

# PLAICE

## *Pleuronectes platessa*

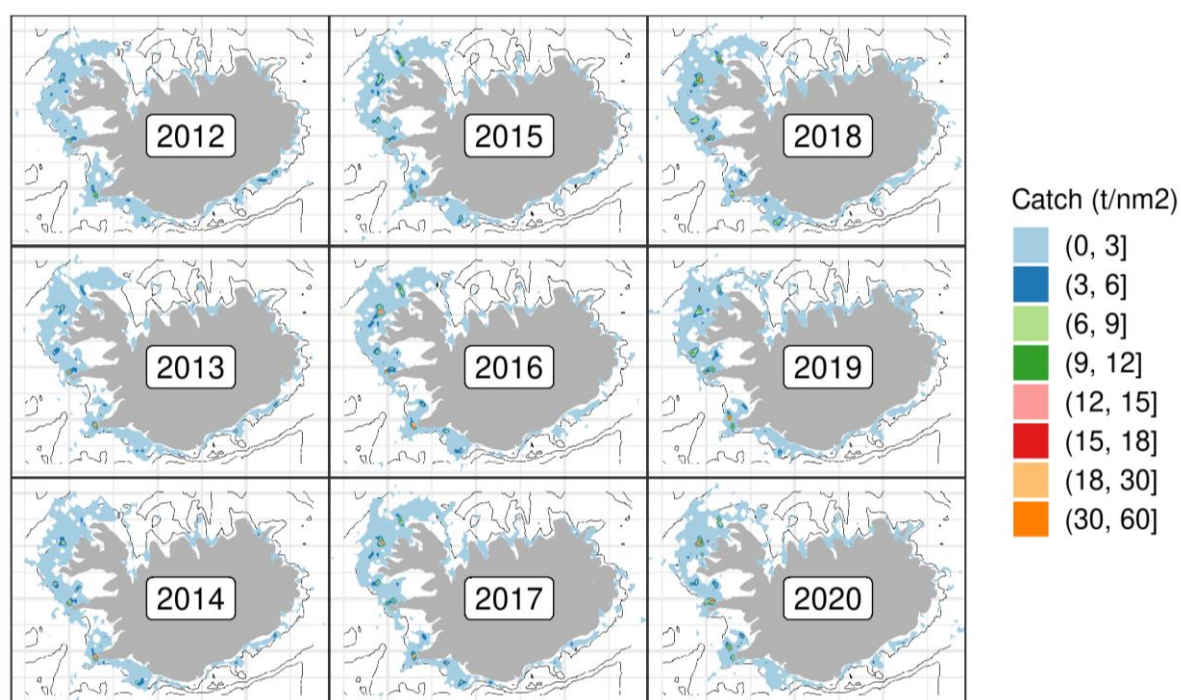
### GENERAL INFORMATION

Plaice is found on the continental shelf around Iceland with the highest abundance in the southwest and west of the island. It is mainly found on a sandy or muddy substrate, occurring at depths ranging from the coast down to 200 meters, sometimes even deeper.

Females grow larger than males. Only a small proportion of males become larger than 45 cm, but about the same proportion of females grow larger than 55 cm. Size at sexual maturity differs between the sexes. At the length of 33 cm about half the males have reached maturity, but females reach that level at 38 cm length. Spawning occurs mostly at 50-100 m depth in the relatively warm waters south and west of Iceland, but there is small-scale spawning off the northwest and north coast. After metamorphosis, the juveniles seek bottom in shallow waters and spend the first summer just below the tidemark.

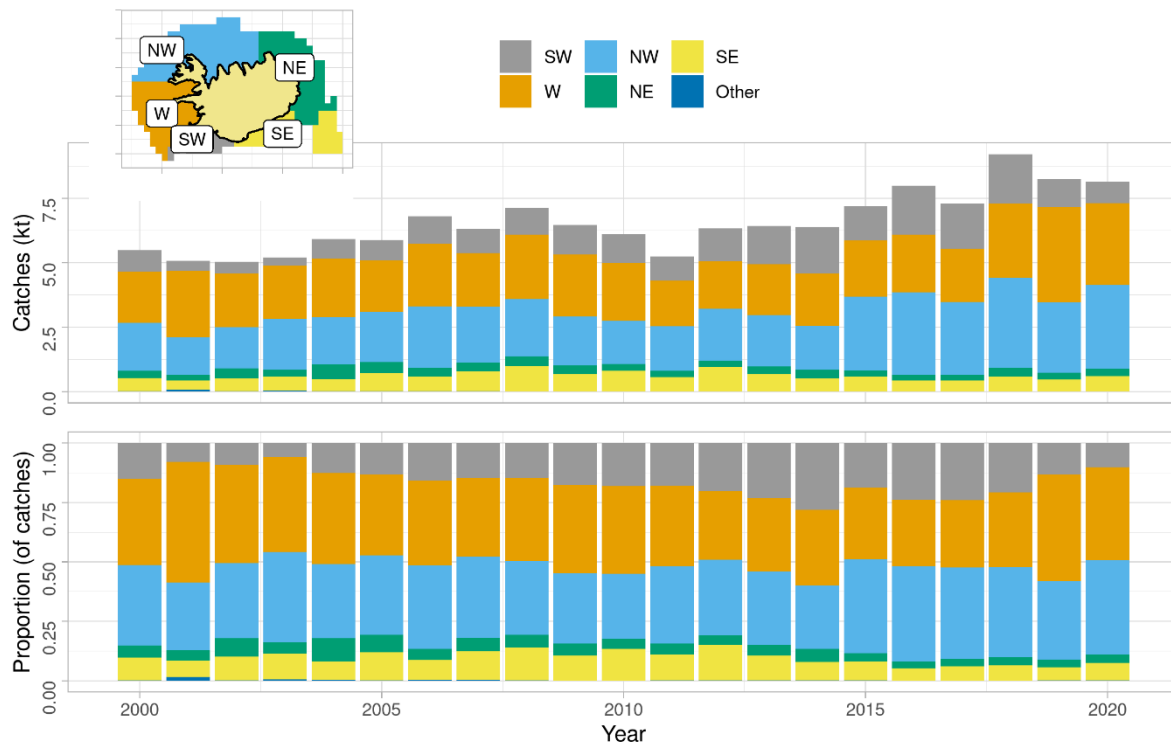
### THE FISHERY

Main fishing grounds for plaice are in the west and southwest of Iceland, with smaller fishing grounds in the southeast and several fjords in the north. Demersal seine is the main fishing gear for plaice in Iceland followed by demersal trawl, while a small proportion of the catch is taken in gillnets and longline. Seiners dominate the coastal plaice fishery, but trawlers catch them deeper and further offshore. Plaice fishing grounds in 2012-2020, as reported by mandatory logbooks, are shown in Figure 1.



**Figure 1. Plaice. Geographical distribution of the Icelandic fishery since 2012. Reported catch from logbooks.**

Since 2000, the main fishing grounds of plaice have been on the southwestern, western and northwestern part of the Icelandic shelf (Figure 2). Spatial distribution of the Icelandic plaice fishery has been relatively stable, with around 60% of the plaice caught on the western and northwestern part of the shelf. In the last decade, reported catch has increased in the southwestern part but has decreased again in the last two years to previous proportions. On the contrary, an increase in reported catch has been observed in the western and northwestern parts of the shelf.



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

Plaice is caught in relatively shallow water, with majority of the catch (60-80%) taken at depths of 21-80 m (Figure 3).

Most of the plaice is caught in demersal seine (65-71% since 2011) and demersal trawl (23-30%) or around 95% of the total catch (Figure 4). This proportion has been relatively stable through the years, as well as the relative amount caught in other gear (predominantly gillnets) with around 5-10% of the catch since 2004.

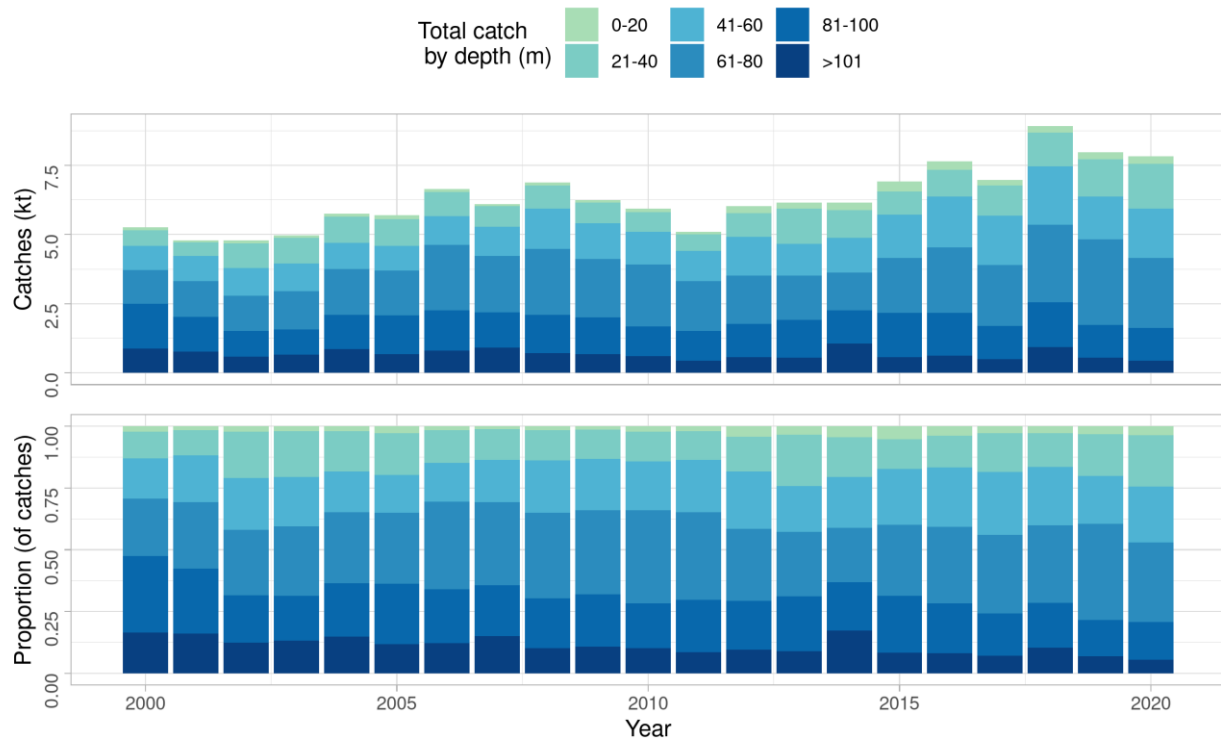


Figure 3. Plaice. Depth distribution of demersal seine and trawl catches according to logbooks.

