

# WITCH

## *Glyptocephalus cynoglossus*

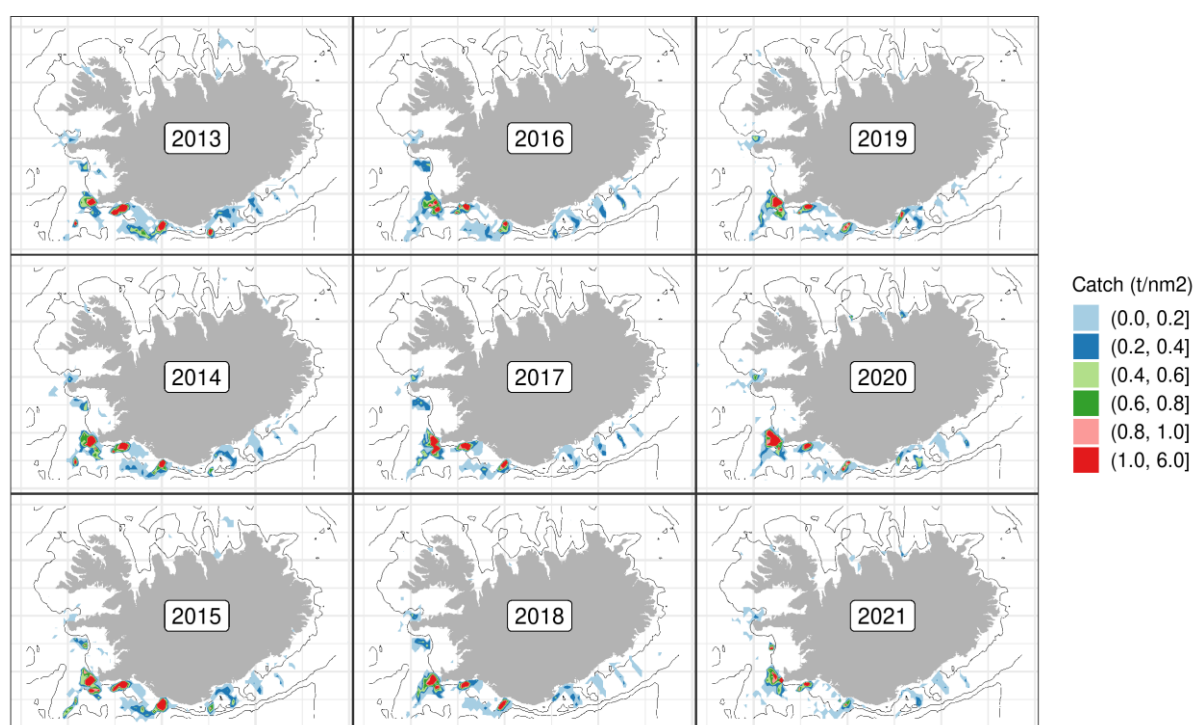
### GENERAL INFORMATION

Witch is found all around Iceland, but the highest concentration is observed in the relatively warm waters south and west of Iceland. It is a demersal flatfish species found at 25-500 m depth but is most common at 50-300 m on a sandy or muddy substrate.

Females grow larger than males. Only a small proportion of males become larger than 40 cm, whereas females regularly grow larger than 45 cm. Size at sexual maturity differs between the sexes where about half of the males reached maturity at 25 cm length, but females reach that level at 32 cm.

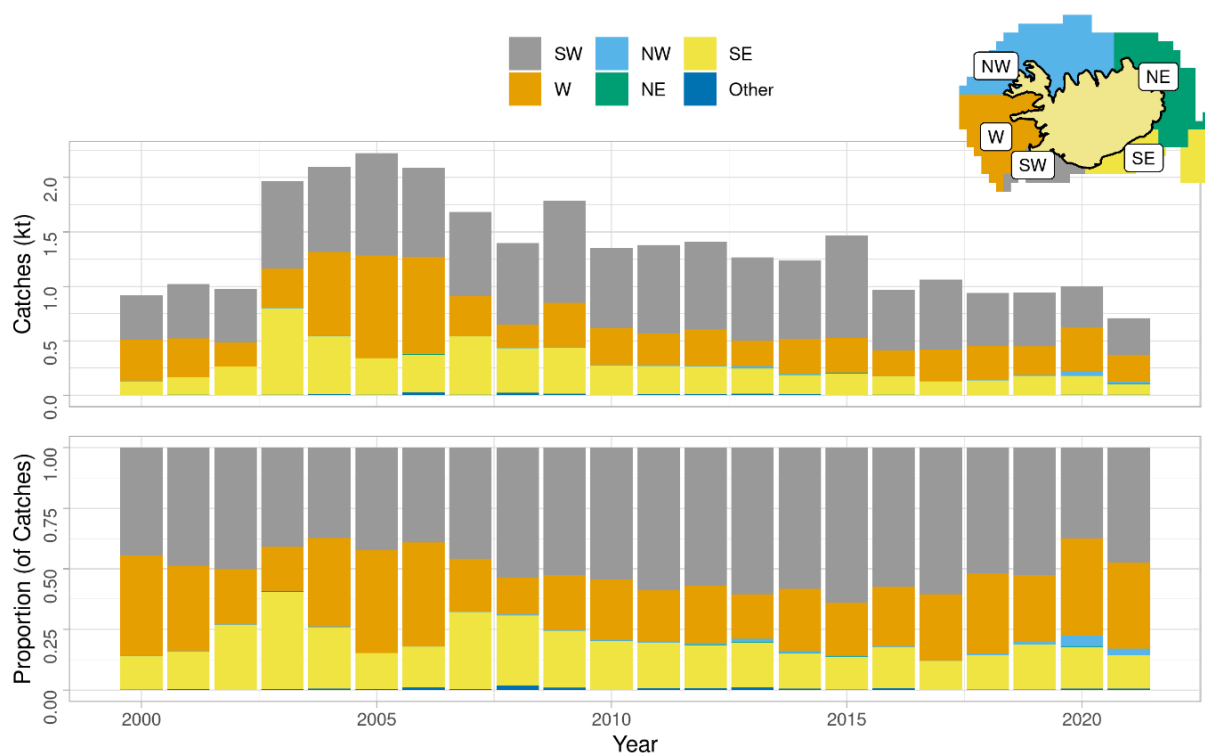
### THE FISHERY

The geographical distribution of the witch fisheries has remained more or less unchanged in recent years (Figure 1), with main fishing grounds in the southwest of Iceland, extending along the south coast in the deeper areas. Very little catch has been reported from the northwest, north and east of Iceland. Witch is common bycatch in the *Nephrops* fishery. In 2019, one of the main *Nephrops* fishing areas, Lónsdjúp, was closed for all trawling (for both *Nephrops* and demersal trawls) to protect young *Nephrops*. There was also a closure for *Nephrops* trawling in Jökuldjúp (area already closed for all demersal trawling) and demersal trawling in Breiðamerkurdjúp and Hornafjarðardjúp (MFRI 2021). Those closures can influence the distribution of the witch catch.



**Figure 1. Witch. Geographical distribution of the Icelandic fishery since 2013. Reported catch from logbooks. 100, 300 and 1000 m isobaths are shown.**

Since 2000, the main fishing grounds of witch have been in the southern and western part of the Icelandic shelf (Figure 2) according to logbook entries. Spatial distribution of the Icelandic witch fishery is considerably stable, with around 50% of the witch caught on the south-western part of the shelf.



