WHITING

Merlangius merlangus

GENERAL INFORMATION

Whiting is a demersal gadoid species like cod and haddock, but smaller with a maximum length of about 80 cm, males and females being similar in size. In Icelandic waters, sexual maturity is reached at around 30 cm.

THE FISHERY

Whiting has been caught mainly as bycatch all around Iceland in recent years, though mostly around south and west of Iceland (Figures 1 and 2). Annual catches have been between 500 and 1000 tonnes except for 2008-2012 when catches increased with a peaked in 2011 at 2602 tonnes (Figure 2). Increased catches in this period occurred almost exclusively in the southwest (Figure 2). In 2021, catches increased to similar levels as in 2013 (Figures 2-4 and table 1). Whiting is found at depths ranging from 10 to 300 m but is mostly caught between 100 and 250 m (Figure 3).

Whiting is mainly caught in demersal trawls but to some extent in *Nephrops* trawls, longline and demersal seine (Table 1, Figure 4). The number of boats reporting whiting catches increased with increased catches between 2007 and 2012 but has since then decreased (Figures 2 and 4, and Table 1).

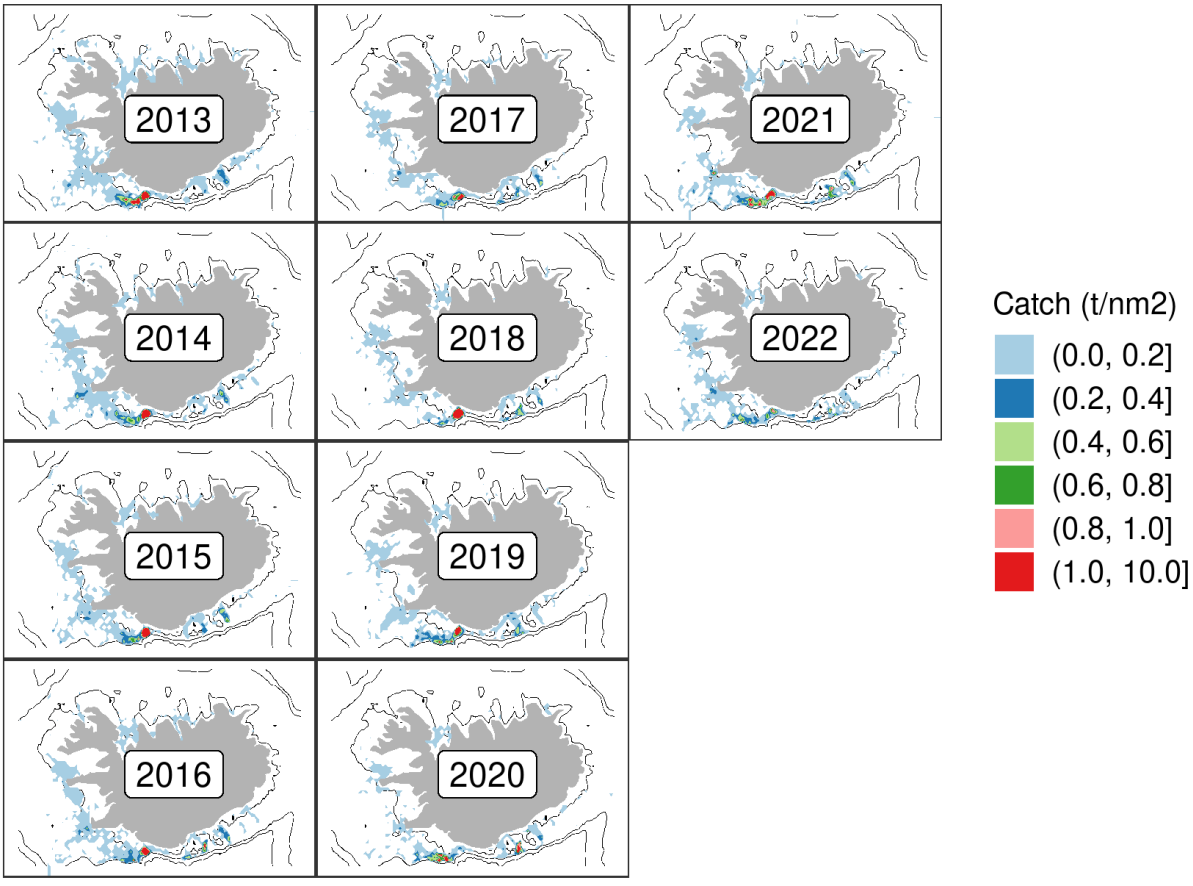

Figure 1. Whiting. Geographic distribution of the Icelandic fishery 2013-2022 as reported in logbooks.

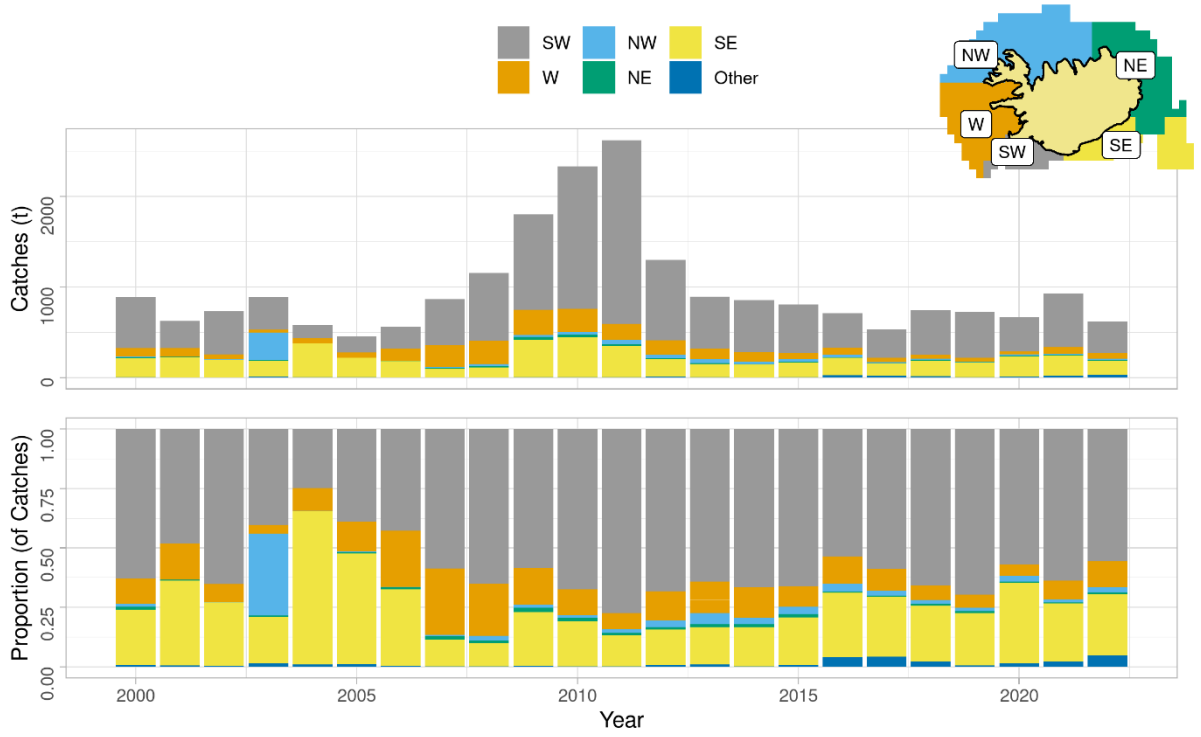

Figure 2. Whiting. Catch distribution and proportions by area since 2000, according to logbooks.