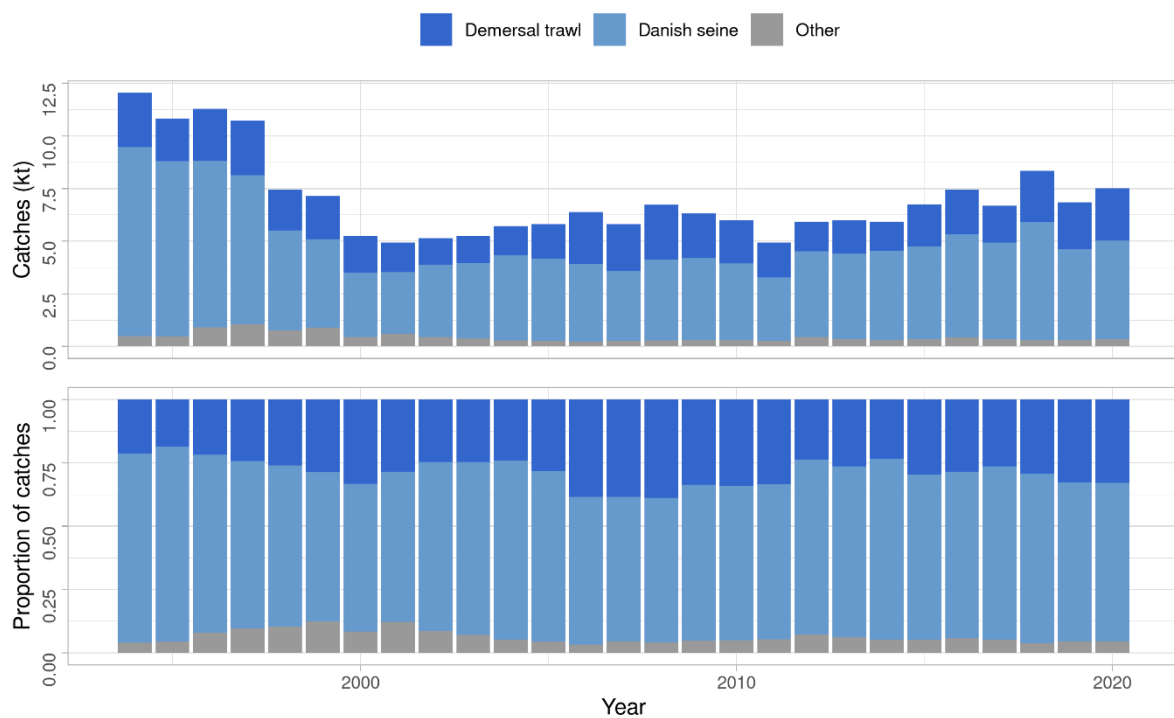


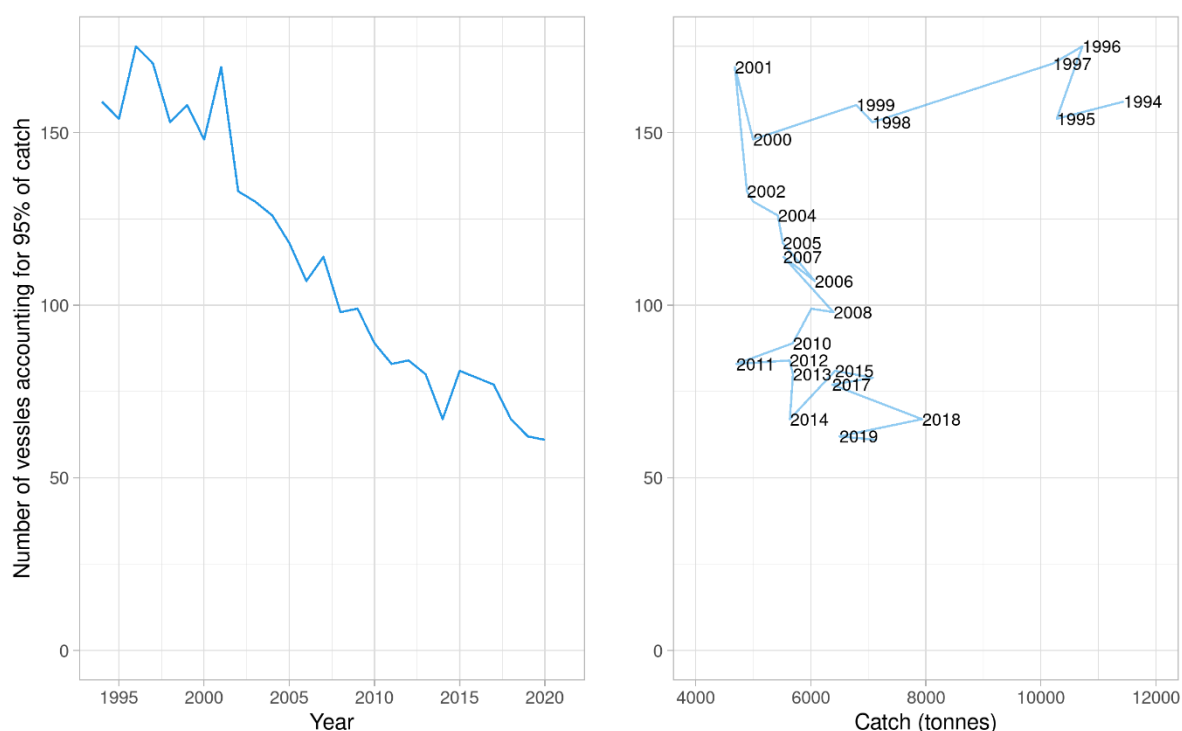
Figure 4. Plaice. Total catch (landings) by fishing gear since 1994, according to statistics from the Directorate of Fisheries.

Since 2000, the number of vessels reporting catches over 1000 kg of plaice in total annually has decreased, whereas total catches have been increasing in the past few years. This decrease is most noticeable in the demersal seiner fleet, where the number dropped from 92 vessels in 2004, to 41 in 2018 and remained there since. The number of trawlers has remained relatively stable since 2010, until last year when approximately 66 trawlers landed more than one tonne of plaice (Table 1). Total annual catch of plaice has been relatively stable (4900-8300 t) over the last 20 years. In 2020, a total of 7509 t were caught, which is 675 t more than in 2019.

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

YEAR	NUMBER OF VESSELS			CATCHES (TONNES)			
	<i>Trawlers</i>	<i>Seiners</i>	<i>Other</i>	<i>Demersal trawl</i>	<i>Demersal seine</i>	<i>Other</i>	<i>Sum</i>
2000	89	81	78	1759	3052	409	5220
2001	77	87	106	1393	2906	610	4909
2002	67	87	86	1257	3420	465	5142
2003	71	90	65	1288	3602	342	5232
2004	60	92	73	1368	4015	309	5692
2005	67	81	63	1637	3894	261	5792
2006	70	75	44	2443	3704	223	6370
2007	74	68	59	2242	3282	292	5816
2008	66	67	52	2600	3828	290	6718
2009	62	65	57	2121	3872	323	6316
2010	57	55	66	2033	3639	311	5983
2011	42	52	65	1658	3020	265	4943
2012	44	48	85	1402	4075	453	5930
2013	45	48	65	1559	4041	379	5979
2014	40	43	61	1374	4235	313	5922
2015	55	45	66	2001	4404	363	6768
2016	52	41	71	2118	4893	432	7443
2017	52	43	64	1762	4578	354	6694
2018	53	41	59	2436	5578	327	8341
2019	49	41	59	2231	4287	316	6834
2020	66	41	51	2475	4681	350	7509

The number of vessels accounting for 95% of the catch of plaice in Icelandic waters was relatively constant around 150-200 vessels in 1994-2001, despite a 50% reduction in total catch (Figure 5). In 2001-2011 catches were stable but the number of vessels dropped by half to around 80. The number of vessels has not changed much since 2011, despite an increase in total catch of about 3000 tonnes.



**Figure 5. Plaice. 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.**

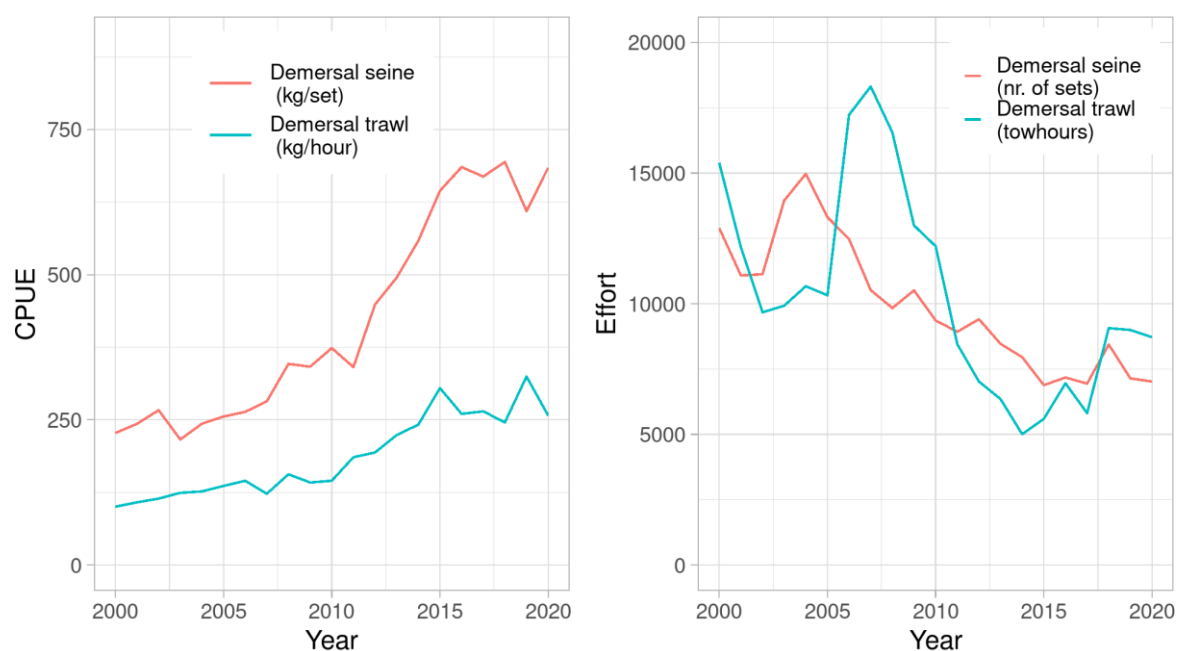
### CATCH PER UNIT OF EFFORT (CPUE) AND EFFORT.

CPUE estimates of plaice in Icelandic waters are not considered representative of stock abundance as changes in fleet composition and technical improvements have not been accounted for when estimating CPUE.

Non-standardised estimates of CPUE in demersal seine (kg/set) is calculated as the total weight in sets in which plaice was more than 10% of the catch. CPUE gradually increased from 250 kg/set to about 700 kg/set in 2016 (Figure 6). CPUE of plaice in demersal seine has been around that level since then.