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

Of the combined catch in demersal seine and *Nephrops* trawl, about 85-90% of witch was caught at 101-200 m depth in most years (Figure 3). In 2011-2016, that proportion had declined to about 60% while the proportion of the catch taken at 51-100 m depth increased. This was solely due to increase in demersal seine effort at that depth range. Most of the catch in demersal seine was taken at 101-150 m, but at 151-200 m depth in *Nephrops* trawl.

Witch on Icelandic fishing grounds is mainly caught in demersal seine and *Nephrops* trawl, or approximately 95% of all reported landings (Figure 4, Table 1). This proportion has been a relatively stable throughout the years. During the last nine years, however, the proportion of witch landed by seiners has decreased and reported landings from *Nephrops* trawlers increased. The drop in proportion of witch landed by *Nephrops* trawl since 2019 is most likely due to area closures in the SE and W areas mentioned previously. Since 2000, 37-83 vessels have landed over 1000 kg of witch annually (Table 1).

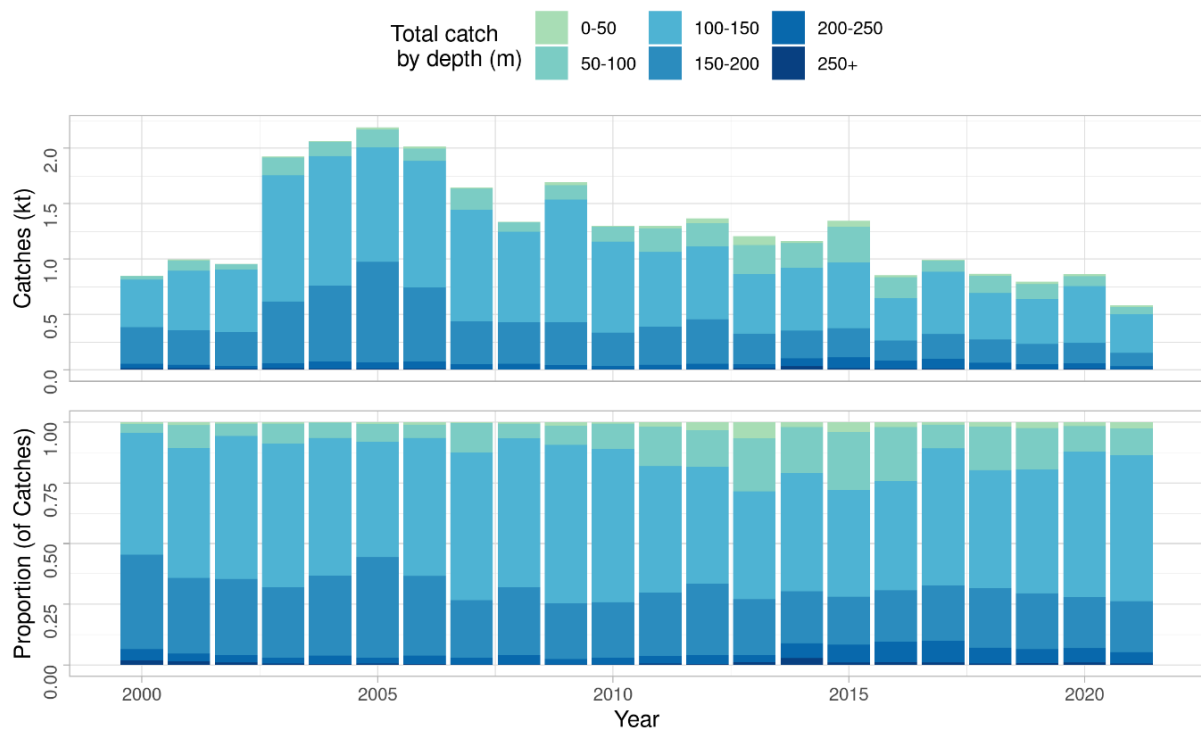


Figure 3. Witch. Depth distribution of catches from demersal seine and *Nephrops* trawl according to logbooks.

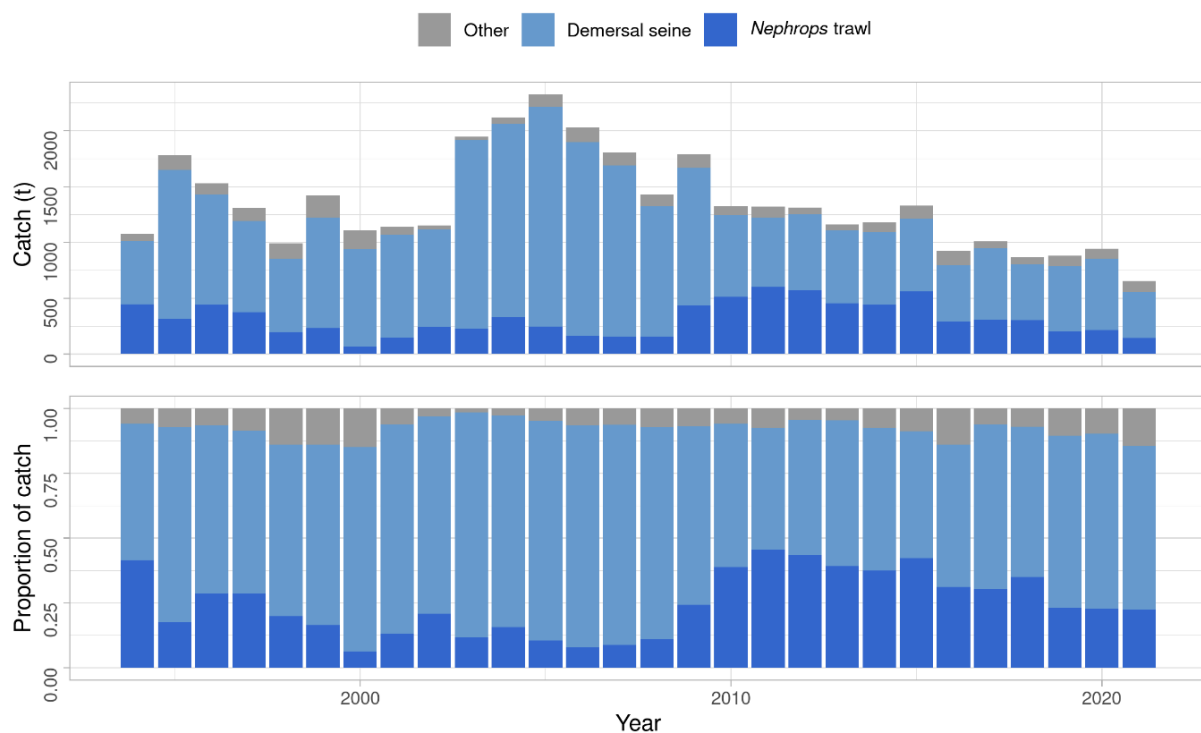
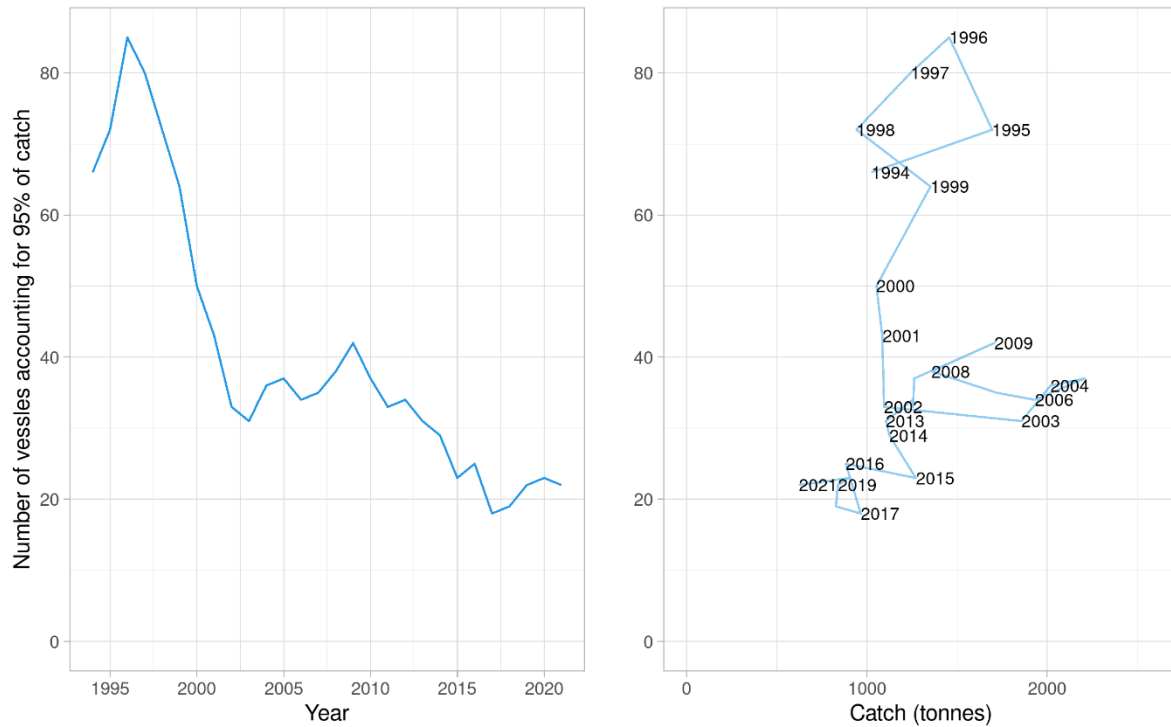