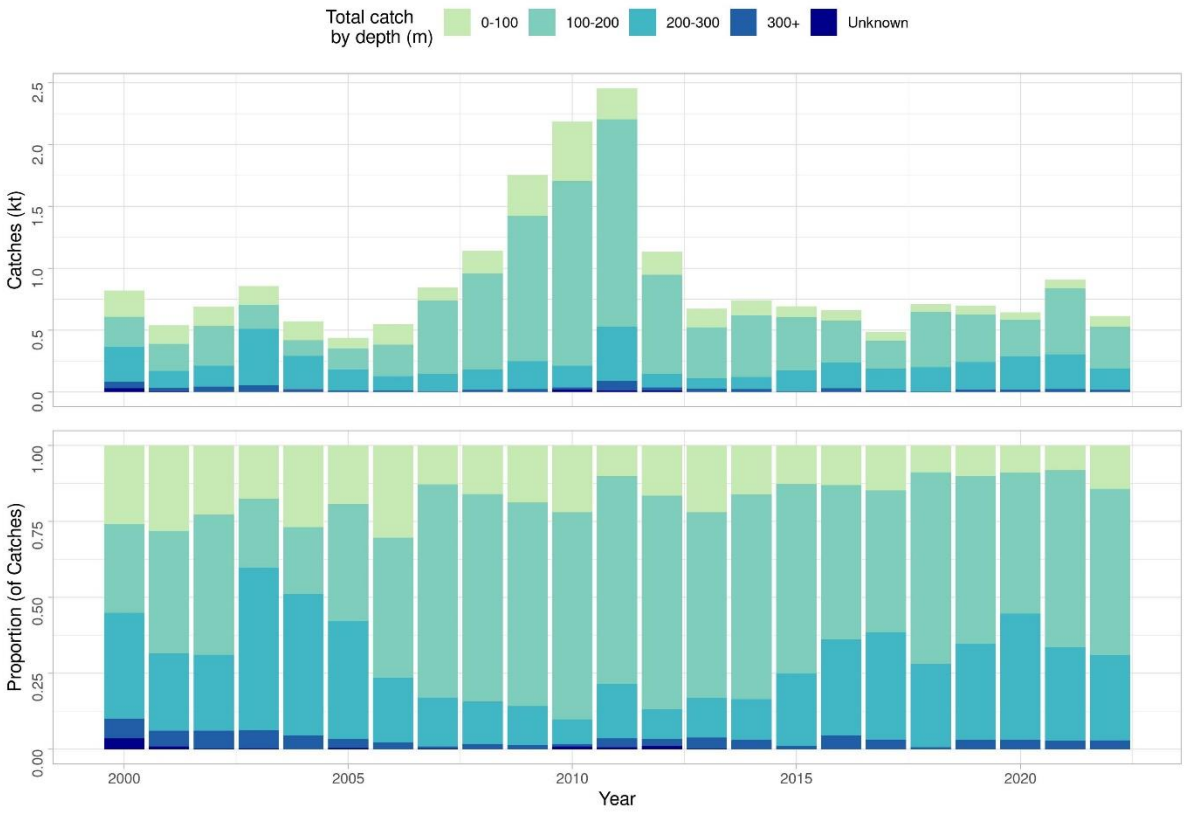

Figure 3. Whiting. Depth distribution of catches since 2000 according to logbooks.

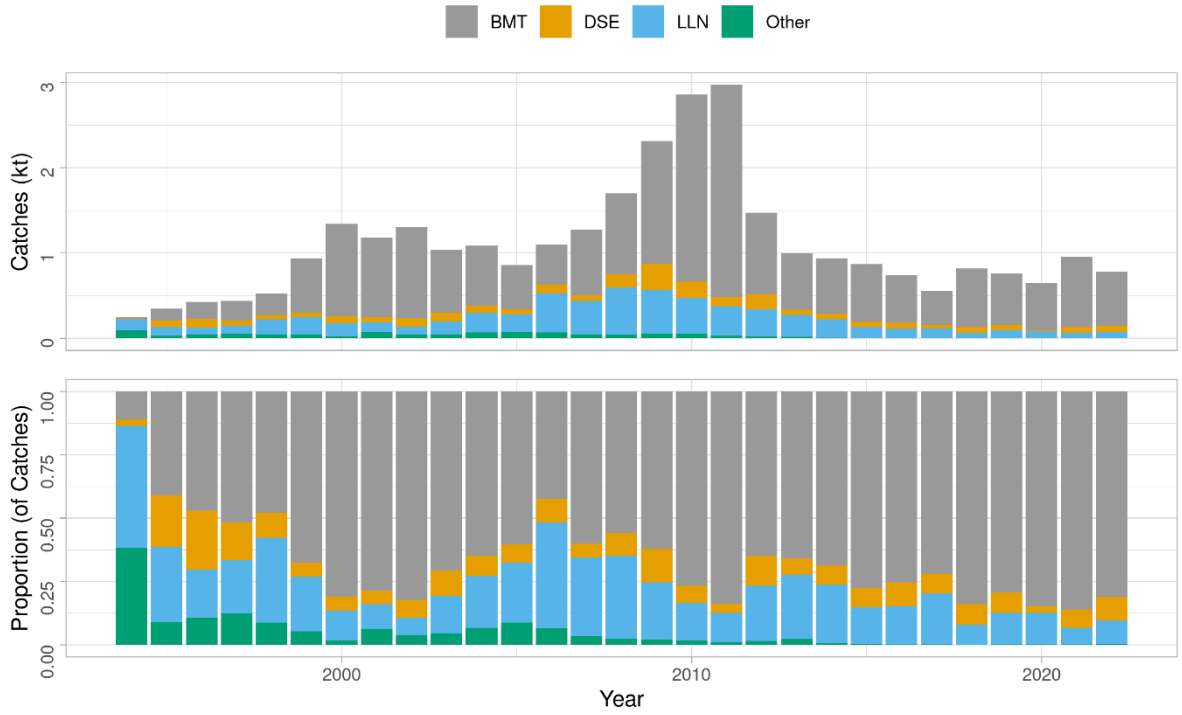

Figure 4. Whiting. Total catch (landings) of whiting by fishing gear since 2000, according to statistics from the Directorate of Fisheries.

Table 1. Whiting. Number of Icelandic boats reporting catches of whiting, landings by fishing gear and yearly reported landings according to the Directorate of Fisheries.