CPUE of demersal trawl (kg/hour), in hauls where plaice is more than 10% of the catch, remained relatively stable around 150 kg/hour until 2010. CPUE of plaice has in trawl fishery, like in the demersal seine fishery, gradually increased from 120 kg/hour in 2000 to almost 250 kg/hour in 2014 and has slightly fluctuated around that level since.

Fishing effort for plaice in the demersal seine fishery is estimated as the number of sets where plaice was more than 10% of the total catch. Fishing effort by seiners was high but variable in 2000-2006 since that period the effort decreased continuously and reached the lowest level in 2014 and stayed at around that mark since (Figure 6). This is both because fewer seiners are fishing and CPUE is higher. Effort in the demersal trawl fishery (number of towing hours where plaice was 10% or more of the total catch) has gradually decreased from the peak in 2004 to the lowest value in 2014 (Figure 6). Since 2014, effort in the demersal trawl increased and was stable in the last two years.



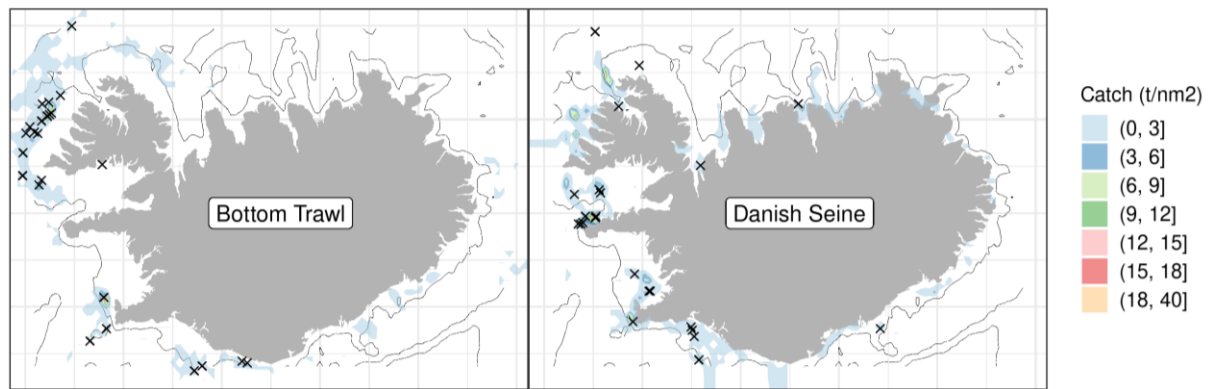
**Figure 6. Plaice. Non-standardised estimates of CPUE (left) and fishing effort (right) from demersal seine (kg/set or nr. of sets) in red and demersal trawl (kg/hour or towhours) in blue.**

#### AGE DISTRIBUTION OF LANDED PLAICE

Since 2013, the number of samples from the landed catch has been greatly reduced. Before this change, around 6000-7000 otoliths were being sampled yearly, but for the last five years 27-45 samples from demersal seine and 14-23 samples from bottom trawl were collected, or a total of 550-1125 and 350-573 otoliths, respectively (Table 2, Figure 7). Samples are not taken from other gear, as they represent a very small proportion (~5%) of the total catch.

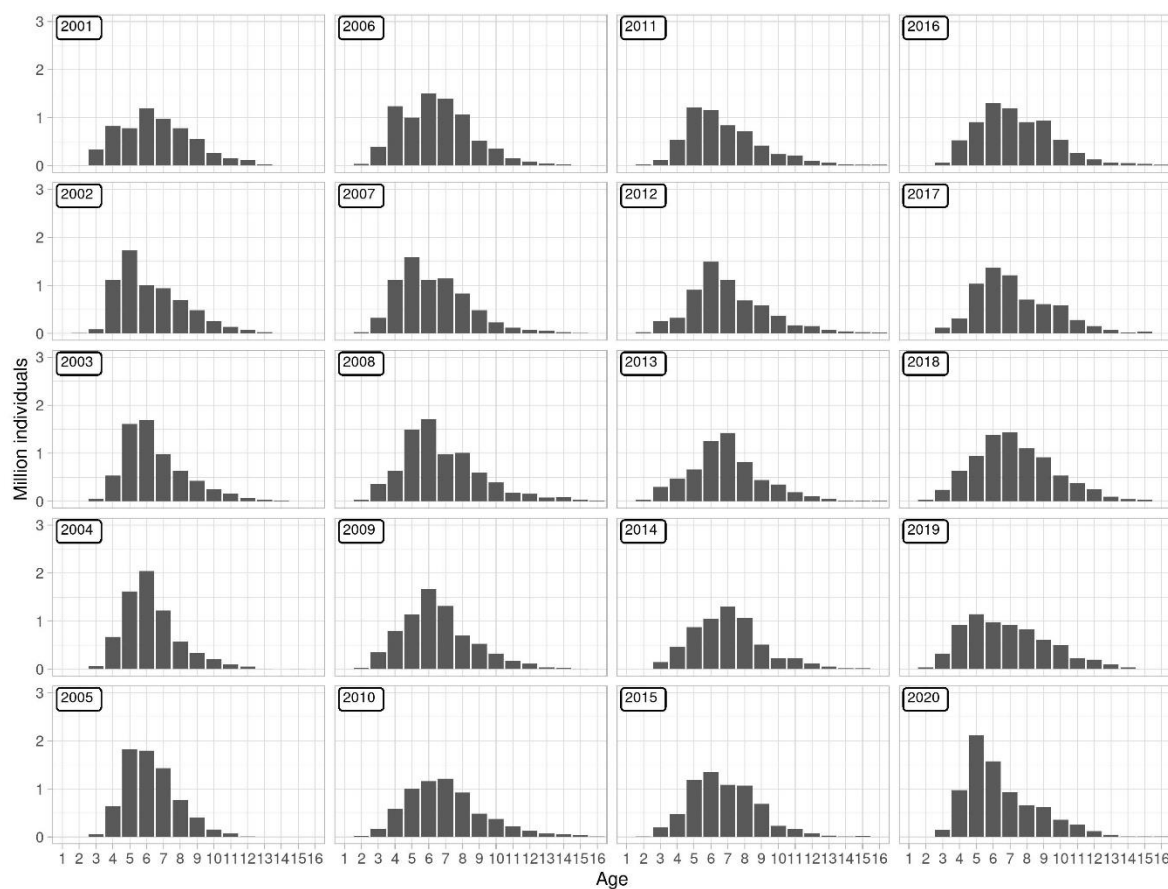
**Table 2. Plaice. Number of samples and aged otoliths from landed catch.**

Year	<i>Demersal seine</i>		<i>Demersal trawl</i>	
	Samples	Otoliths	Samples	Otoliths
2010	92	3953	41	2017
2011	91	4200	50	2452
2012	107	5199	37	1835
2013	104	4160	27	1350
2014	37	900	20	575
2015	33	800	27	670
2016	45	1125	23	573
2017	39	974	22	550
2018	35	880	14	350
2019	30	750	18	451
2020	27	550	24	550



**Figure 7. Plaice. Fishing grounds in 2020 as reported in logbooks (colours) by gear and positions of samples taken from landings (x).**

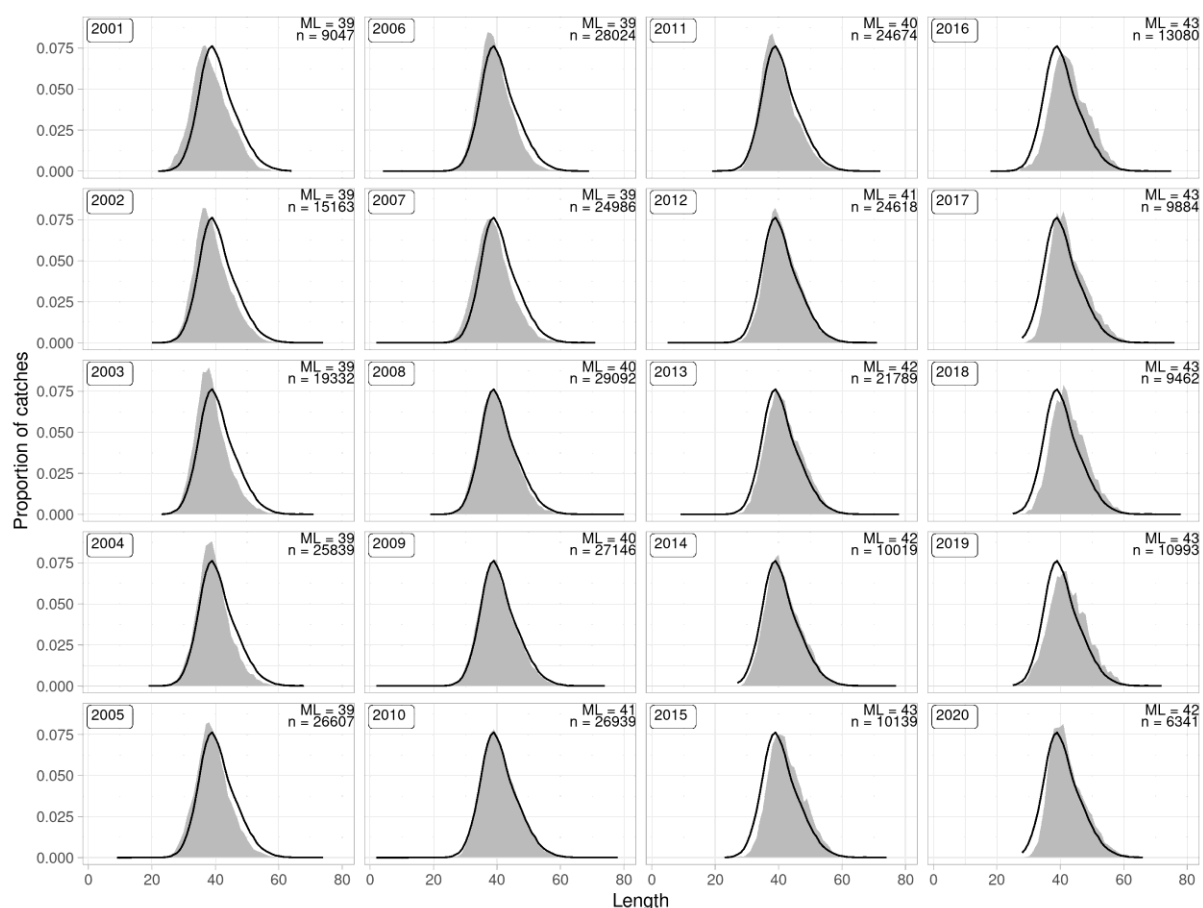
In 2002-2005, most of the catch was 4-7 years old plaice, or about 60% of landings in terms of estimated numbers (Figure 8). The proportion of these age classes in the catch then decreased and for the last five years it has been 40-45%. Thus, plaice in the catch have gradually become older, and as an example the average age of plaice caught has increased from 6.3 years in 2001-2007 to 7.0 years in 2012-2016. There is a noticeable shift towards younger fish in the catch in the last two years.