Figure 4. Witch. Total catch (landings) by fishing gear since 1994, according to statistics from the Directorate of Fisheries.

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

YEAR	NUMBER OF VESSELS			CATCHES (TONNES)			
	<i>Seiners</i>	<i>Nephrops trawl</i>	<i>Other</i>	<i>Demersal seine</i>	<i>Nephrops trawl</i>	<i>Other</i>	<i>Sum</i>
<b>2000</b>	30	19	34	877	56	165	1098
<b>2001</b>	26	24	18	920	136	77	1133
<b>2002</b>	22	27	7	874	236	37	1147
<b>2003</b>	31	22	9	1689	228	30	1947
<b>2004</b>	32	22	17	1731	334	59	2124
<b>2005</b>	32	23	24	1967	242	115	2324
<b>2006</b>	30	20	24	1738	170	122	2030
<b>2007</b>	26	14	26	1530	150	125	1805
<b>2008</b>	27	15	22	1166	158	103	1427
<b>2009</b>	32	16	23	1230	418	141	1789
<b>2010</b>	30	16	17	734	546	76	1326
<b>2011</b>	29	15	18	620	603	101	1324
<b>2012</b>	32	15	17	697	521	95	1313
<b>2013</b>	26	15	12	652	456	54	1162
<b>2014</b>	21	14	14	650	422	107	1179
<b>2015</b>	20	13	14	647	548	130	1324
<b>2016</b>	17	11	16	506	277	142	925
<b>2017</b>	18	9	10	641	309	63	1012
<b>2018</b>	20	10	9	502	304	61	867
<b>2019</b>	22	8	16	584	204	93	881
<b>2020</b>	23	7	15	638	216	92	946
<b>2021</b>	19	7	17	412	146	96	654

The number of vessels accounting for 95% of the total catch of witch in Icelandic waters decreased from about 80 vessels in 1996-1997 to about 30 vessels in 2002, despite annual catches being at similar levels (Figure 5). In 2002-2014, the number of vessels accounting for 95% of the catches (ranging from 1200-2300 tonnes) remained relatively constant. In the last three years only about 20 vessels have accounted for 95% of the annual catch of witch.



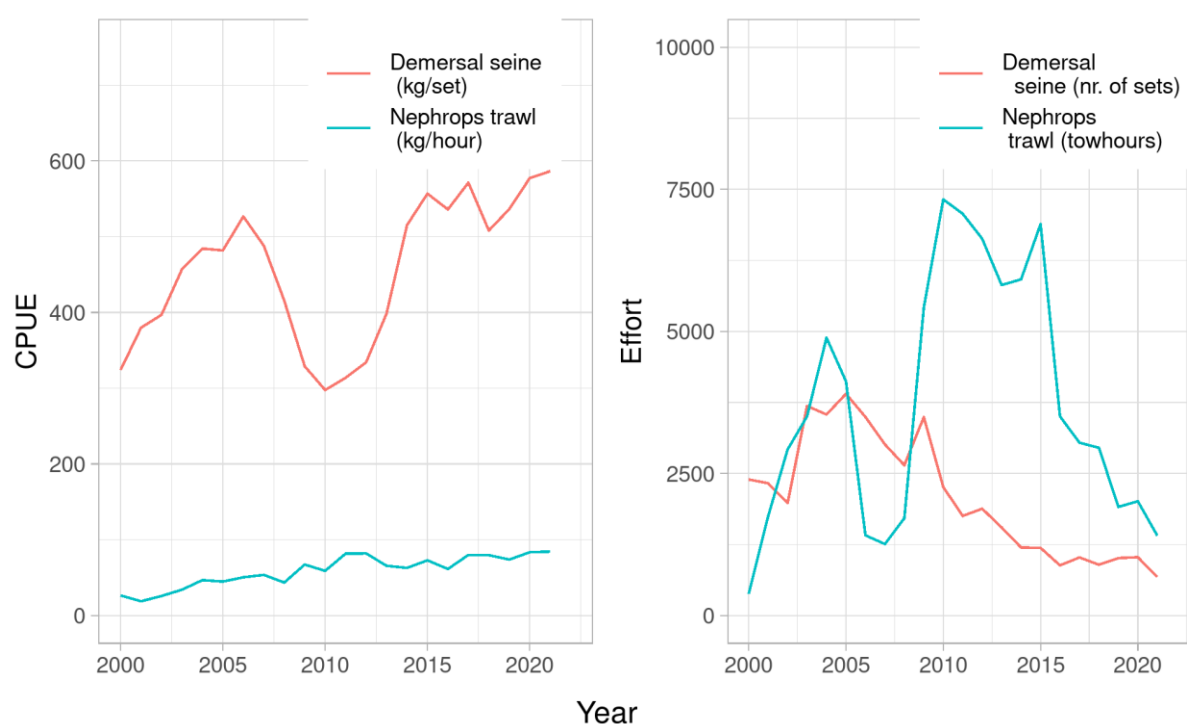
**Figure 5. Witch. Number of vessels (all gear types) accounting for 95% of the total catch annually since 1994. Left: Plotted against year from 1994. Right: Plotted against total catch. Data from the Directorate of Fisheries.**

## CATCH PER UNIT EFFORT (CPUE) AND EFFORT.

CPUE estimates of witch 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 in demersal seine (kg/set) is calculated as the total weight in sets in where witch was more than 10% of the catch. CPUE in demersal seine has fluctuated between 300 and 590 kg/set, with highest value in 2021. CPUE for witch in *Nephrops* trawl (kg/h), in hauls where witch is more than 10% of the catch, has remained relatively stable around 85 kg/hour since 2011 (Figure 6).