YEAR	NUMBER OF VESSELS				CATCHES (TONNES)				
	Demersal trawl	*Nephrops trawl*	*Longline*	*Other*	*Demersal trawl*	*Nephrops trawl*	*Longline*	*Other*	*Sum*
2000	76	13	131	79	1037	51	157	99	1344
2001	59	15	111	102	792	136	114	131	1173
2002	62	23	81	92	913	150	90	145	1298
2003	54	22	100	94	671	62	153	139	1025
2004	51	18	116	76	682	22	224	110	1038
2005	54	13	115	77	488	26	205	79	798
2006	50	15	144	83	439	29	460	124	1052
2007	53	7	181	90	741	22	394	102	1259
2008	58	12	190	84	928	21	557	182	1688
2009	56	13	201	151	1404	35	520	349	2308
2010	52	17	186	133	2036	155	425	234	2850
2011	52	15	187	120	2288	176	345	156	2965
2012	46	15	174	102	777	178	320	194	1469
2013	37	15	172	70	417	240	255	70	982
2014	33	15	154	69	518	124	205	81	928
2015	32	13	130	41	546	129	115	69	859
2016	36	11	127	33	494	65	103	71	733
2017	27	8	95	23	360	41	107	44	552
2018	32	8	72	28	659	30	60	68	817
2019	39	8	76	28	581	25	93	62	761
2020	39	5	72	29	529	19	67	19	634
2021	42	6	69	38	800	20	57	74	950
2022	43	2	57	37	630	2	67	76	775

LENGTH DISTRIBUTIONS FROM COMMERCIAL CATCHES OF WHITING

Length measurements of whiting from commercial catches are scarce and missing for several years, but show substantial recruitment in 1980, 1996, 2007 and 2019 (Figure 6). Most whiting caught in the commercial fishery are 38-55 cm (Figure 6).

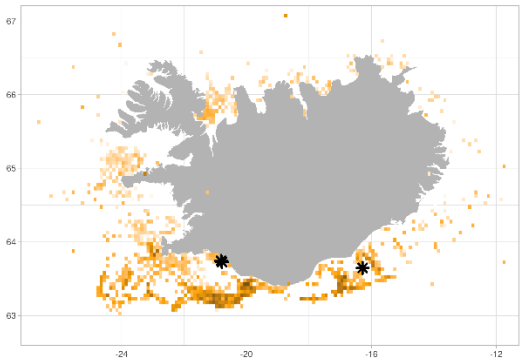

Figure 5. Whiting. Distribution of commercial catches 2021 and sampling locations. No samples were collected 2022.

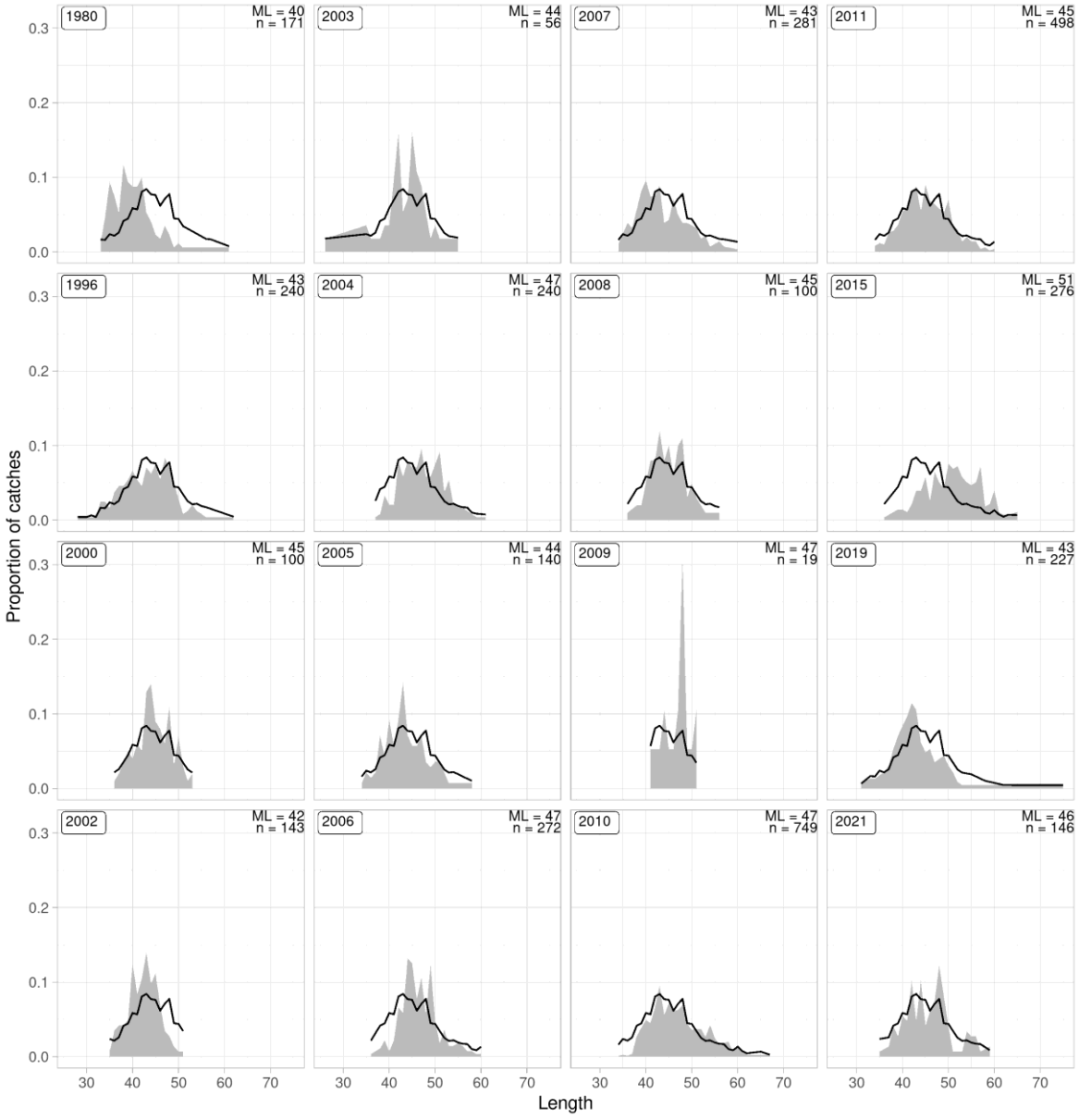

Figure 6. Whiting. Relative length distribution from commercial catches in years since 1980 where length measurements are available.

SURVEY DATA

Annual Icelandic groundfish surveys have been conducted in March (IS-SMB) since 1985 and October (IS-SMH) since 1996. Both surveys cover the distribution area of whiting on Icelandic grounds. For monitoring, harvestable biomass and recruitment indices were estimated for both surveys (Figure 7). The harvestable biomass index is calculated as the biomass of individuals 40 cm and larger. The recruitment index is defined as whiting smaller than 20 cm.

Both the total biomass index and harvestable biomass index in IS-SMB increased from 2003 to a maximum in 2005 but decreased to a low level in 2015 (Figure 7). Since then, both indices have increased, and harvestable biomass is approaching the highest value in the timeseries (1990). The biomass indices from IS-SMH are much more variable but show similar trends as IS-SMB. Recruitment indices show similar trends in both surveys (Figure 7). Strong recruitment was observed in 2003, 2007 and 2019-2021 in IS-SMH and in 2004, 2008 and 2021-2022 in IS-SMB. These peaks can be observed in the length distributions (Figures 8 and 9), and in the harvestable biomass indices 2-3 years later.

Spatial distribution of whiting from the spring survey is similar to what is observed in commercial catches, that is, mostly in the south of Iceland (Figures 1-2, and 10-11). The autumn survey however shows the highest indices in a larger area, southeast, southwest, and west (Figures 12 and 13). The recent increase in the biomass indices has mostly taken place in the southeast and southwest areas (Figures 11 and 13).