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

## LENGTH DISTRIBUTION OF LANDED PLAICE

There has been a shift towards larger fish in the length distribution of landed catch (Figure 9). As a result, the average length in the samples taken from commercial catch has increased from 38.5 cm in 2001 to 43.1 cm in 2016 and was 42.3 cm in 2020.



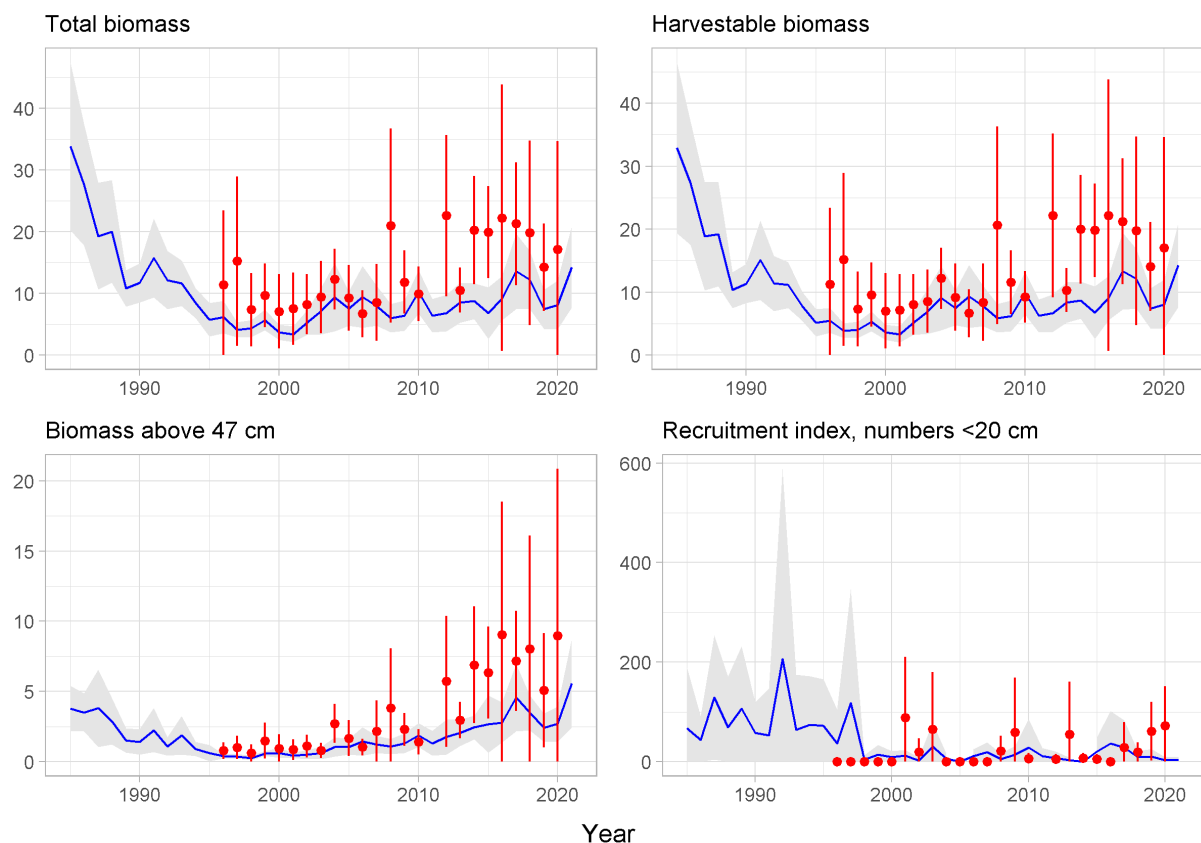
**Figure 9. Plaice. Length distribution from landed catch in 2001-2020. The dotted line represents the mean length distribution for the period.**

## SURVEY DATA

The Icelandic spring groundfish survey (hereafter spring survey or IS-SMB), which has been conducted annually in March since 1985, covers the most important distribution area of the plaice fishery. In addition, the Icelandic autumn groundfish survey (hereafter autumn survey or IS-SMH) was commenced in 1996. The autumn survey was not conducted in 2011. IS-SMB is considered to measure changes in abundance/biomass better than the autumn survey. It does not, however, adequately cover the main recruitment grounds for plaice, as recruitment takes place in shallow water in habitats unsuitable for demersal trawling. In addition to these two major surveys, a designated flatfish survey with beam trawl, conducted annually in July/August since 2016, with the aim to cover most of the recruitment grounds of plaice and other flatfish species. The plan is to incorporate this survey in the stock assessment for plaice in the future.

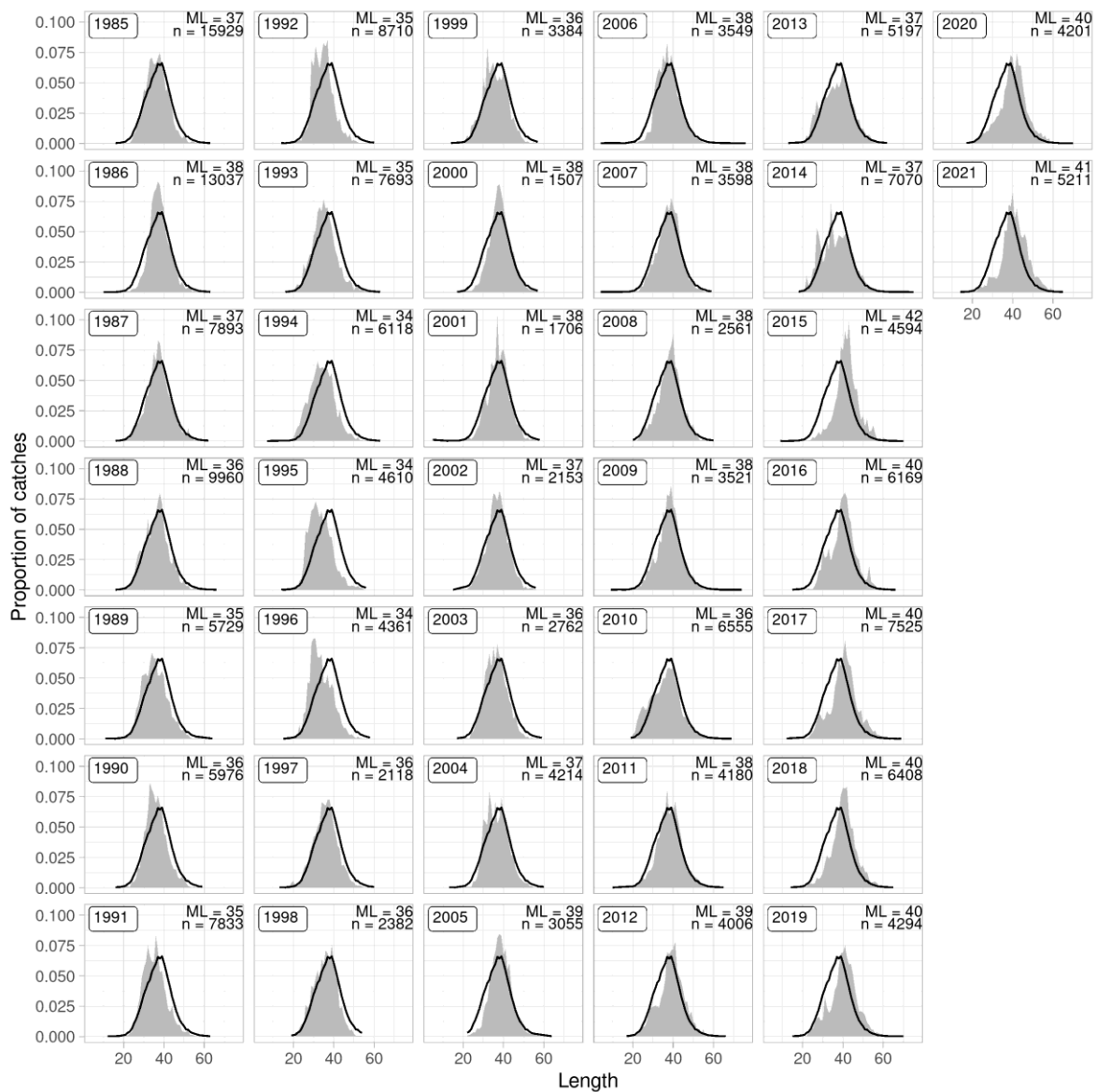
Figure 10 shows trends in various biomass indices and a recruitment index based on abundance of plaice smaller than 30 cm. Survey length-disaggregated abundance indices are shown in Figures 11 and 12, and abundance and changes in spatial distribution in Figure 14-17.

Total biomass index of plaice and plaice larger than 30 cm (harvestable part of the stock), decreased rapidly in the first years of the spring survey and were at the lowest level in 1997-2002. In 2003-2016 the indices gradually increased. Since 2017 there have been annual fluctuation in the indices around similar levels. This year's spring survey biomass index is in correspondence with the biomass from early 1990. The indices are now only one-third to half of what they were in the first four years of the time series. The index of plaice larger than 50 cm in the spring survey also decreased to lowest levels in 1997-2002 but has since increased and has been in recent years at similar level as in the beginning of the time series. The index of juvenile abundance (<20 cm) has maintained at the low level since 1998 with occasional small peaks. Trends in the autumn survey are similar to those observed from the spring survey, but standard deviations in the measurements are higher.