Total fishing effort for witch in demersal seine decreased gradually from a peak in 2005 to the lowest level in 2016 and has remained at that level since (Figure 6). Effort (number of towing hours) in *Nephrops* trawl has fluctuated during this same period (Figure 6). These fluctuations are in line with fluctuations in the annual total towing hours of the *Nephrops* fleet. Witch is a bycatch in the *Nephrops* fishery and reporting was poor early on. Before 2003, less than 50% of witch landings from *Nephrops* trawl were reported in logbooks. Comparison of the length composition of the witch catch in the *Nephrops* survey to the catch from the *Nephrops* trawlers indicated some discarding of the smaller witch in earlier years.



**Figure 6. Witch. Non-standardised estimates of CPUE (left) and fishing effort (right) from demersal seine (kg/set or nr. of sets) and *Nephrops* trawl (kg/hour or towhours).**

## AGE DISTRIBUTION OF LANDED WITCH

Table 2 shows otoliths sampling from the commercial witch catch 2010-2021. Analysis done in 2013 by the Marine Research Institute (MRI) suggested that excessive amounts of otoliths were being taken from commercial catches, and as a result the number of witch samples was reduced. Before this change, around 5000 otoliths from 100 samples were collected annually, but since 2014, annual number of samples have been between 15-60 and number of otoliths sampled between 375-1500 (Table 2, Figure 7). In general, over 95% of the otoliths sampled are age read.

**Table 2. Witch. Number of samples and aged otoliths from landed catch.**

<i>Year</i>	<i>Demersal seine</i>		<i>Nephrops trawl</i>		<i>Demersal trawl</i>	
	Samples	Otoliths	Samples	Otoliths	Samples	Otoliths
2010	45	2239	48	2400	7	350
2011	38	1900	56	2800	3	150
2012	46	2300	50	2500	1	50
2013	40	1950	28	1400	3	150
2014	26	650	18	450	3	75
2015	35	875	24	600	1	25
2016	20	500	10	250	3	75
2017	30	750	12	300	5	123
2018	19	475	8	200	4	100
2019	18	450	8	200	3	75
2020	15	375	4	100	4	100
2021	8	200	3	75	4	100



**Figure 7. Witch. Fishing grounds in 2021 as reported in logbooks (colours) by gear and positions of samples taken from landings (x).**

In 2002-2005, most of the witch catch was 4-7 years old (Figure 8). The proportion of these age classes has since decreased and shift towards 8-10 year old was noticeable in 2016-2018. Thus, witch in the catch has become older, and there are little signs of recruitment of younger fish into the fishery.

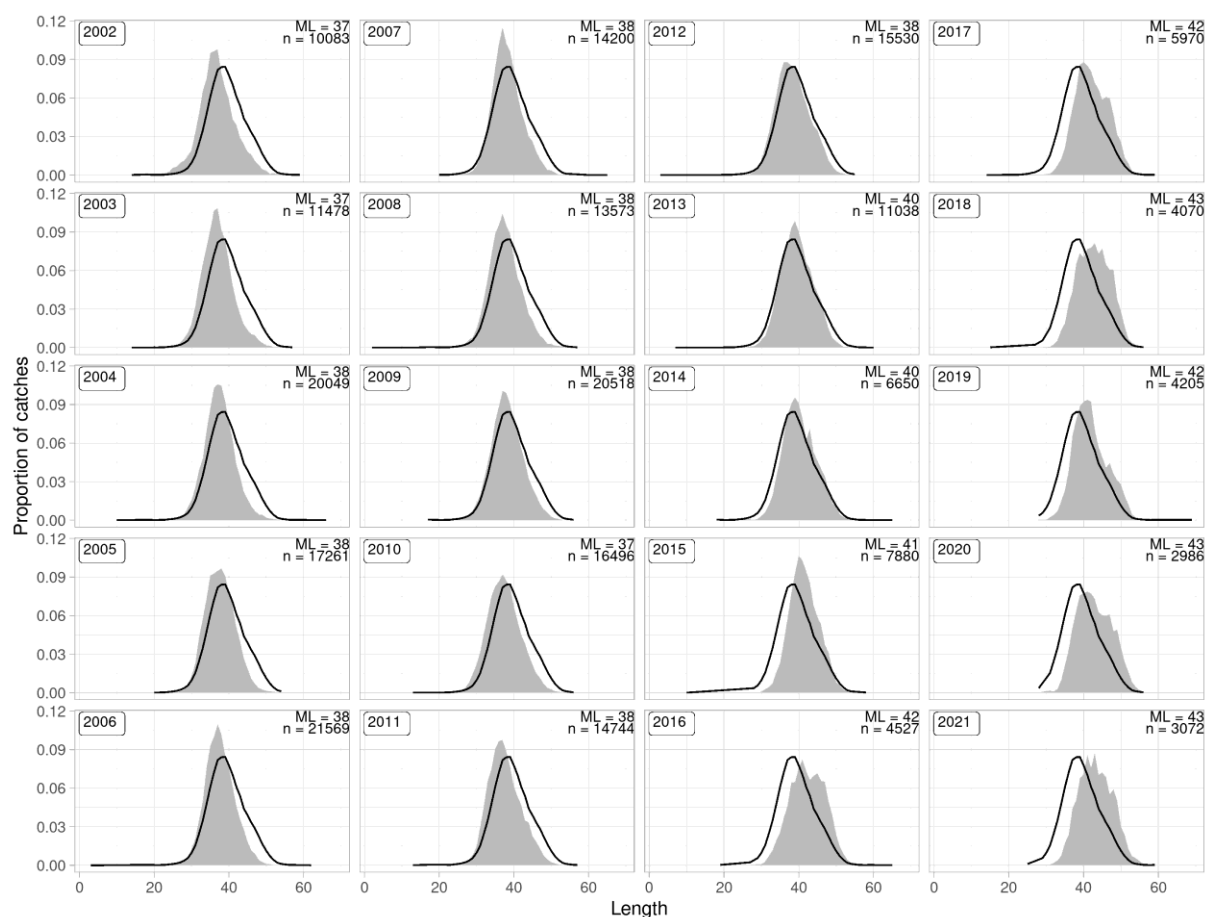


**Figure 8. Witch. Estimated age distribution of landed catch based on landings and otoliths collected from landed catch.**



## LENGTH DISTRIBUTION OF LANDED WITCH

Over the past eight years, there has been a shift towards larger fish in the relative length distribution of landed catch (Figure 9). As a result, the average length in the samples taken from commercial catch has increased from 38 cm in 2012 to 43 cm in 2020. Few smaller fish have been seen entering the fishery over the past 5 years.



