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 2013-2021, as reported by mandatory logbooks, are shown in Figure 1.

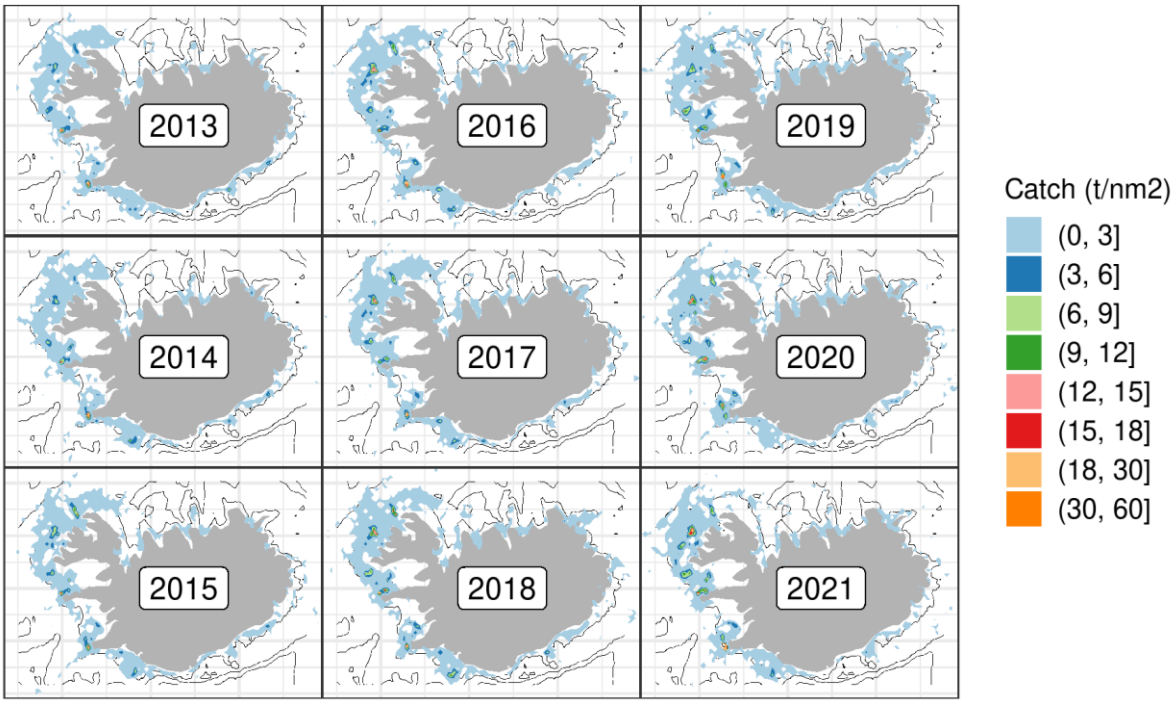

Figure 1. Plaice. Geographical distribution of the Icelandic fishery since 2013. Reported catch from logbooks.

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 70% of the plaice caught west and north-west in recent years. Catch in the south-west area has been increasing during last decade but decreased again to previous levels in most recent years. On the contrary, an increase in reported catch has been observed in the western and northwestern parts of the shelf.