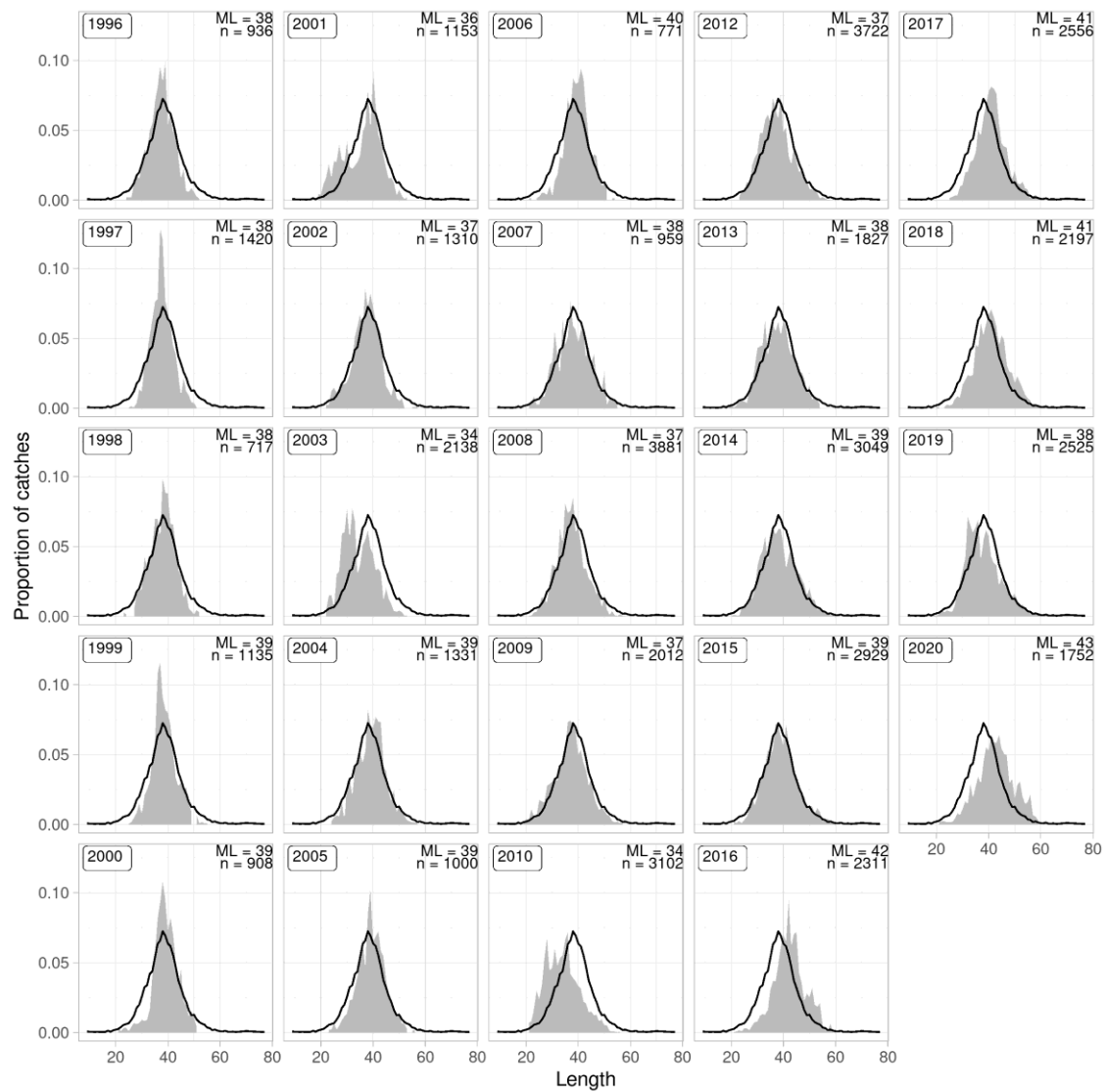


**Figure 10. Plaice. Total biomass indices (upper left), harvestable biomass indices ( $\geq 30$  cm, upper, right), biomass indices of larger individuals ( $\geq 47$  cm, lower left) and juvenile abundance indices ( $\leq 20$  cm, lower right) from the spring survey (blue) from 1985 and autumn survey (red) from 1996, along with the standard deviation.**

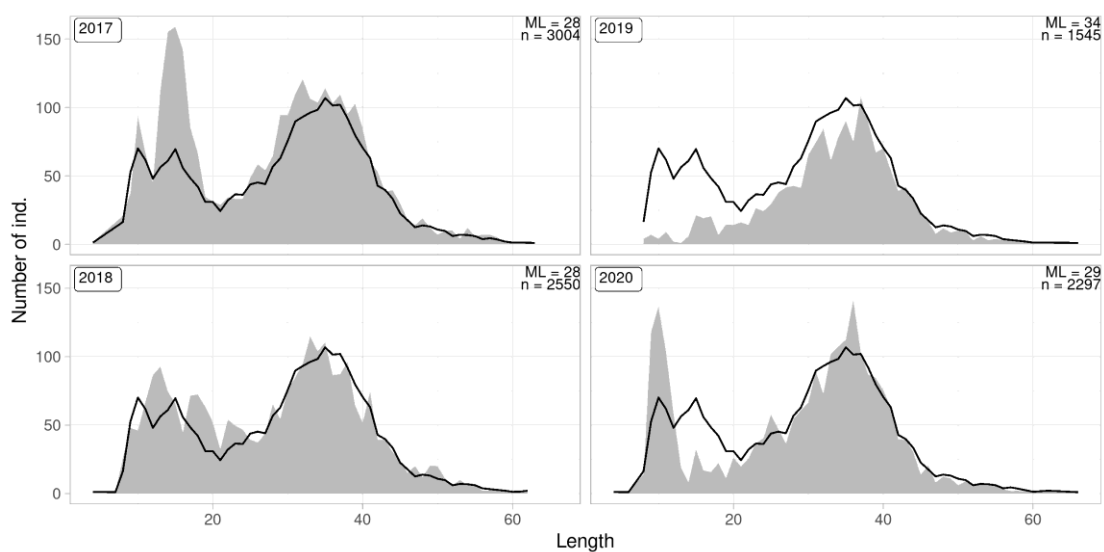
Like in the commercial catch, there has been a shift towards larger fish in the length distribution from the spring survey (Figure 11). The average length of plaice has increased from 33.5 cm in 1995 to 41 cm in 2021. Data from the autumn survey tells a similar story, with a marked increase in average size of plaice caught (Figure 12). In Figure 13, the length distributions from the beam trawl survey are shown. As this survey was specially designed to target the recruitment grounds of several flatfish species, plaice juveniles down to 8 cm are registered.



**Figure 11. Plaice. Length-disaggregated abundance indices from the spring survey. The black line shows the mean for all years. Note different scale on y-axes.**

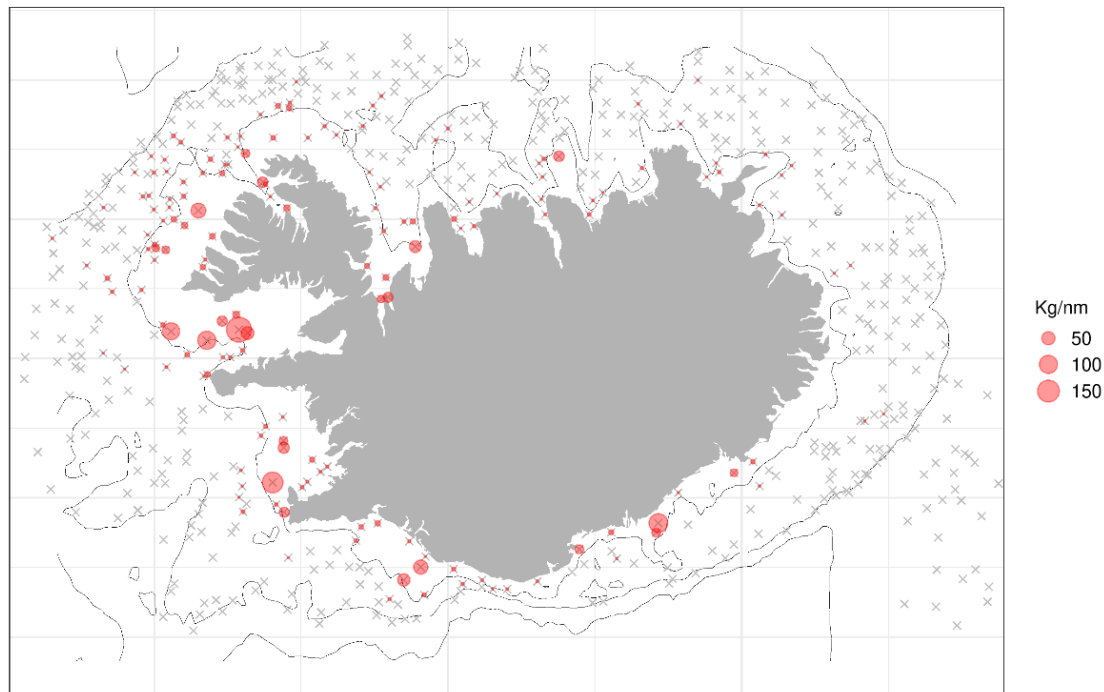


**Figure 12. Plaice. Length-disaggregated abundance indices from the autumn survey. The black line shows the mean for all years. Note different scale on y-axes.**

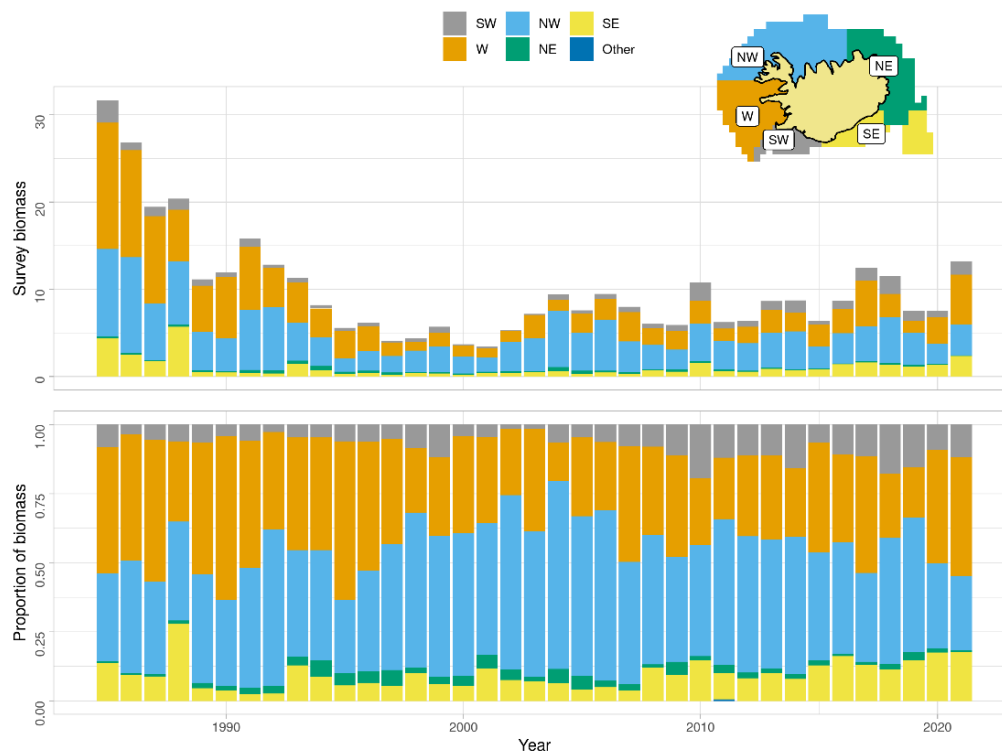


**Figure 13. Plaice. Length distribution from beam trawl survey. The black line shows the mean for all years.**

Plaice was mostly caught in the northwest area as well as on the main spawning grounds off the western part of the country in the spring survey in 2021 (Figure 14). Spatial distribution of plaice catch in the spring survey shows some temporal changes, particularly between catches taken in the west and northwest areas (Figure 15). This could be due to annual variation in timing of plaice moving to their traditional spawning grounds in the western part of the country as the survey takes place around that same time every year.