**Figure 9. Witch. Relative length distribution of fish sampled from landed catch since 2001. The dotted line represents the mean length for all years.**

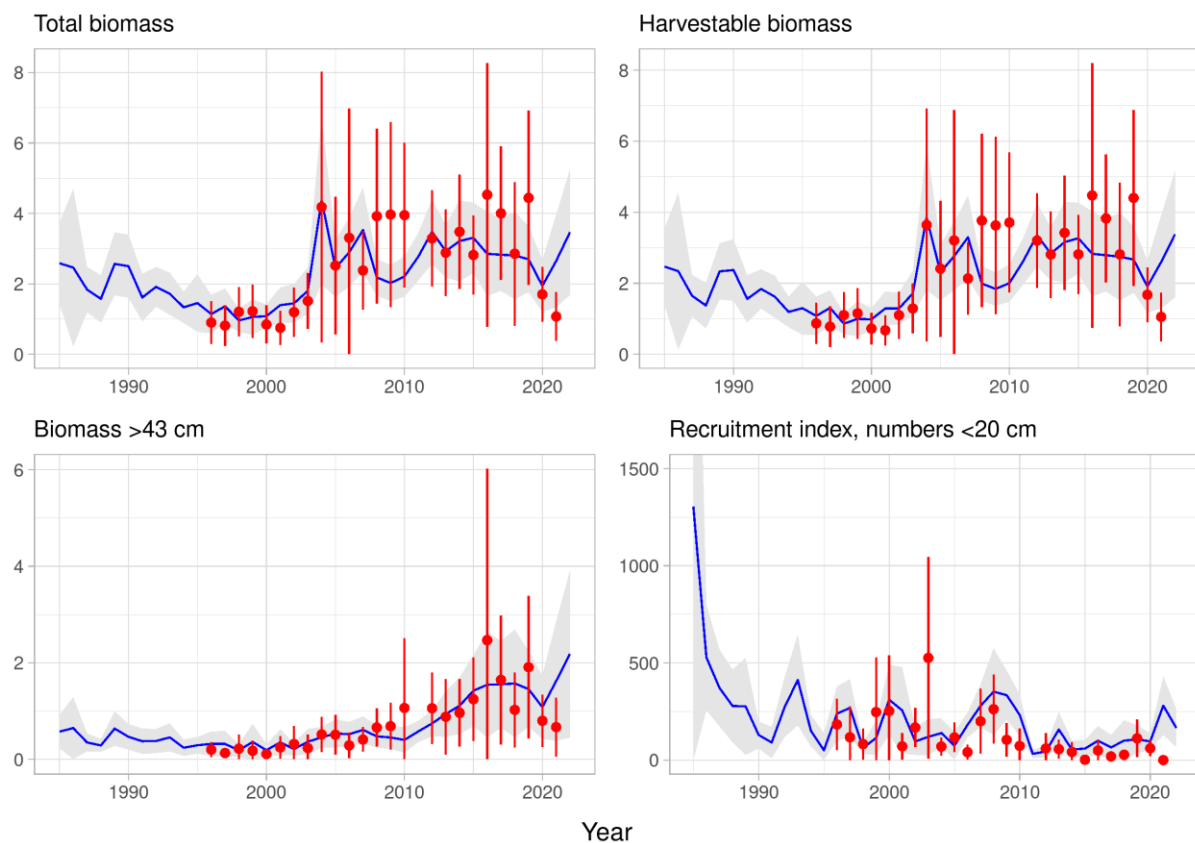
## SURVEY DATA

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 witch fishery. In addition, the Icelandic autumn groundfish survey (hereafter autumn survey, IS-SMH) was commenced in 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. It does not, however, adequately cover the main recruitment grounds for witch that are poorly known.

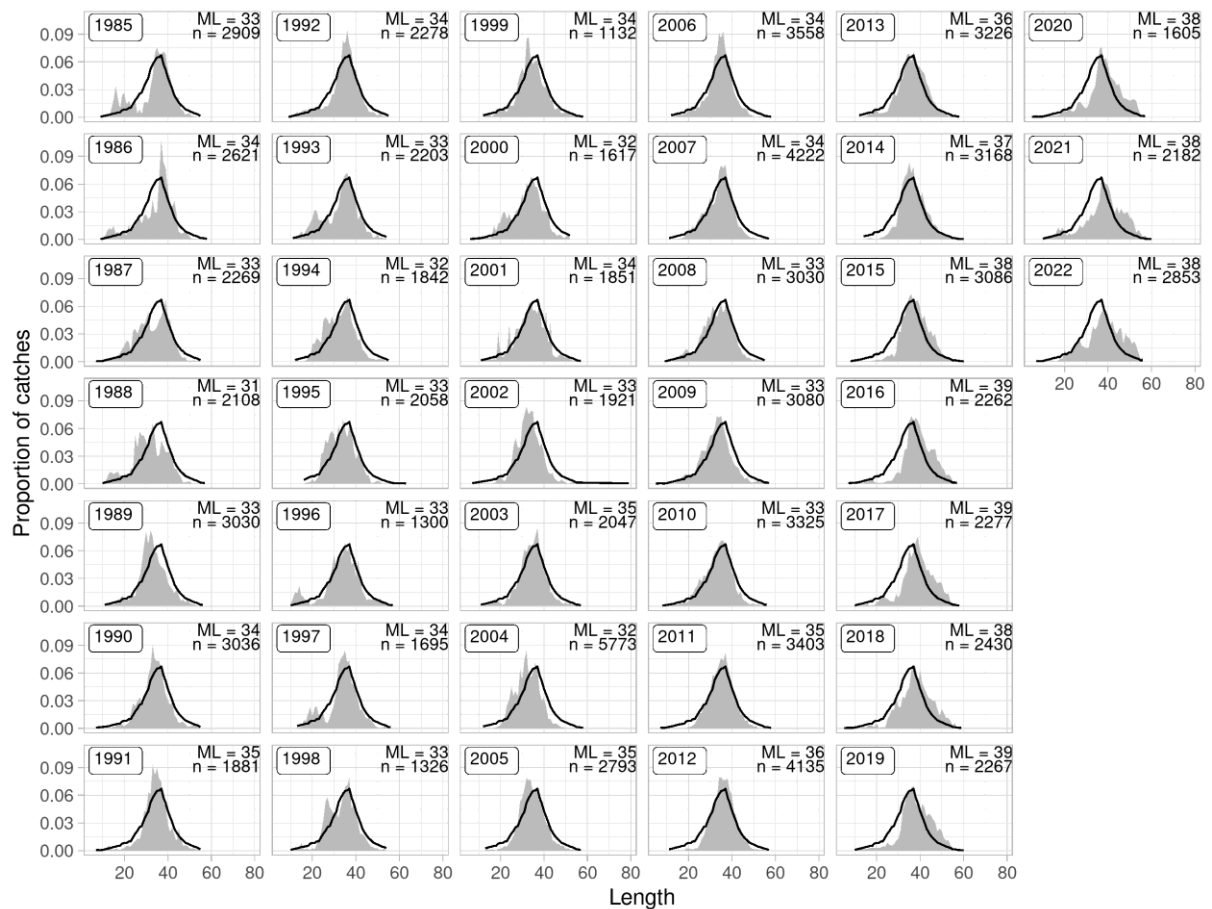
Figure 10 shows trends in various biomass indices and a recruitment index based on abundance of witch smaller than 30 cm in the spring and autumn surveys. Survey length disaggregated abundance indices are shown in Figures 11-12, and abundance and changes in spatial distribution in Figures 13-16.