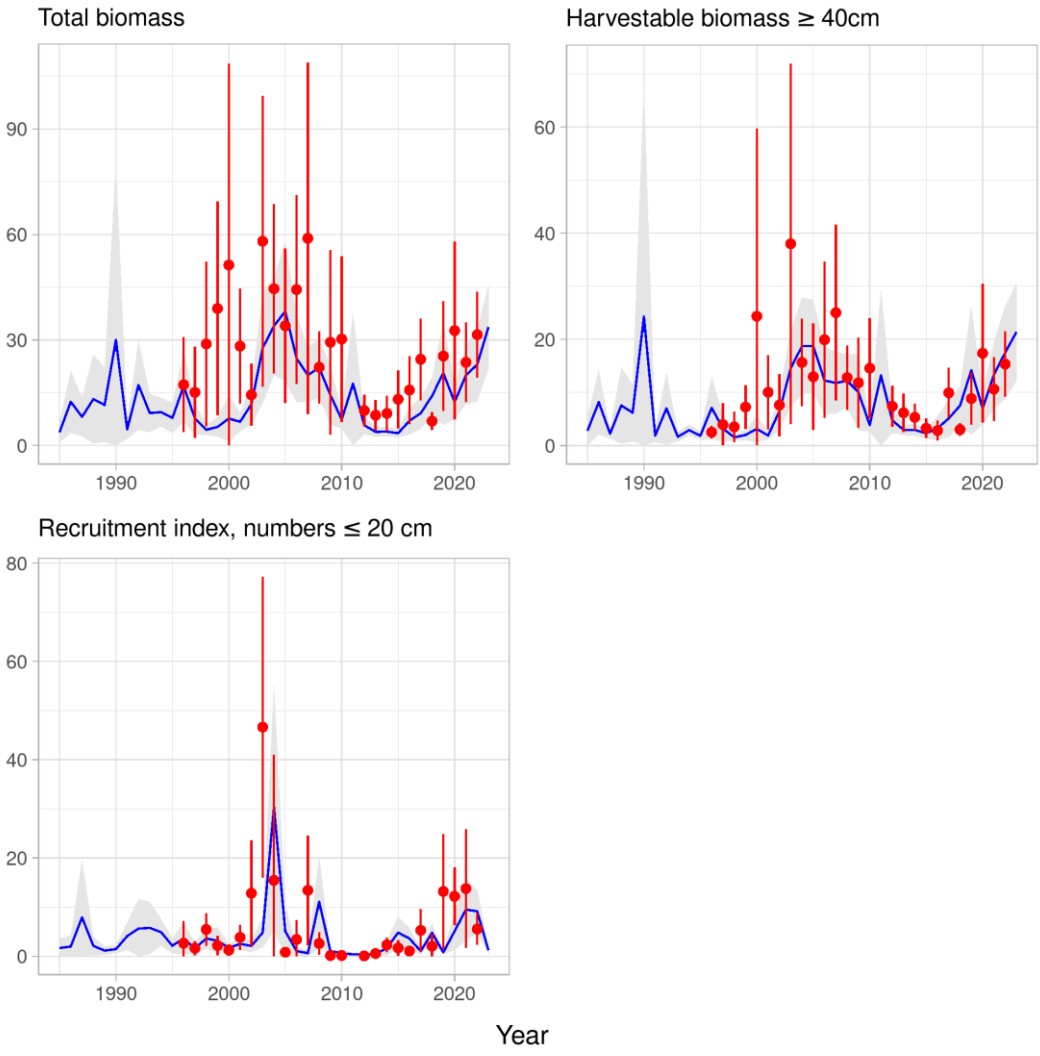

Figure 7. Whiting. Total biomass indices (upper left), harvestable biomass indices (≥40 cm, upper right), and juvenile abundance indices (≤20 cm, lower) from IS-SMB (blue) 1985-2022 and IS-SMH (red) 1996-2021, along with 95% CI.

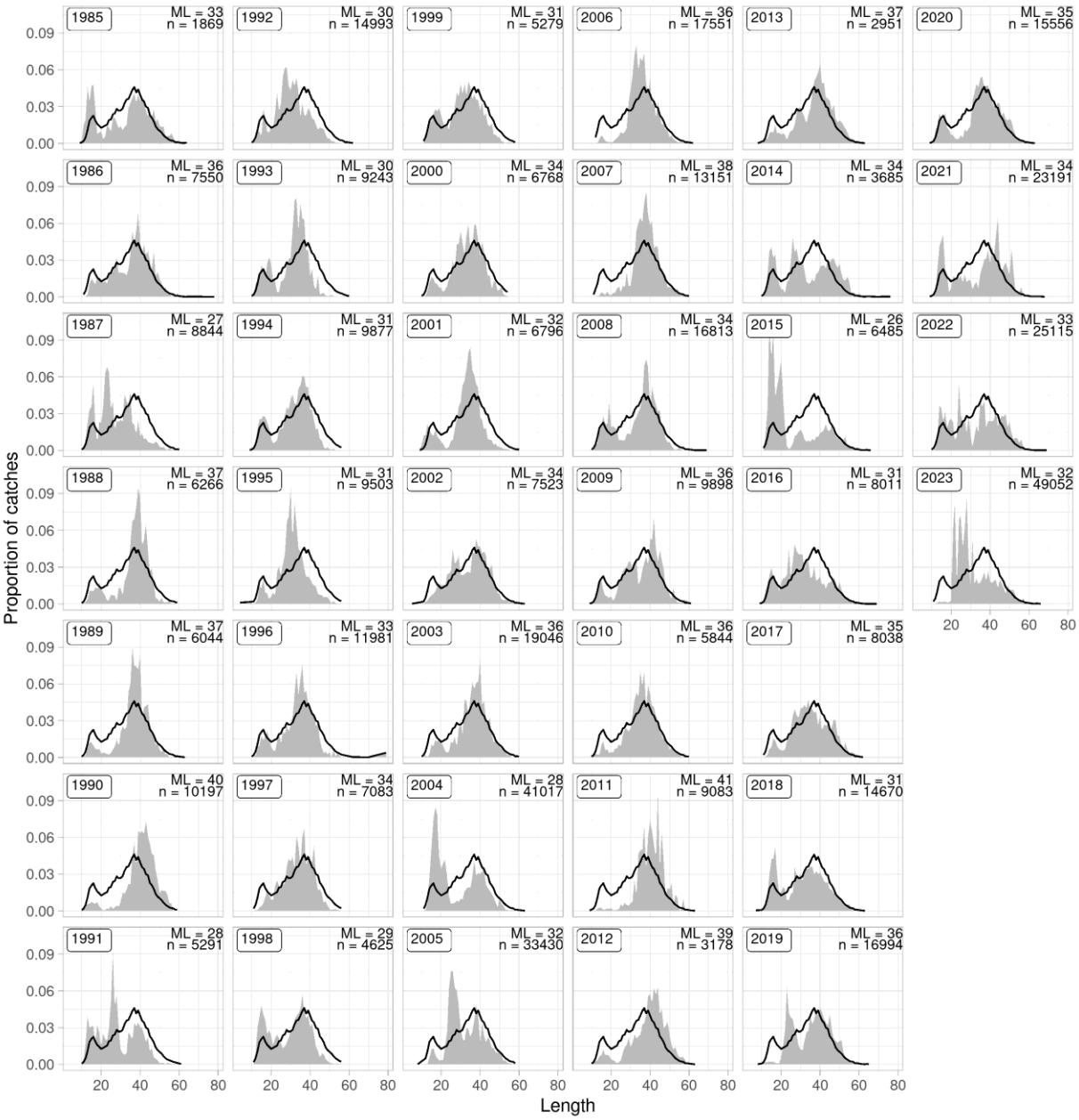

Figure 8. Whiting. Relative length-disaggregated abundance indices from IS-SMB 1985-2022. The line shows the mean for all years.