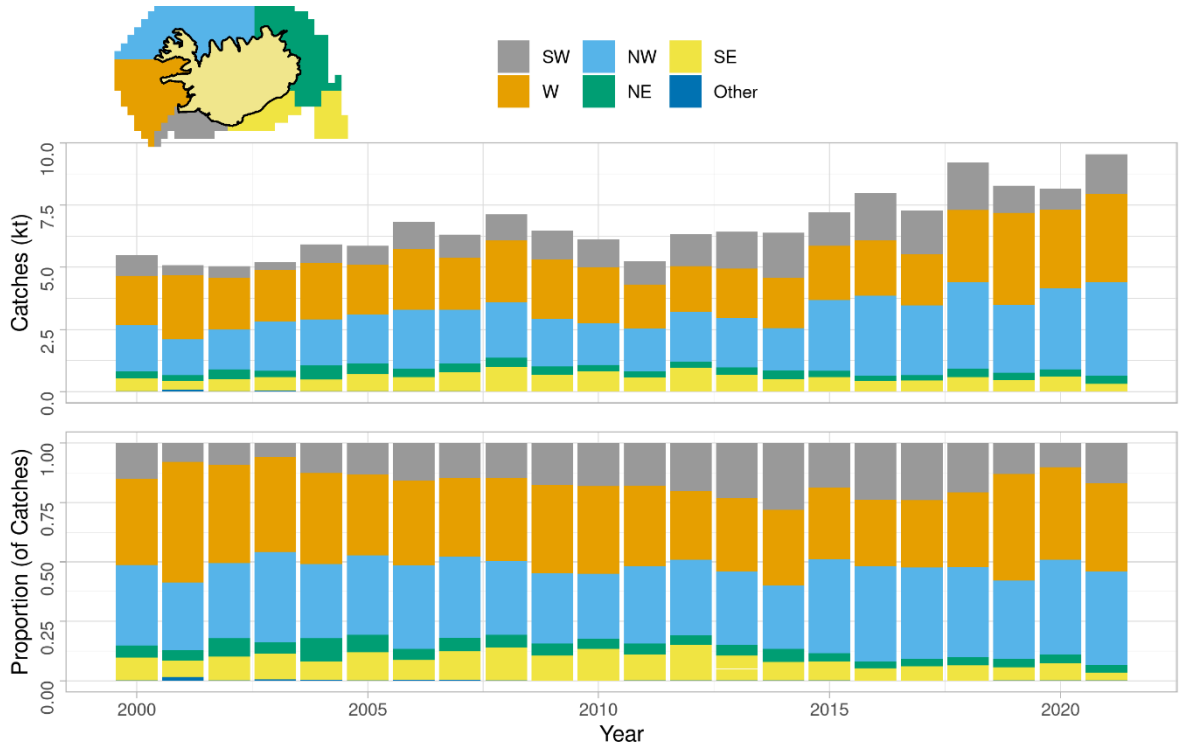

Figure 2. Plaice. Spatial distribution of the Icelandic fishery by fishing area from 2000 according to logbooks. All gears combined.

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.

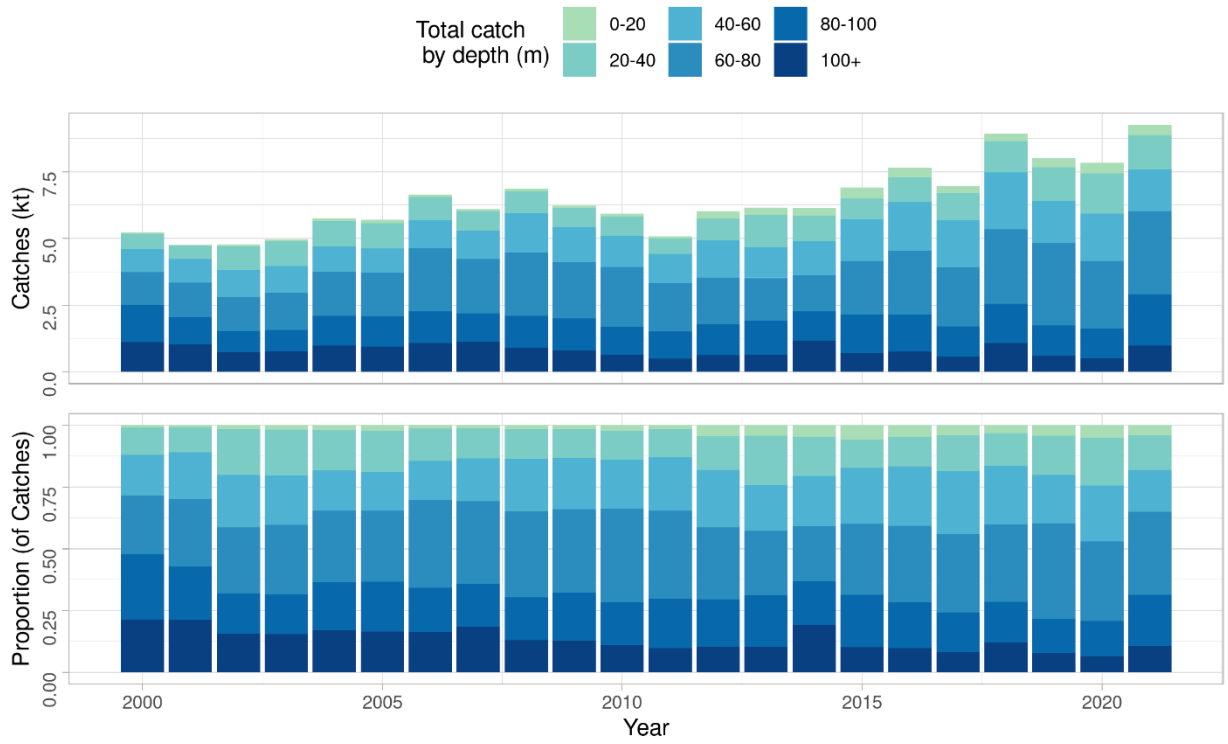

Figure 3. Plaice. Depth distribution of demersal seine and trawl catches according to logbooks.