In both surveys, total biomass indices and biomass indices for witch larger than 30 cm (harvestable part of the stock) increased rapidly in 2004 (Figure 10) and have remained relatively high and stable since. Biomass of large fish (43 cm and larger) increased rapidly from 2010-2015 and remained at that level since. Recruitment indices (numbers below 20 cm) have decreased rapidly from quite high numbers in the beginning of the spring survey 1985 and stayed at that level through the period with small recruitment pulses occasionally. In 2011-2019, the recruitment indices from both surveys were at an all-time low. A recruitment spike was visible in spring survey in 2021 and was still present in 2022.

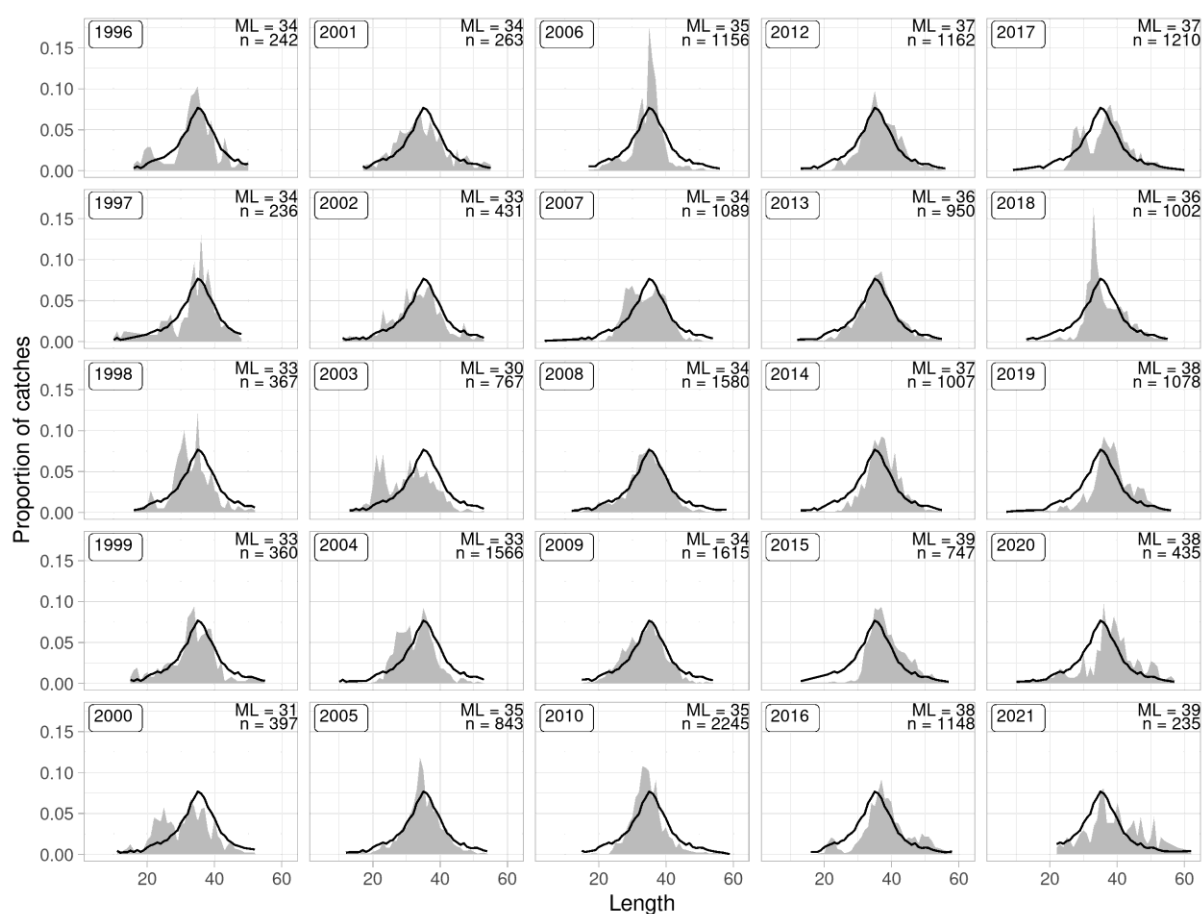


**Figure 10. Witch. Total biomass indices (upper left), harvestable biomass indices ( $\geq 30$  cm, upper, right) and biomass index of larger individuals ( $\geq 43$  cm, lower left), juvenile abundance indices ( $\leq 20$  cm, lower right), from the spring survey (blue) and autumn survey (red), along with the standard deviation.**

Relative length distribution of witch in the spring survey has shifted towards larger fish (Figure 11). The average length of witch increased from 31 cm in 1988 to 38-39 cm in 2016-2021. Data from the autumn survey tells a similar story, with a marked increase in average size of witch (Figure 12).



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



**Figure 12. Witch. Relative length-disaggregated abundance indices from the autumn survey since 1996. The black line shows the mean for all years.**

Witch is caught all around Iceland in the spring survey, but only in very small quantities off the east coast (Figures 13-14). Abundance of witch is highest and quite stable in the SW and W areas. Abundance in the SE area is quite low except for years 2002-2012. In the northern areas abundance has increased in 2008 and remained stable since. The autumn survey shows a similar trend (Figures 15-16).

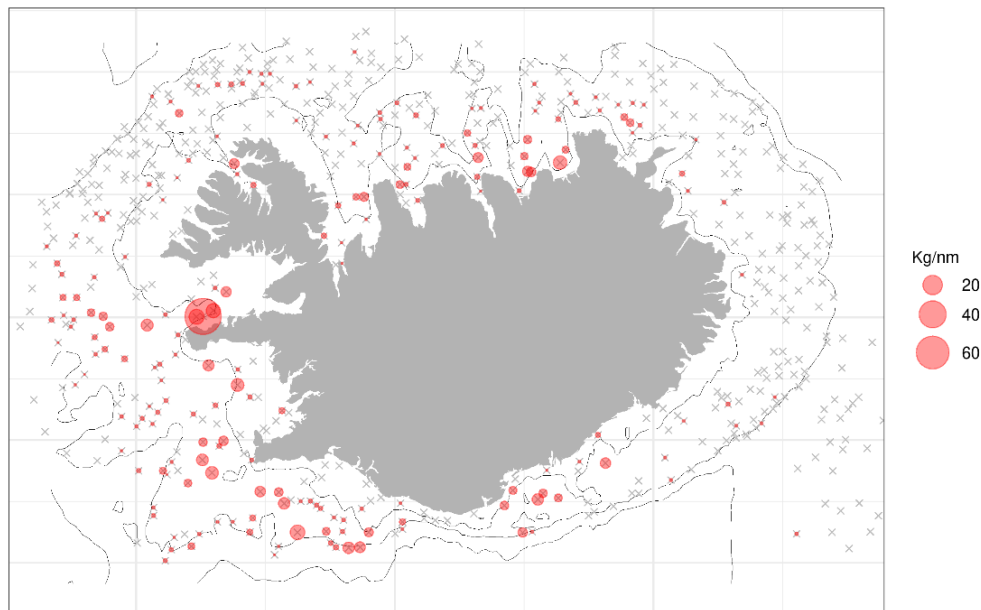


Figure 13. Witch. Spatial distribution in the spring survey in 2022.