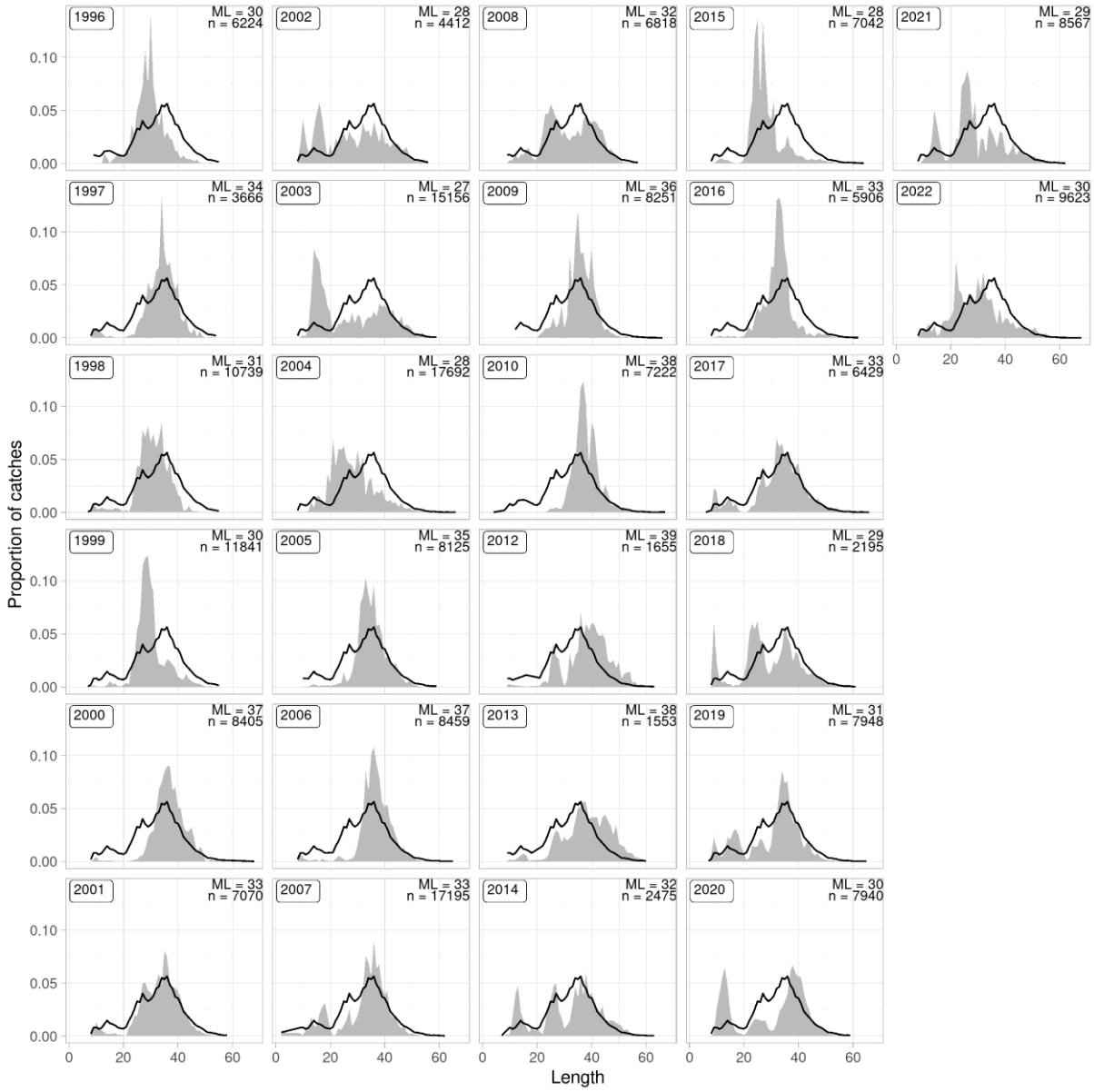

Figure 9. Whiting. Relative length-disaggregated abundance indices from IS-SMH 1996-2021. The line shows the mean for all years.

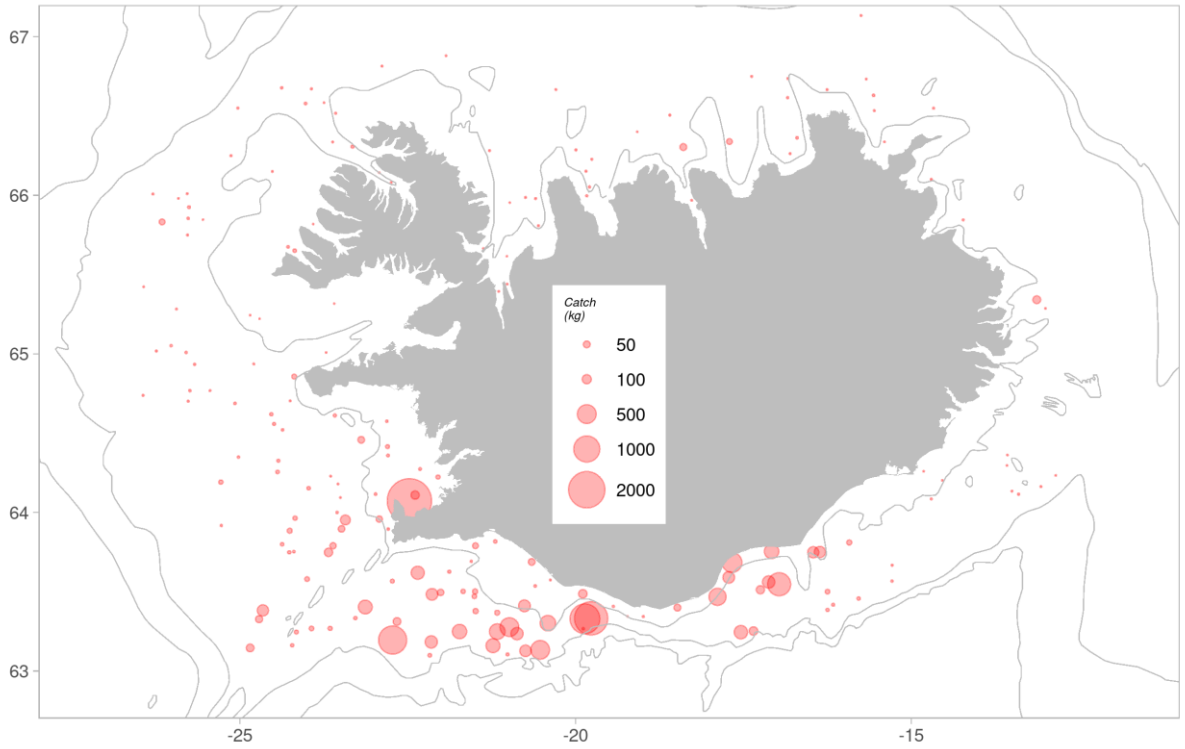

Figure 10. Whiting. Spatial distribution from IS-SMB in 2022.