**Figure 14. Plaice. Spatial distribution in the spring survey in 2021.**



**Figure 15. Plaice. Spatial distribution of biomass index from the spring survey.**

Plaice was mainly caught on species main feeding grounds in the northwest of the country in the autumn survey 2020 (Figure 16). Most plaice in the autumn survey have been caught on the traditional feeding grounds in the northwest, since 1996. However, there has been an increase in the relative abundance of plaice in the western part in recent years, from around 10% in 2004 and 2005 up to 25% in 2010-2015 (Figure 17). In 2020, however, almost 90% of the plaice was caught in the NW area.

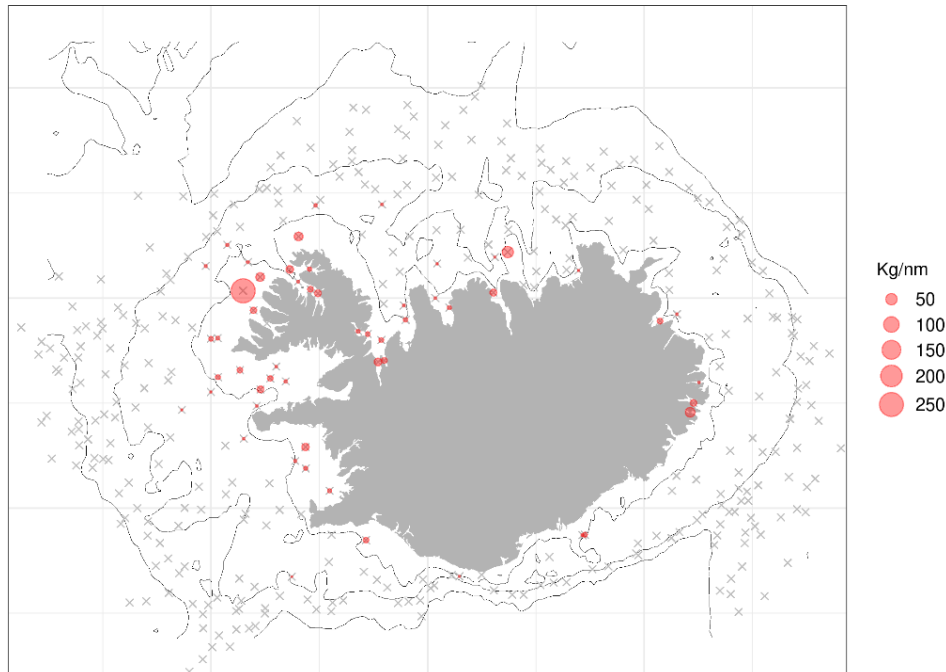


Figure 16. Plaice. Spatial distribution in the autumn survey in 2020.

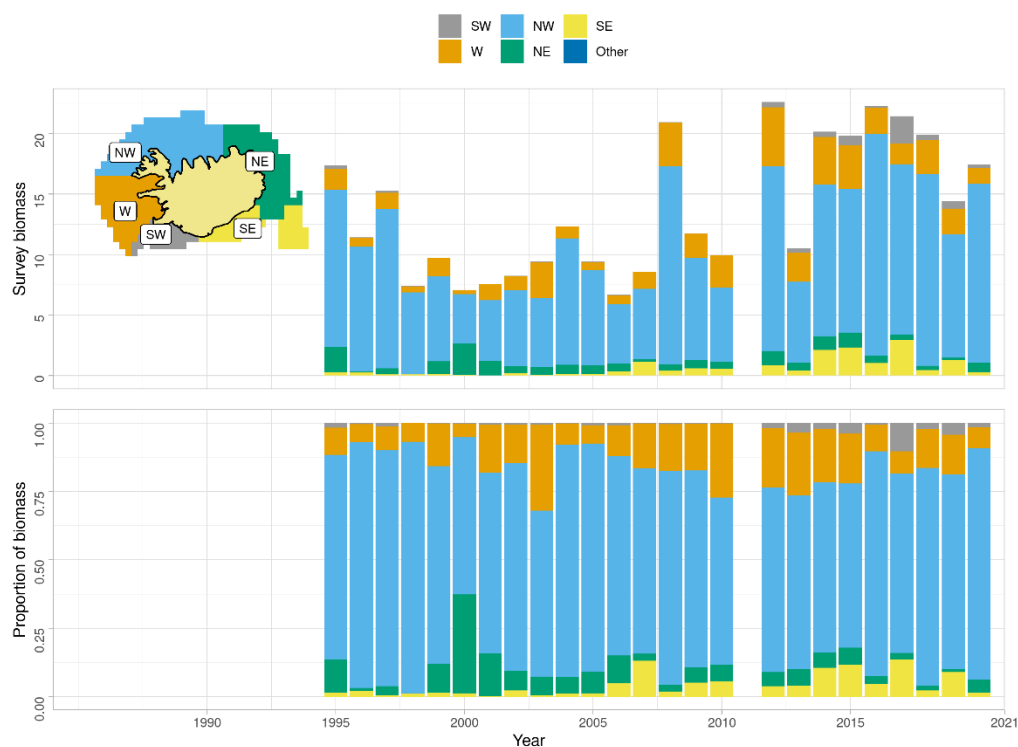


Figure 17. Plaice. Spatial distribution of biomass index from the autumn survey.

Figures 18 and 19 show spatial distribution of plaice in the beam trawl survey, which is usually conducted in July-August at very shallow depth (10-30 m).

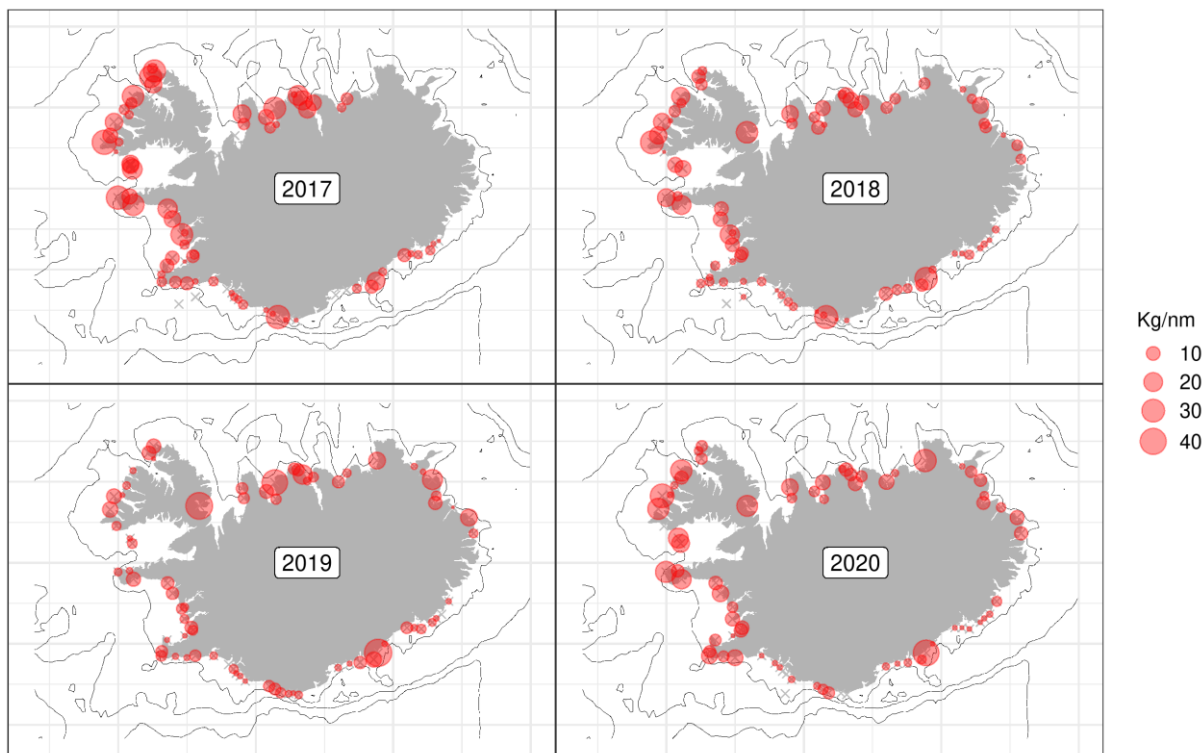


Figure 18. Plaice. Spatial distribution in the beam trawl survey since 2017. The NE area was not sampled in 2017.