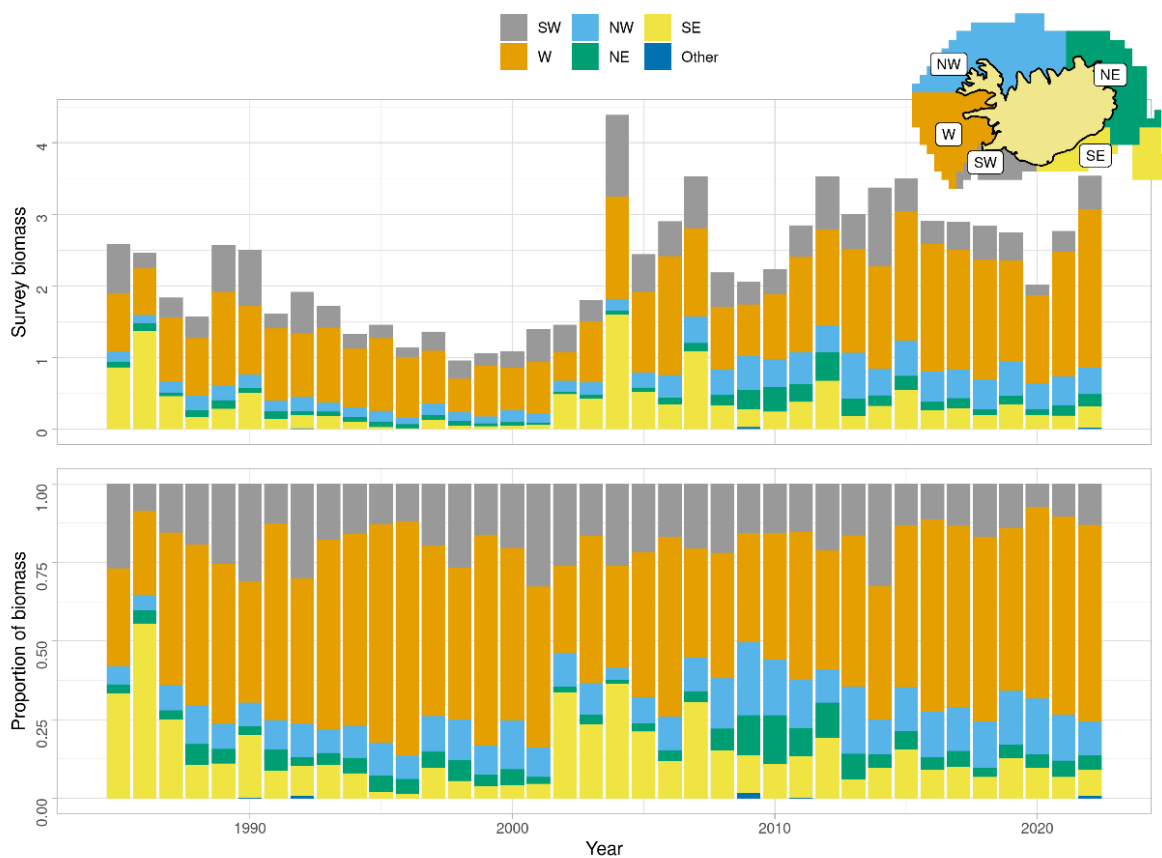


Figure 14. Witch. Spatial distribution of biomass index from the spring survey since 1985.

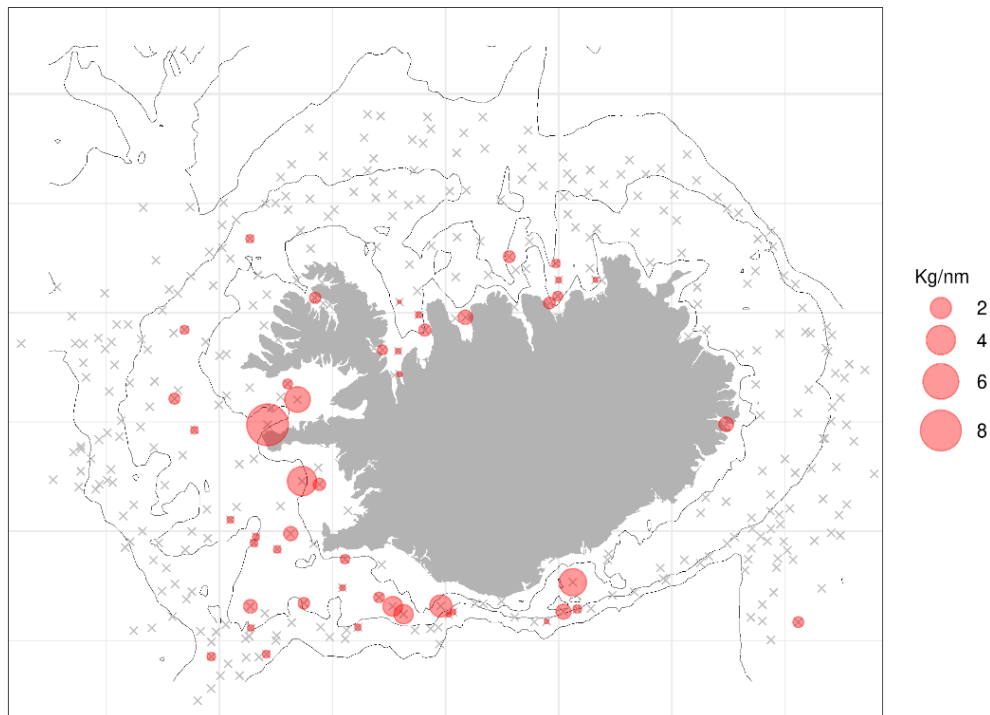


Figure 15. Witch. Spatial distribution in the autumn survey in 2021.