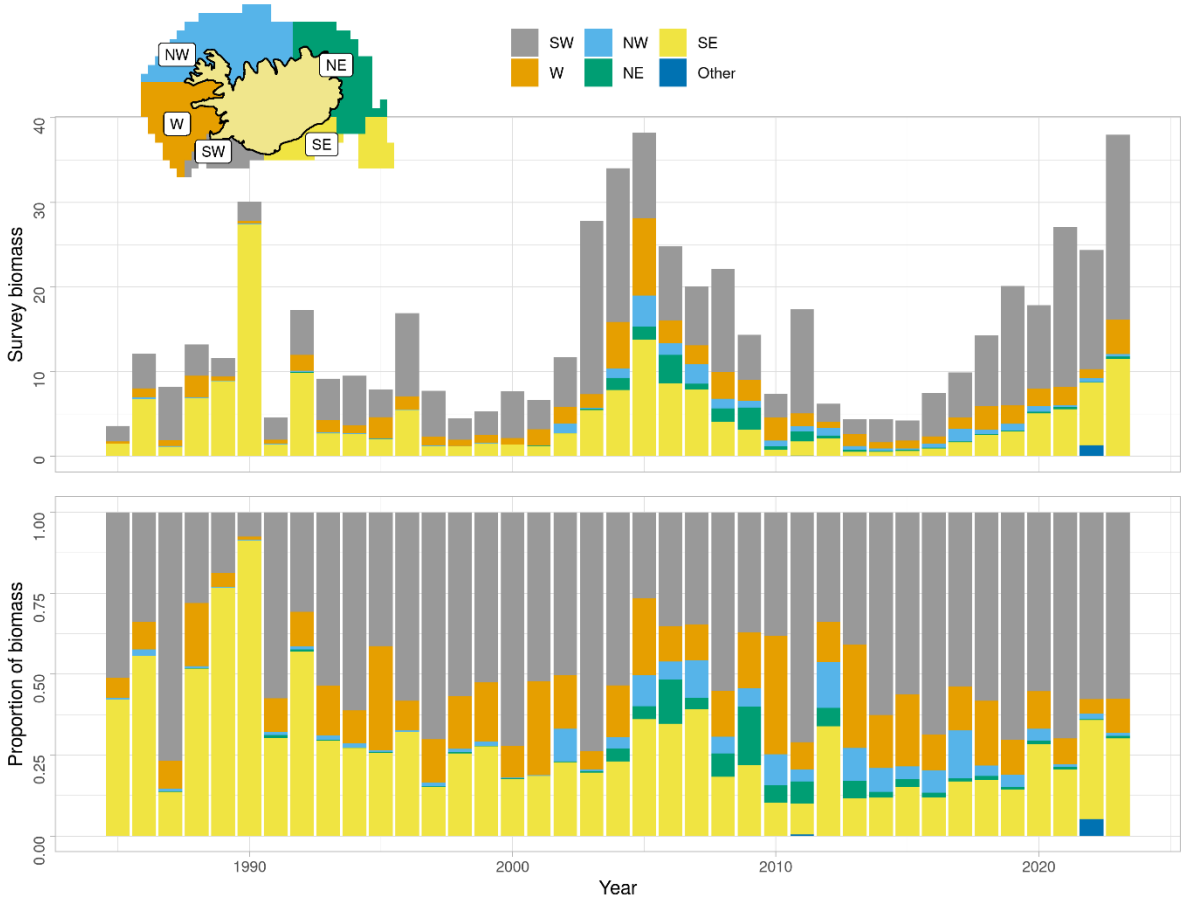

Figure 11. Whiting. Spatial distribution of biomass index from IS-SMB 1985-2022.

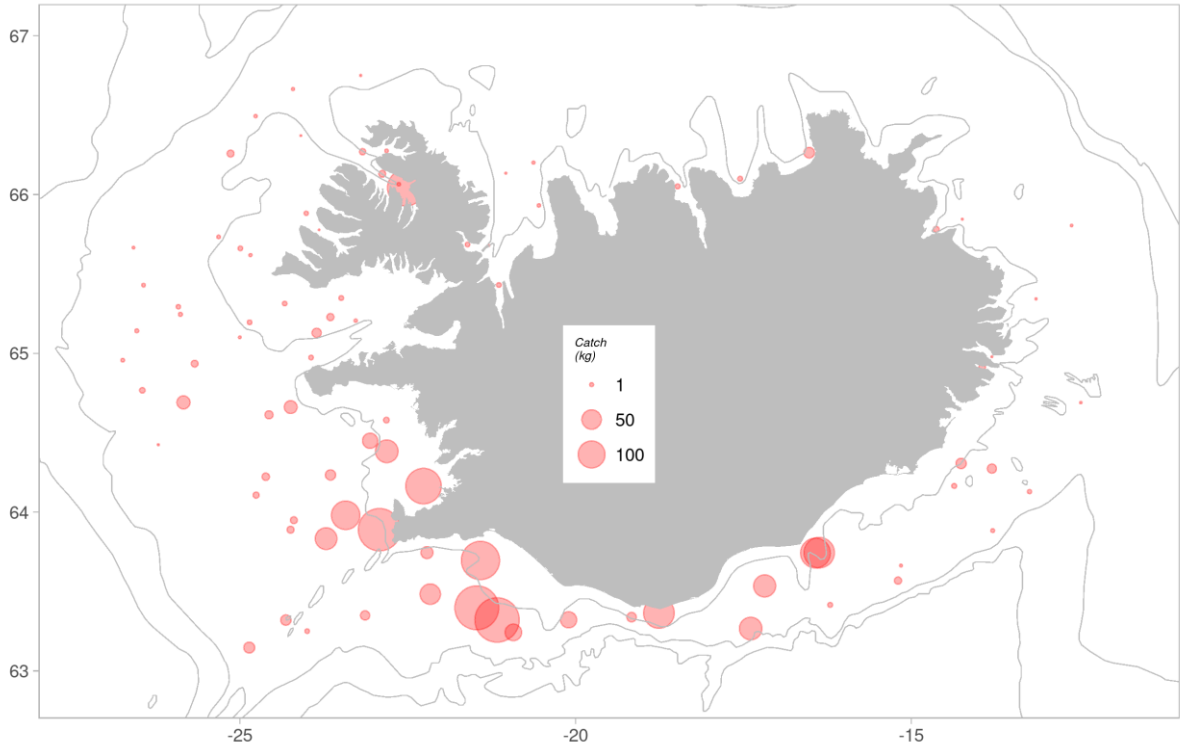

Figure 12. Whiting. Spatial distribution of catches from IS-SMH 2021.