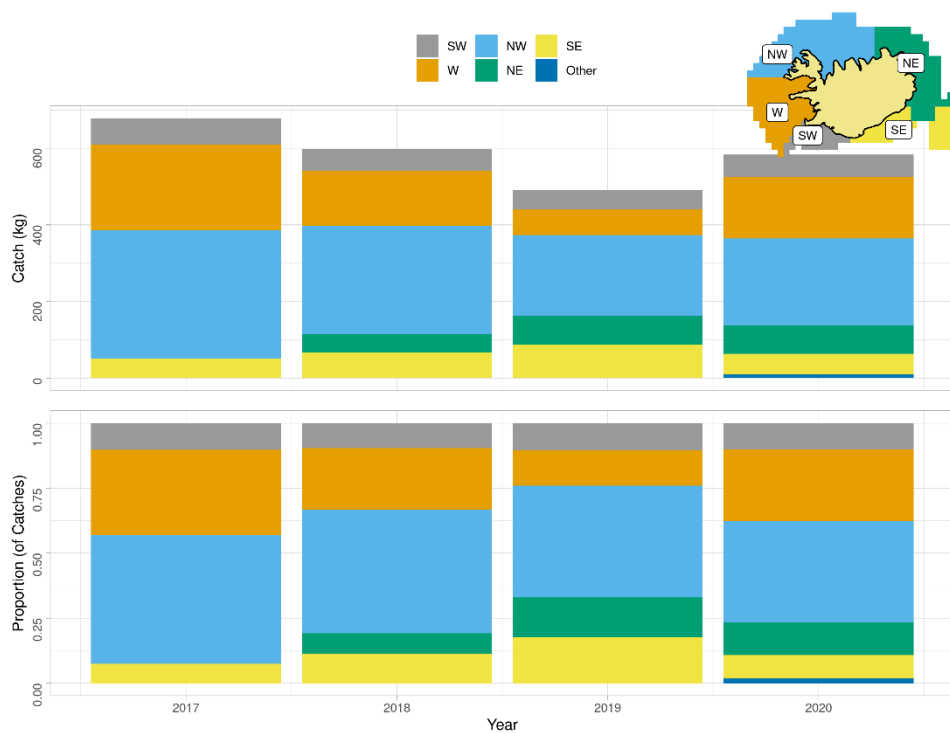
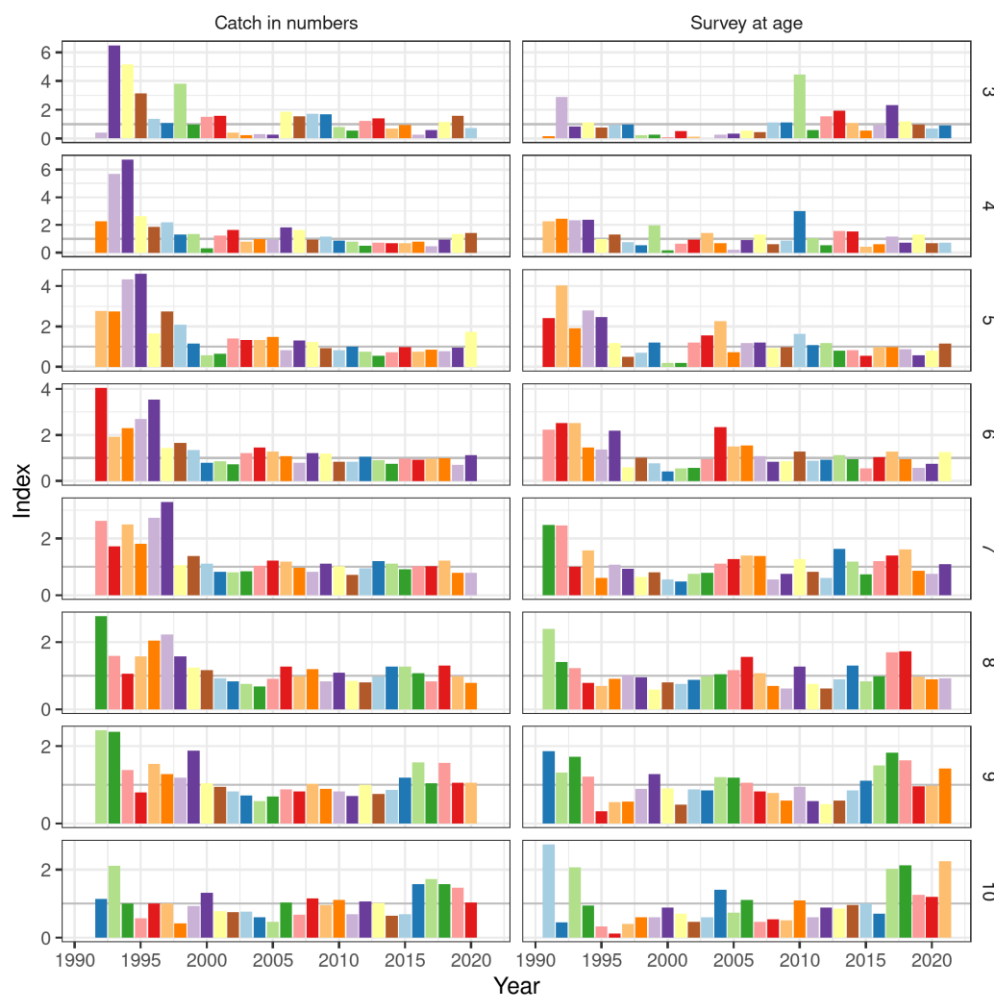


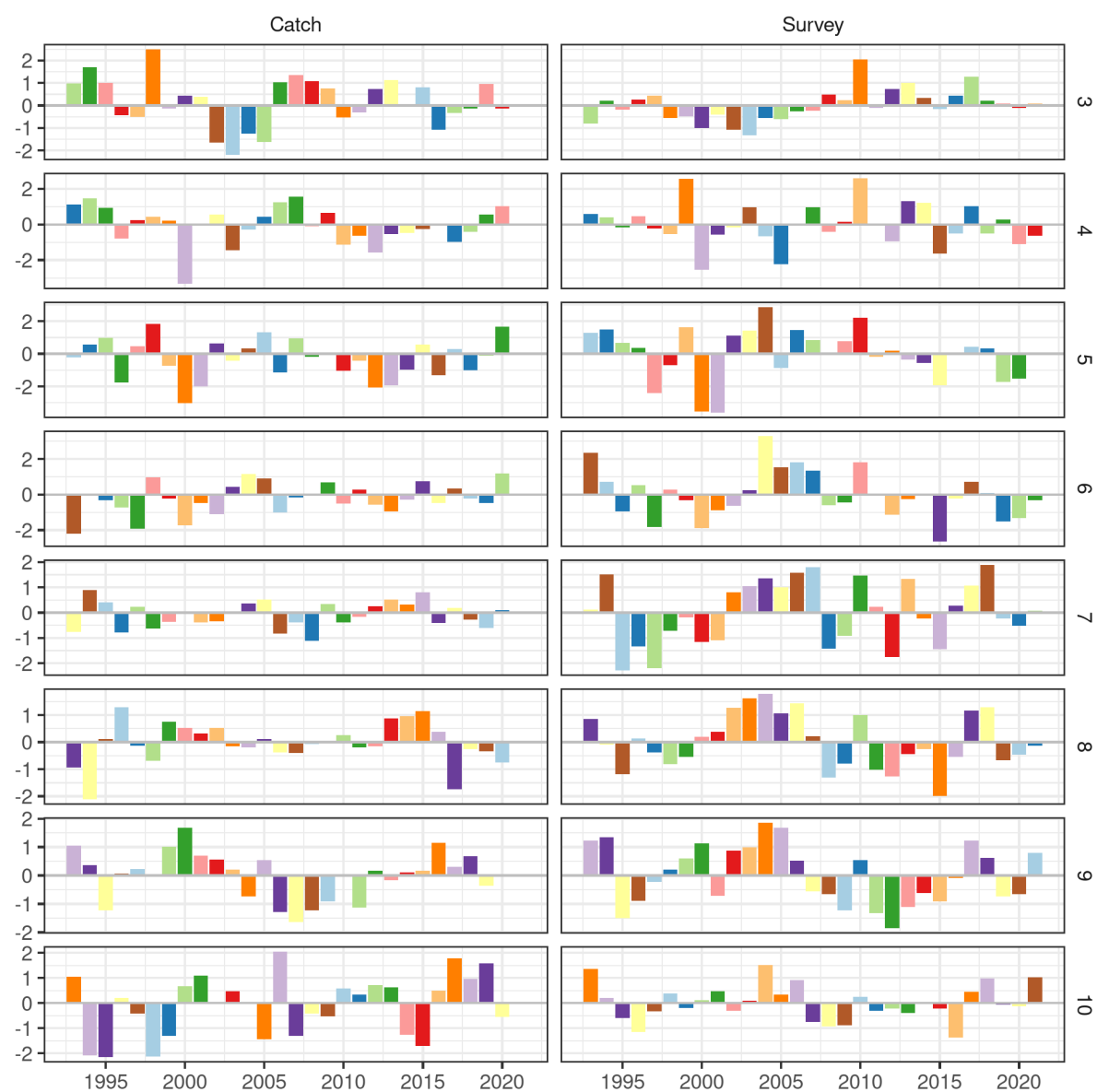
Figure 19. Plaice. Spatial distribution in the beam trawl survey since 2017. The NE area was not sampled in 2017.

## STOCK ASSESSMENT

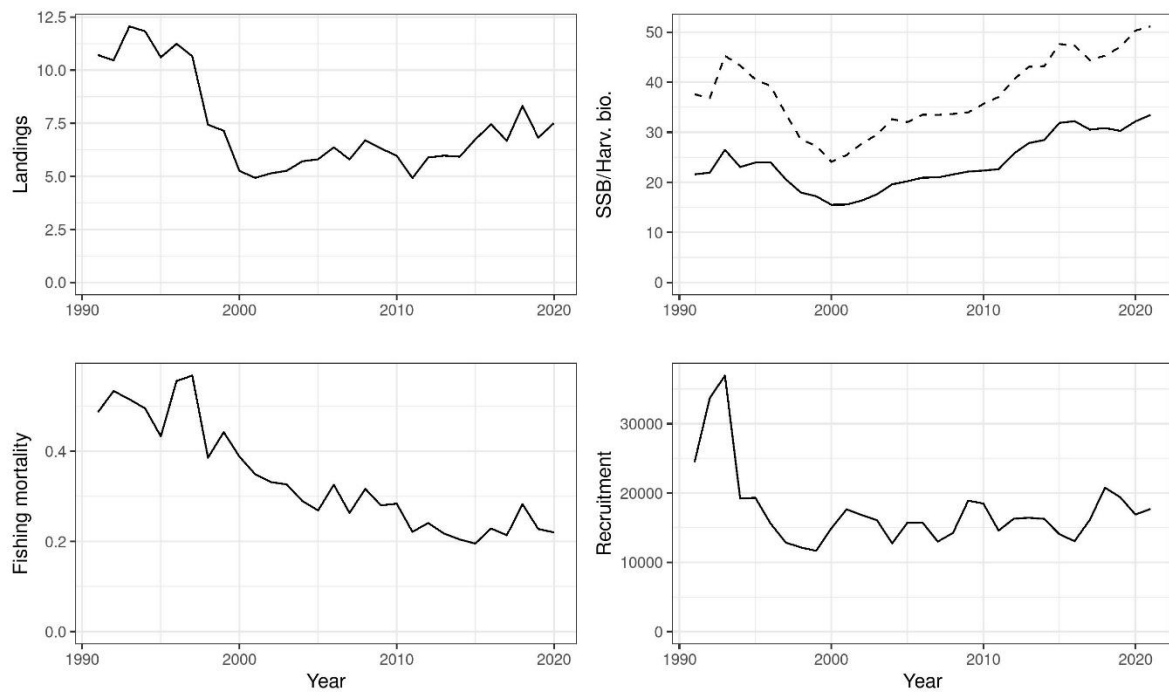
Analytical age-based stock assessment model using catch in numbers and age-disaggregated indices from the spring survey has been used to assess the stock since 2016. The model runs from 1991 onwards and ages 3-10 are tracked by the model, where age 10 is a plus group. Natural mortality is set to 0.2 for all age groups. Considerable uncertainty is present in the model due to limited information on recruitment, and the model has large residuals blocks, especially for the survey data (Figure 21). The result of the assessment indicate that the stock has increased and both harvestable biomass and the SSB are now at the highest level since the early 1990 (Figures 22 and 23). Maximum sustainable yield is the basis for the advice, and the reference point is set as  $F=0.22$ .