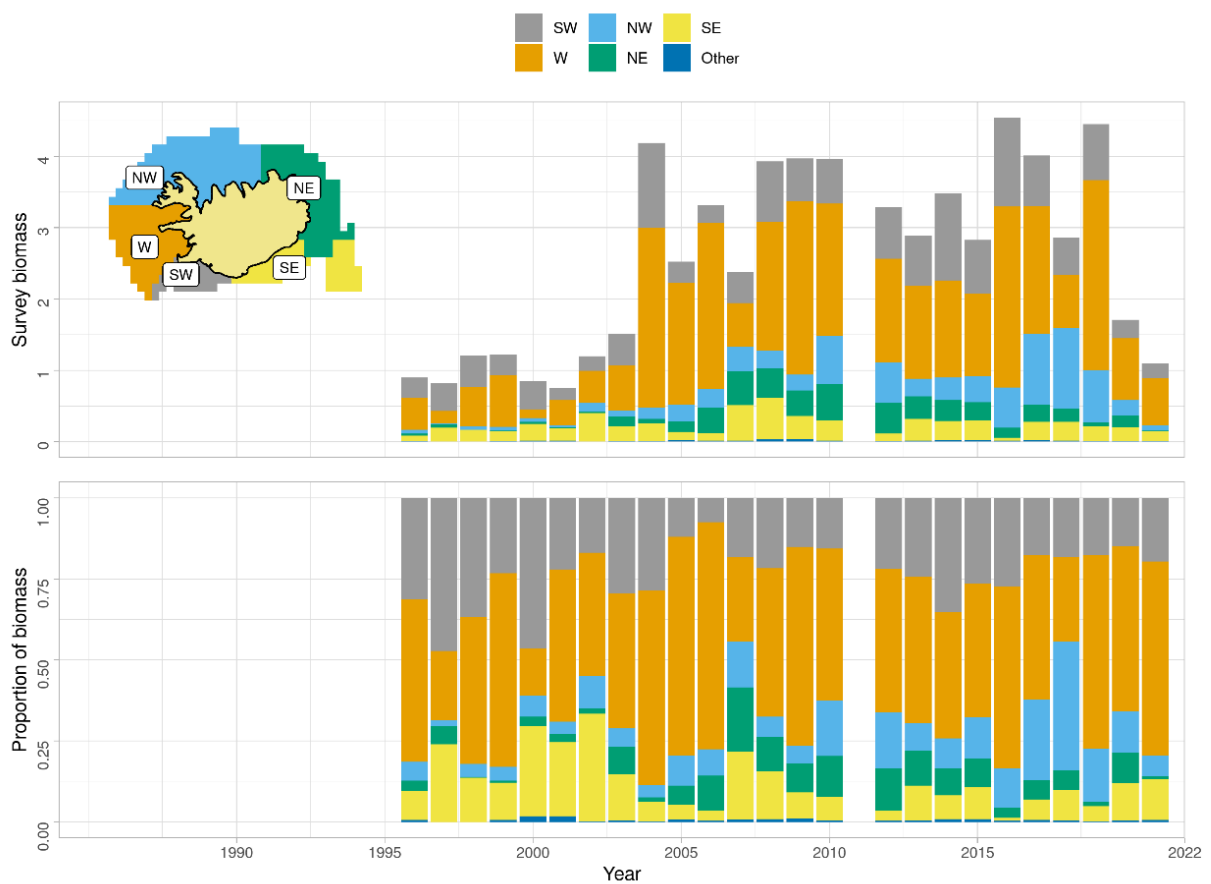


Figure 16. Witch. Spatial distribution of biomass index from the autumn survey.

## MANAGEMENT

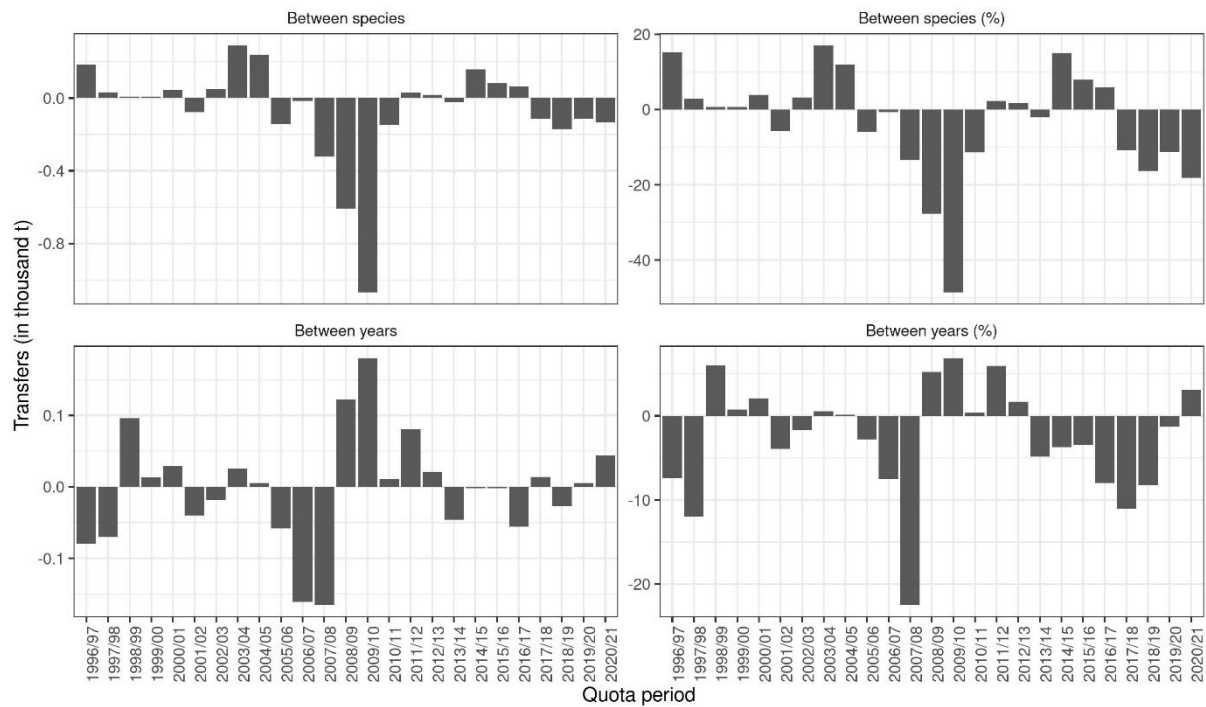
The Ministry of Food, Agriculture and Fisheries is responsible for management of the Icelandic fisheries and implementation of legislation. The Ministry issues regulations for commercial fishing for each fishing year (1. September – 31. August), including an allocation of the TAC for each stock subject to such limitations. Witch was included in the ITQ system in the 1996/1997 fishing year and as such subjected to TAC limitations. For the fishing years 2005/2006 to 2009/2010 the TAC was set higher than recommended by Marine Research Institute (MRI), but since the 2010/2011 fishing year TAC has been the same as recommended TAC (Table 3).

For most fishing years the net transfers between witch and other species in the Icelandic ITQ-system are less than 15% of the national TAC (Figure 17). The main exception from this was during the fishing years 2008/2009 and 2009/2010 when the national TAC was set considerably higher than recommended, and considerable proportion of witch quota was transferred to other species (Figure 17, Table 3). For the last three fishing years there has been a net transfer from witch to other species in the quota system. Transfer of witch quota between fishing years is usually within 10% (Figure 17).

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

<b>FISHING YEAR</b>	<b>REC. TAC</b>	<b>NATIONAL TAC</b>	<b>CATCH</b>
<b>1994/95</b>	1500	-	1760
<b>1995/96</b>	1400	-	1660
<b>1996/97</b>	1200	1200	1260
<b>1997/98</b>	1100	1100	960
<b>1998/99</b>	1100	1100	1160
<b>1999/00</b>	1100	1100	1110
<b>2000/01</b>	1100	1100	1160
<b>2001/02</b>	1350	1350	1220
<b>2002/03</b>	1500	1500	1530
<b>2003/04</b>	1500	1500	2000
<b>2004/05</b>	2000	2000	2250
<b>2005/06</b>	2200	2400	2190
<b>2006/07</b>	2000	2400	2200
<b>2007/08</b>	2000	2400	1540
<b>2008/09</b>	1600	2200	1700
<b>2009/10</b>	1600	2200	1300
<b>2010/11</b>	1300	1300	1220
<b>2011/12</b>	1100	1300	1450
<b>2012/13</b>	1100	1100	1180
<b>2013/14</b>	1100	1100	1170
<b>2014/15</b>	1100	1100	1220
<b>2015/16</b>	1100	1100	1140
<b>2016/17</b>	1110	1100	1090
<b>2017/18</b>	1116	1116	885
<b>2018/19</b>	1100	1100	844
<b>2019/20</b>	1067	1067	940
<b>2020/21</b>	854	854	733
<b>2021/22</b>	1025		





**Figure 17. Witch. Net transfers of quota to and from witch in the Icelandic ITQ system by fishing year. Between species (upper): Positive values indicate a transfer of other species to witch, but negative values indicate a transfer of witch quota to other species. Between years (lower): Net transfer of quota in a given fishing year.**

## REFERENCES

MFRI 2022. MFRI Assessment Reports 2022. Norway lobster. 21 pp.

<https://www.hafogvatn.is/static/extras/images/040-humartr1235185.pdf>