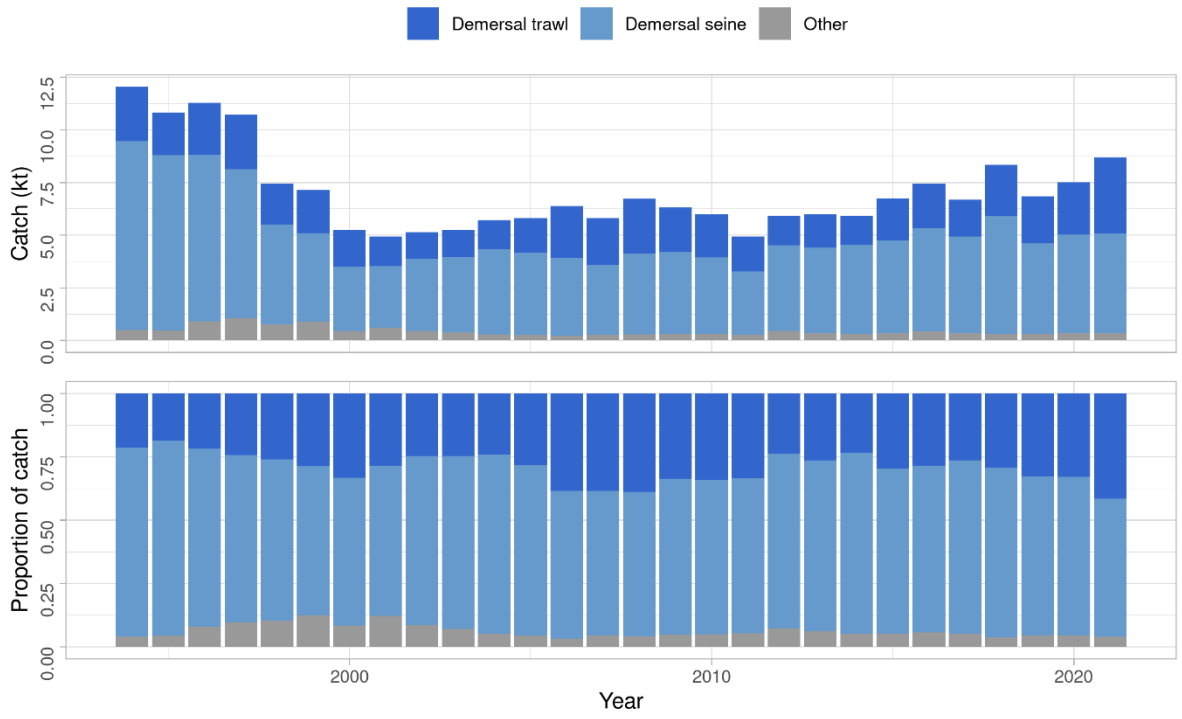

Figure 4. Plaice. Total catch (landings) by fishing gear since 1994, according to statistics from the Directorate of Fisheries.

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 35 last year. The number of trawlers has remained relatively stable since 2010, i.e. fluctuating around 50 vessels (Table 1). In 2021, a total of 8677 t was caught, which is approximately 1168 t more than in previous year.

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

	NUMBER OF VESSELS			CATCHES (TONNES)			
YEAR	*Trawlers*	*Seiners*	*Other*	*Demersal trawl*	*Demersal seine*	*Other*	*Sum*
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	52	41	51	2475	4681	350	7509
2021	55	35	52	3603	4719	358	8677

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. Since 2011, the number of boats has been relatively stable despite an increase in total catch.

