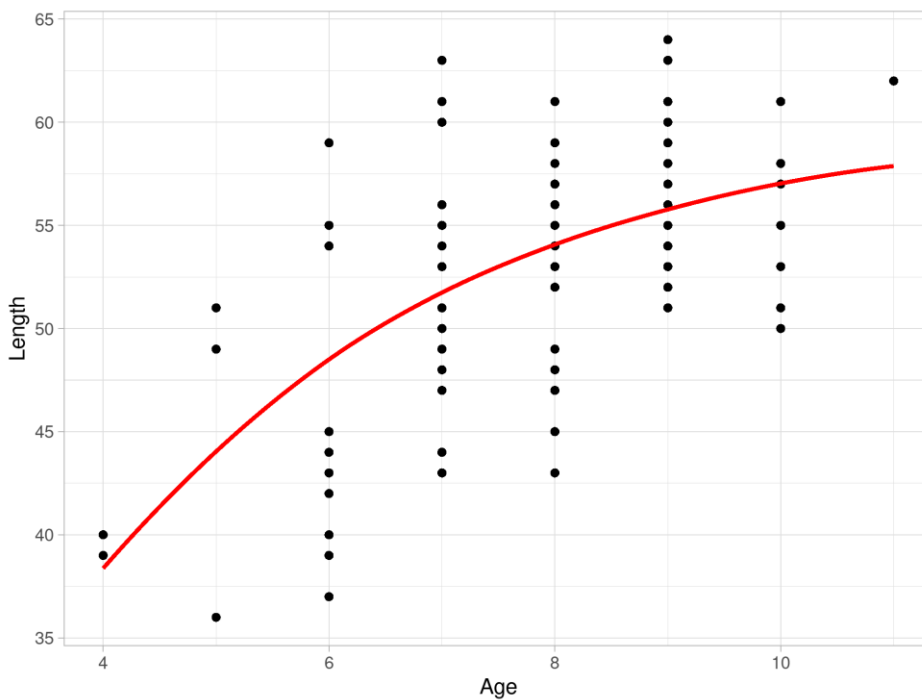


Figure 23. Megrim. The von Bertalanffy growth curve (red line) fitted to age and length data from all available data in the last 5 years.

MANAGEMENT

Megrim is caught as a bycatch and usually in small quantities. However, due to low recruitment for a prolonged time and substantial decline in survey biomass indices, the Marine and Freshwater Research Institute has made recommendations on TAC for megrim since the 2021/2022 fishing year.

Table 3. Megrim. Recommended TAC, national TAC set by the Ministry, and landings (tonnes).

<i>FISHING YEAR</i>	REC. TAC	NATIONAL TAC	CATCH
<i>2010/11</i>	-	-	270
<i>2011/12</i>	-	-	429
<i>2012/13</i>	-	-	380
<i>2013/14</i>	-	-	369
<i>2014/15</i>	-	-	429
<i>2015/16</i>	-	-	498
<i>2016/17</i>	-	-	467
<i>2017/18</i>	-	-	387
<i>2018/19</i>	-	-	341
<i>2019/20</i>	-	-	289
<i>2020/21</i>	-	-	194
<i>2021/22</i>	206	-	86
<i>2022/23</i>	132	-	