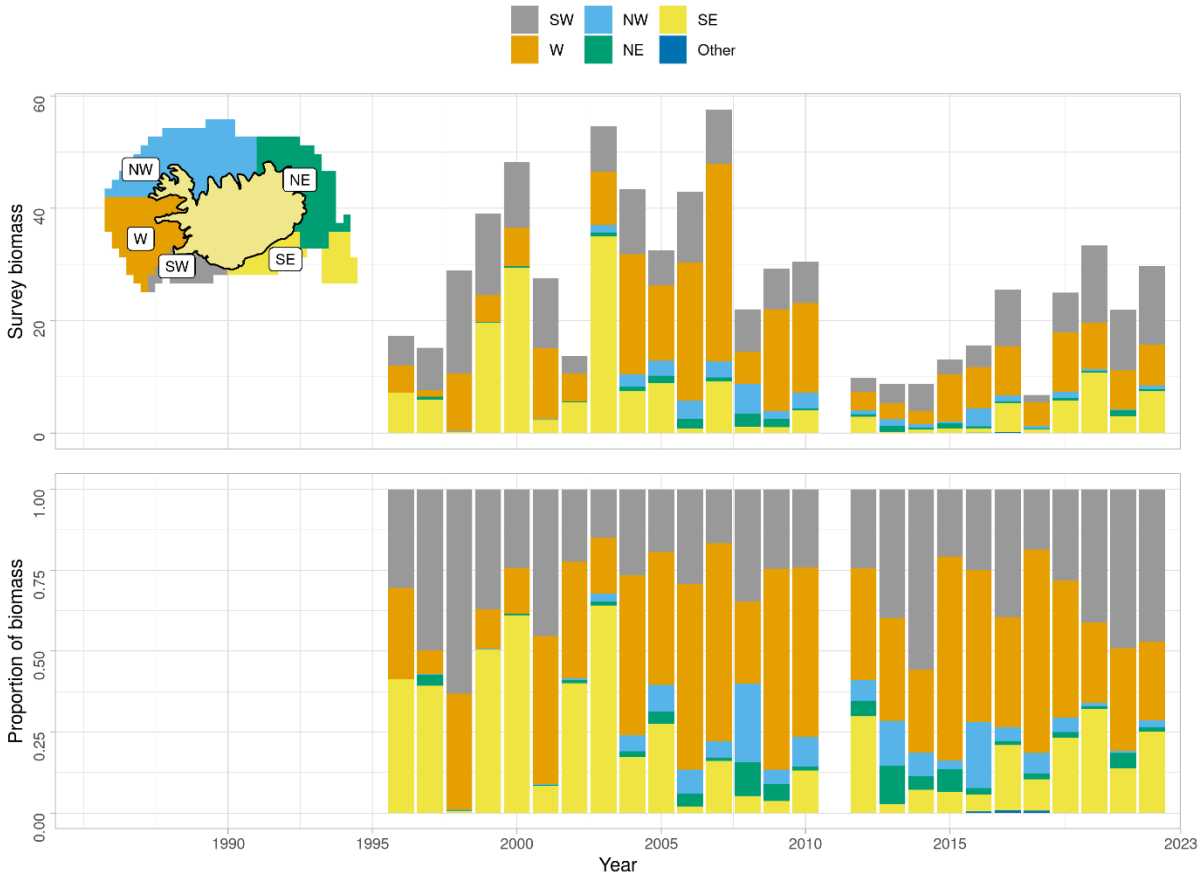

Figure 13. Whiting. Spatial distribution of biomass index from IS-SMH 1996-2021.

STOCK ASSESSMENT

COMMENTS ON THE ASSESSMENT AND ADVICE

The assessment is for this stock based on ICES constant harvest rate (chr)-rule for data limited stocks for the first time in 2023, where a constant harvest rate ($F_{proxy,MSY}$), that can be considered a proxy for harvest rate at maximum sustainable yield, is applied to the spawning stock biomass index (ICES 2021). The chr-rule has the following form:

$$A_{y+1} = I_y \, F_{proxy,MSY} \, b \, m$$

where A_{y+1} is the advised catch, I_{y-1} is the last year's index, $F_{proxy,MSY}$ is the fishing pressure proxy at MSY, b is a biomass safeguard (reducing the catch when biomass index drops below a trigger value) and m is a multiplier that is applied to maintain the probability of the biomass declining below B_{lim} under 5%.

$F_{proxy,MSY}$ is the ratio of the catch and index for the set of historical years (U) where $f > 1$:

$$F_{proxy,MSY} = \frac{1}{u} \sum_{y \in U} \frac{C_y}{I_y}$$

f is the length-ratio component where:

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

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

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

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

where L_c is the length where frequency is half that of the modal value (Figure 14), and L_∞ is von Bertalanffy $L_{\infty.}$

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

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

where $I_{trigger} = i_{loss} \cdot 1.4$

m is a multiplier based on stock growth. K for whiting could not be estimated reliably since the most recent data is from 1973 and hence, K from other areas was used instead. K for whiting is 0.38 and therefore m is 0.5 ($0.32 < K < 0.45$ yr^{-1}).

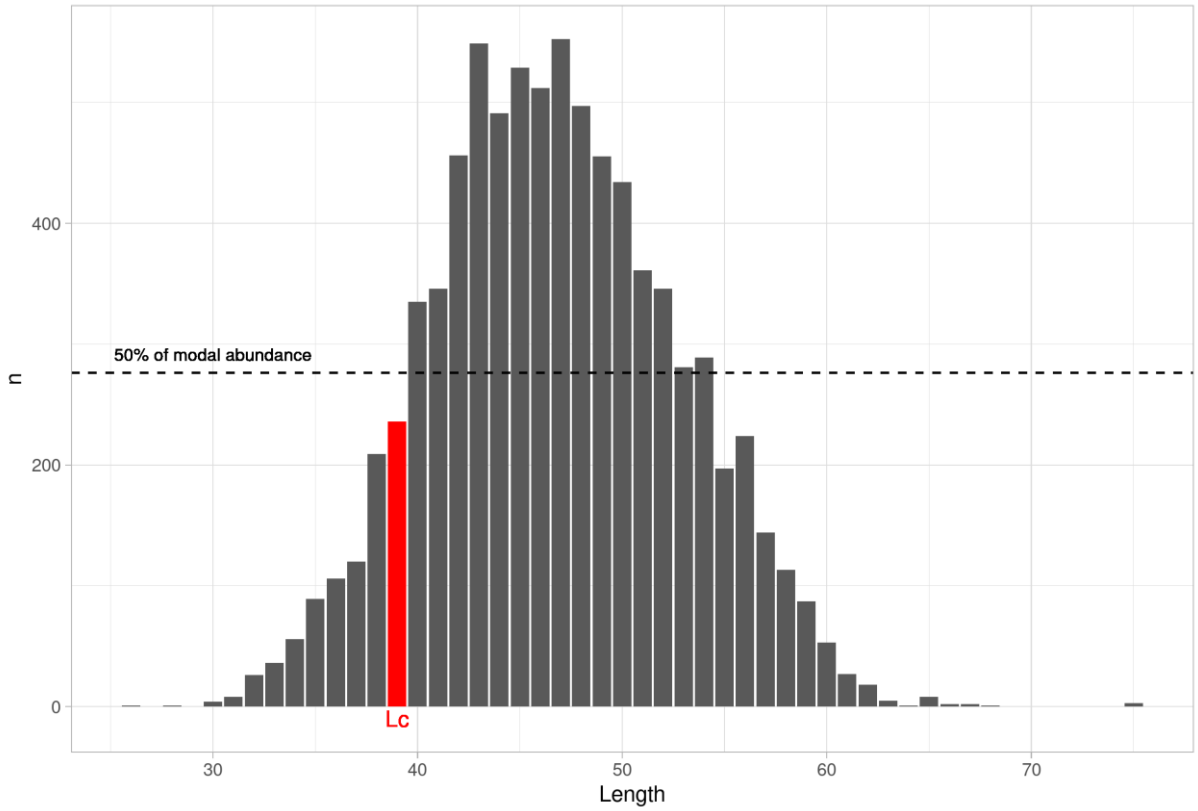

Figure 14. Whiting. Length frequency distribution from catches. Red line is the length at first capture.