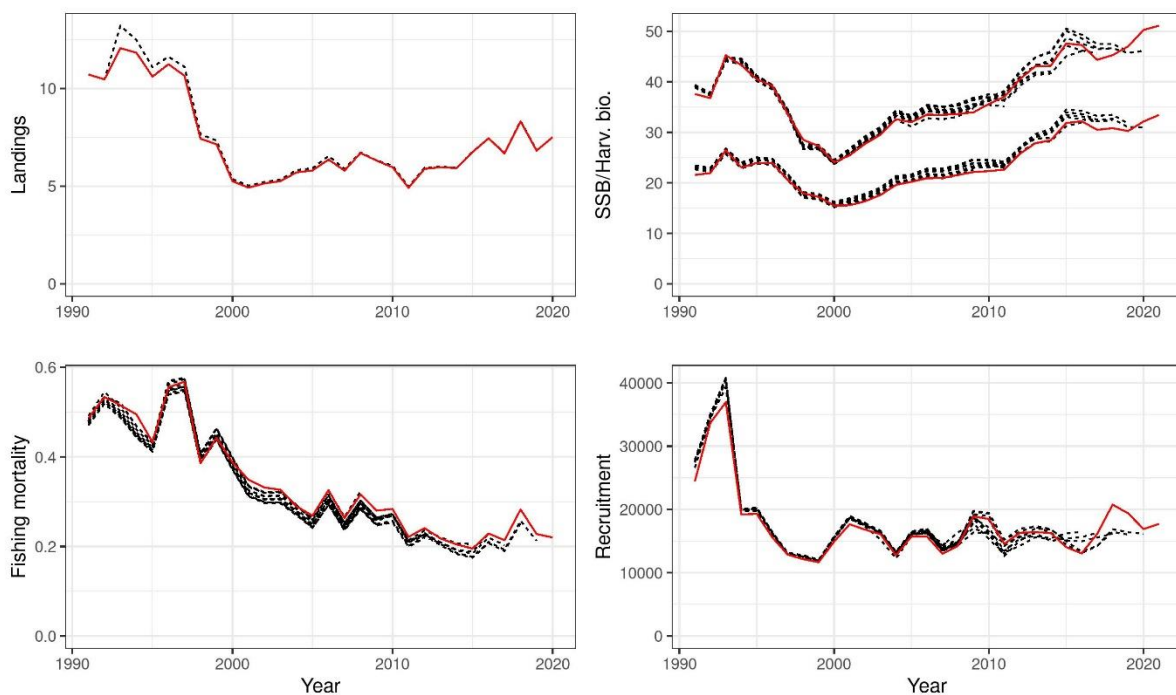
**Figure 20. Plaice.** Estimated numbers of 3–10 year old fish in the commercial catch (1992–2020) and age-disaggregated survey indices from the spring survey (1991–2021). Input data for the stock assessment.



**Figure 21. Plaice. Residuals of the model fit to IS-SMB survey indices and catch data by age.**



**Figure 22. Plaice. Summary from the assessment 2021. Results of spawning stock (SSB) and harvestable stock biomass, fishing mortality, and recruitment (age 3) are shown.**



**Figure 23. Plaice. Analytical retrospective plots illustrating stability in model estimates over a 9-year 'peel' in data. Results of spawning stock (SSB) and harvestable stock biomass, fishing mortality, and recruitment (age 3) are shown.**

**Table 3. Plaice. Age-based stock assessment model results including input catch values, estimated harvestable biomass (harvestable biomass), spawning stock biomass (SSB), recruitment (Rec., age 3 in millions) and fishing mortality (F). Projections from the model are indicated in italics. All weights are in tonnes**

YEAR	HARV. BIO.	CATCH	SSB	RECRUITMENT	F
1991	37 585	10 713	21 571	24.4	0.486
1992	36 793	10 464	21 937	33.7	0.534
1993	45 268	12 061	26 464	36.9	0.515
1994	43 305	11 827	23 046	19.2	0.495
1995	40 531	10 604	23 937	19.3	0.433
1996	39 225	11 241	23 972	15.6	0.556
1997	33 664	10 651	20 590	12.9	0.568
1998	28 516	7 428	17 942	12.1	0.386
1999	27 291	7 142	17 206	11.7	0.442
2000	24 089	5 252	15 501	14.9	0.388
2001	25 434	4 923	15 551	17.6	0.349
2002	27 713	5 139	16 355	16.8	0.332
2003	29 523	5 258	17 594	16.1	0.326
2004	32 604	5 706	19 598	12.7	0.290
2005	32 009	5 802	20 204	15.7	0.269
2006	33 501	6 363	20 923	15.7	0.326
2007	33 460	5 794	20 958	13.0	0.263
2008	33 650	6 693	21 561	14.2	0.316
2009	33 962	6 310	22 131	18.9	0.280
2010	35 630	5 963	22 330	18.5	0.284
2011	37 036	4 914	22 623	14.6	0.221
2012	40 531	5 883	25 735	16.3	0.241
2013	43 087	5 972	27 840	16.4	0.218
2014	43 172	5 923	28 430	16.3	0.204
2015	47 598	6 739	31 859	14.1	0.195
2016	47 291	7 451	32 204	13.1	0.229
2017	44 369	6 670	30 504	16.1	0.214
2018	45 296	8 318	30 831	20.8	0.283
2019	47 010	6 817	30 263	19.4	0.228
2020	50 282	7 505	32 158	16.9	0.220
<i>2021</i>	<i>51 136</i>	<i>6 831</i>	<i>33 457</i>	<i>17.7</i>	<i>0.200</i>
<i>2022</i>	<i>52 596</i>	-	<i>34 786</i>	<i>17.6</i>	<i>0.200</i>
<i>2023</i>	<i>52 856</i>	-	<i>35 162</i>	<i>17.6</i>	<i>0.200</i>

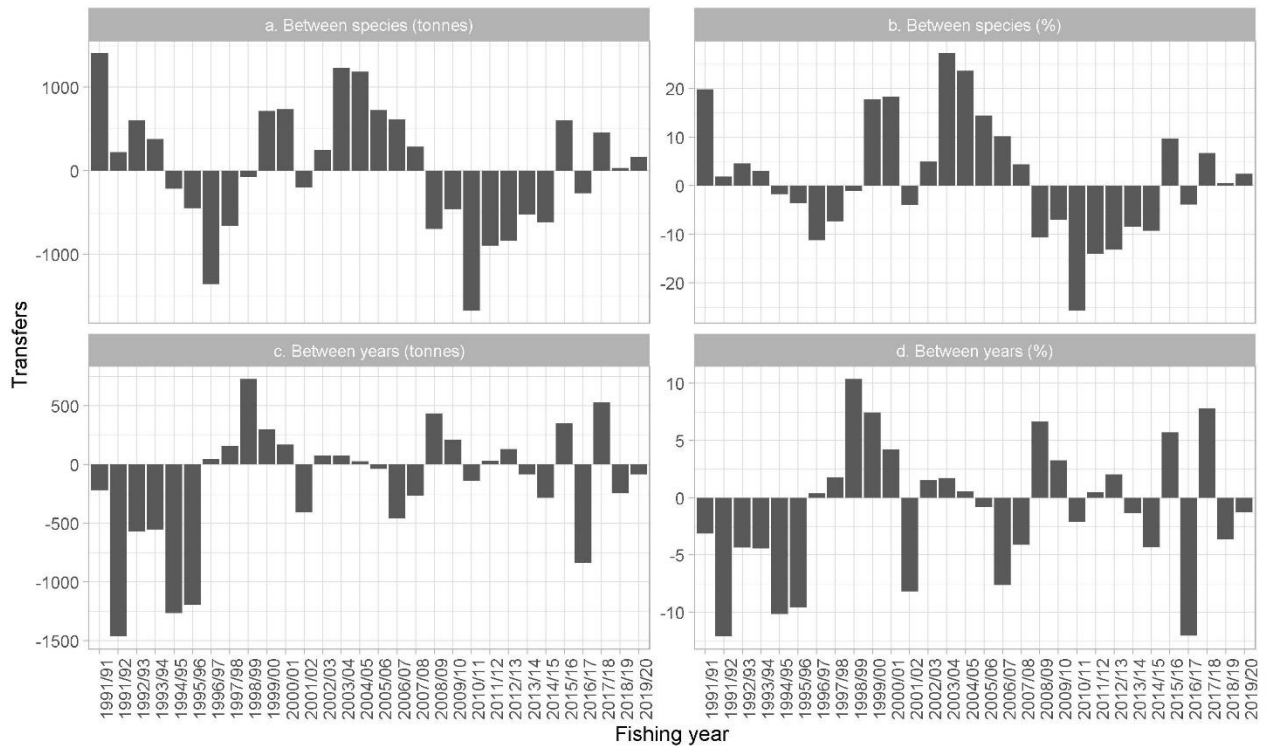
## MANAGEMENT

The Ministry of Industries and Innovation is responsible for management of the Icelandic fisheries and implementation of legislation. Plaice was included in the ITQ system in the 1991/1992 quota year and as such subjected to TAC limitations. For the first six years, the TAC was set higher than recommended by Marine Research Institute (MRI), but this practice stopped in the 2010/2011 quota year.

**Table 4. Plaice. 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>1991/92</b>	10000	11000	10200
<b>1992/93</b>	10000	13000	12400
<b>1993/94</b>	10000	13000	12300
<b>1994/95</b>	10000	13000	11100
<b>1995/96</b>	10000	13000	11000
<b>1996/97</b>	10000	12000	10345
<b>1997/98</b>	9000	9000	8083
<b>1998/99</b>	7000	7000	7452
<b>1999/00</b>	4000	4000	4907
<b>2000/01</b>	4000	4000	4921
<b>2001/02</b>	4000	5000	4402
<b>2002/03</b>	4000	5000	5402
<b>2003/04</b>	4000	4500	5844
<b>2004/05</b>	4000	5000	6184
<b>2005/06</b>	4000	5000	5647
<b>2006/07</b>	5000	6000	6149
<b>2007/08</b>	5000	6500	6620
<b>2008/09</b>	5000	6500	6361
<b>2009/10</b>	5000	6500	6389
<b>2010/11</b>	6500	6500	4843
<b>2011/12</b>	6500	6500	5822
<b>2012/13</b>	6500	6500	5932
<b>2013/14</b>	6500	6500	6030
<b>2014/15</b>	7000	7000	6237
<b>2015/16</b>	6500	6500	7619
<b>2016/17</b>	7330	7330	6369
<b>2017/18</b>	7103	7103	8208
<b>2018/19</b>	7132	7132	7096
<b>2019/20</b>	6985	6985	7177
<b>2020/21</b>	7037	7037	

Figure 24, shows the net transfers in the Icelandic ITQ-system. From 2002-2008 there was a net transfer of other species being transferred to plaice quota (positive values in the figure). However, from 2009-2015, this was reversed, and plaice quota was transferred to other species. In recent years species-transfer of quota through plaice has been low. Net transfer of plaice quota between fishing years has varied between years, and ranges from -10 to 12%.



**Figure 24. Plaice. Net transfers of quota to and from plaice in the Icelandic ITQ system by quota year. Between species (upper): Positive values indicate a transfer of other species to plaice, but negative values indicate a transfer of plaice quota to other species. Between years (lower): Net transfer of quota for a given fishing year.**