ANALYSIS ON THE ASSESSMENT AND ADVICE

The assessment is based on the chr-rule for ICES category 3 data-limited stocks and is applied for whiting for the first time this year and is applied for the next two fishing year (2023/2024). The Icelandic spring trawl survey (IS-SMB) for individuals ≥40 cm was used as the spawning stock biomass index. The advice is according to $A_{y+1} = I_{y-1} F_{proxy,MSY}\ b\ m$ or 21411 t * 0.197 * 1 * 0.5 which result in advice that differs more than +20% from last year's advice and hence, the stability clause is applied. The advice for 2023/2024 is therefore set at 1309 t (20% increase from last year's advice) (Table 2). 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 2. Whiting. Comparison between the *chr*-rule and the "2 over 3" rule.

	chr-rule	Old 2-over-3 rule
Previous advice	1091	1091
Index 2023	21411	
$F_{PROXY,MSY}$	0.197	
Index A		19470
Index B		11488
Ratio (A/B)		1.69
Biomass safeguard	1	-
Multiplier	0.5	-
Initial advice	2113	1849
Stability clause applied	+20%	+20%
Precautionary buffer*	-	-
Final advice	1309	1309
Advice change	+20%	+20%

***Last applied in 2022.**

APPLICATION OF THE CHR-RULE

- r is calculated as the average of last two years values, divided by average of three preceding years values which results in r=1.69 (Figure 15, Table 2).

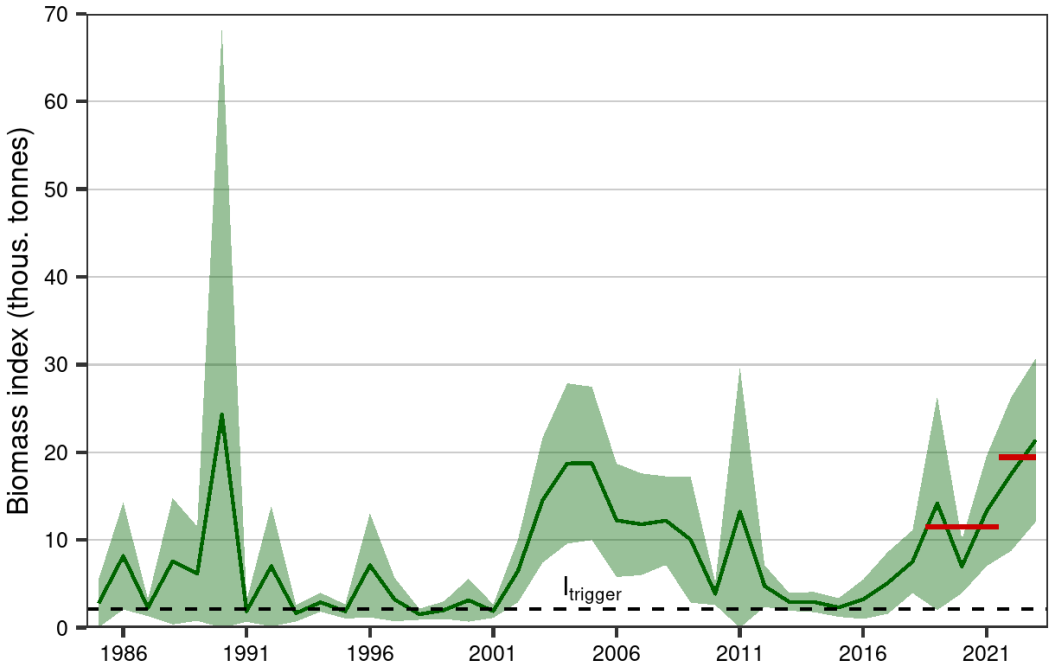

Figure 15. Whiting. IS-SMB biomass index since 1985. The red lines show the average of last two years values and the three preceding years used to calculate *r* for the 2 over 3 rule (table 3).

- *f* is the length-ratio component. The annual mean length from catches and the target reference length (*Lc*, the length where frequency is half that of the modal value * 0.75 + $L\infty$ * 0.25) is **48**. The points along the line in figure 16 indicate years when f>1.

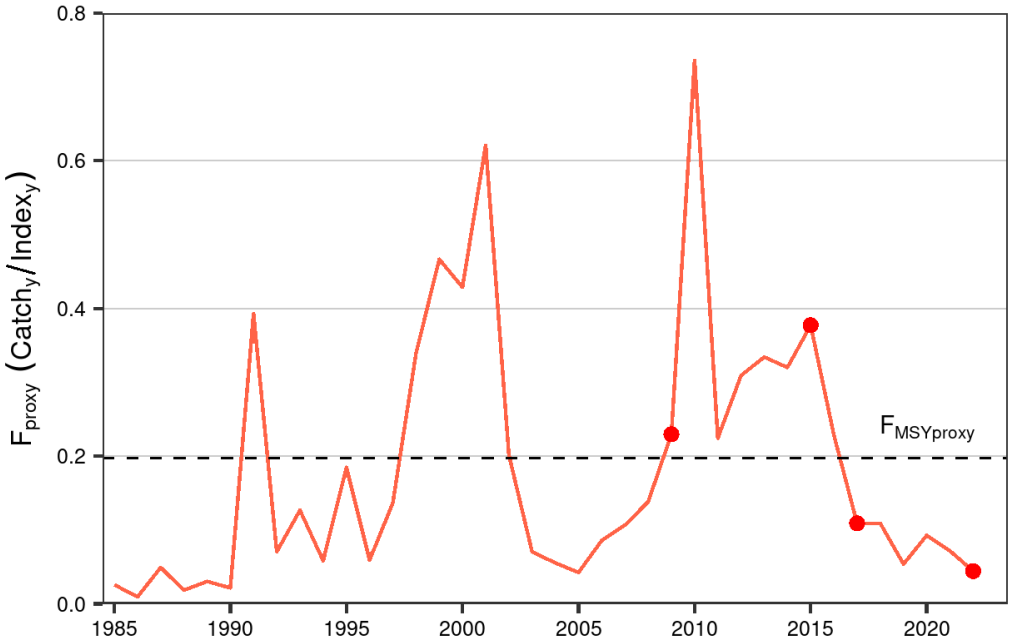

Figure 16. Whiting. Annual fishing pressure proxy (F_{proxy}) for years for which sufficient data was available.

- *b* is the biomass safeguard and is used to reduce catch advice when index falls below trigger. I_{loss} for whiting is 1537 and was based on the lowest biomass index. $I_{trigger}$ is I_{loss} *1.4 or 2152 (Figure 15). The biomass index this year is 21 411, which is above $I_{trigger}$ and hence, *b* is 1.

- *m* is, as previously explained, the tuning parameter and for slow growing species (with von Bertalanffy 0.32 < *K* < 0.45 yr^{-1}), *m* equals 0.5.

MANAGEMENT

Whiting has not been subject to management such as TAC limitations, but advice has been given by the Marine and Freshwater Research Institute since 2019 (Table 3).

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

Fishing year	Rec. Tac	National TAC	Catch
2001/02	-	-	1192
2002/03	-	-	1309
2003/04	-	-	1001
2004/05	-	-	964
2005/06	-	-	895
2006/07	-	-	1030
2007/08	-	-	1812
2008/09	-	-	1984
2009/10	-	-	2835
2010/11	-	-	3249
2011/12	-	-	1601
2012/13	-	-	1060
2013/14	-	-	1034
2014/15	-	-	877
2015/16	-	-	690
2016/17	-	-	642
2017/18	-	-	844
2018/19	-	-	780
2019/20	836	-	607
2020/21	1003	-	844
2021/22	1137	-	826
2022/23	1091		