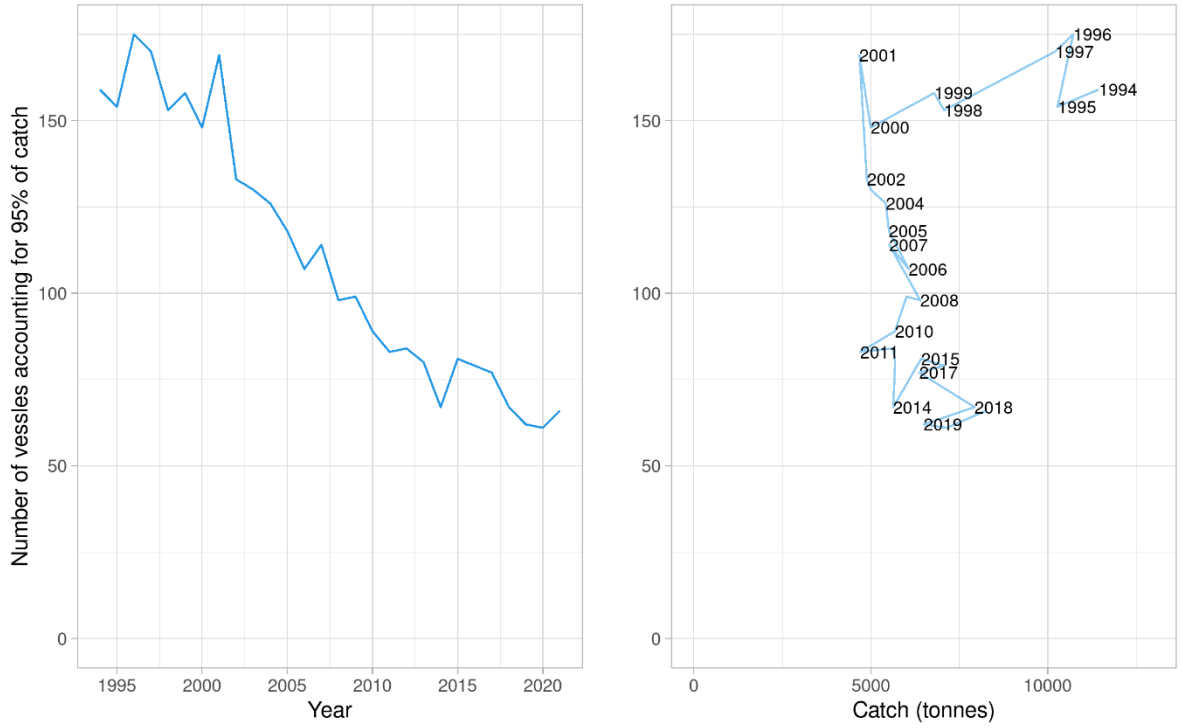

Figure 5. Plaice. Number of vessels (all gear types) accounting for 95% of the total catch annually since 1994. Left: Plotted against year. Right: Plotted against total catch. Data from the Directorate of Fisheries.

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.

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, especially in 2021.

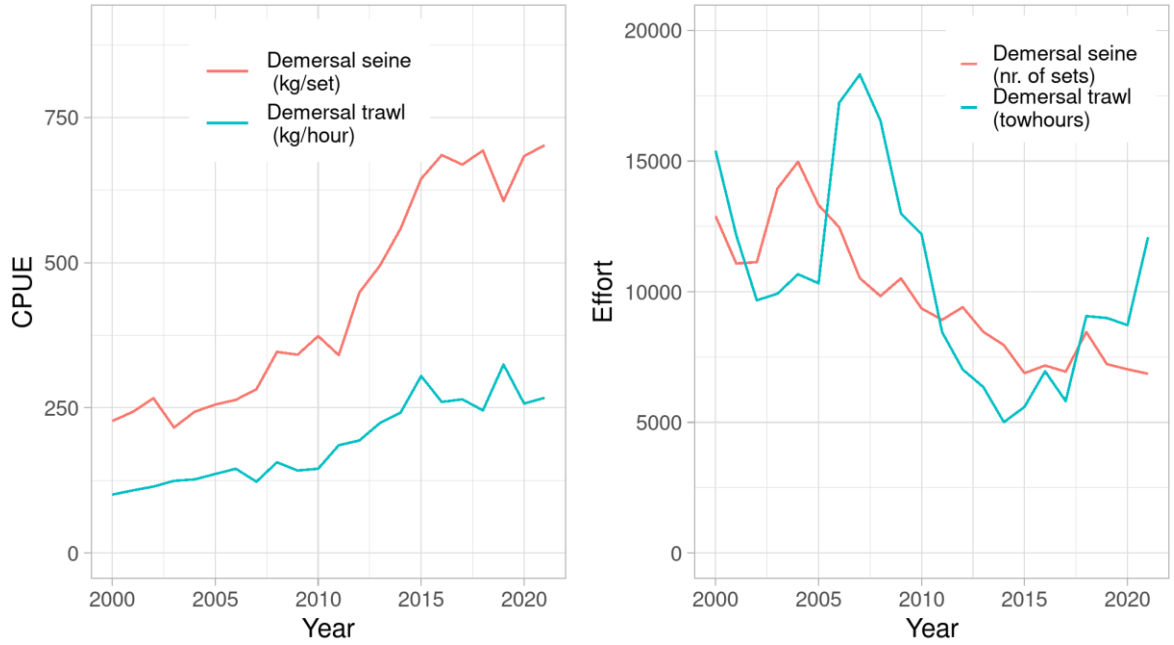

Figure 6. Plaice. Non-standardised estimates of CPUE (left) and fishing effort (right) from demersal seine (kg/set or nr. of sets) in red and demersal trawl (kg/hour or towhours) in blue.

DISCARDS

Discarding is banned by law in the Icelandic demersal fishery. According to discard measurements conducted by MRI and Directorate of Fisheries in mid-2000, the discard rate for plaice caught in demersal seine was high, around 7% of the landed catch and involved mainly fish under 40 cm in length. However, following discards measurements show no discards of plaice caught in demersal seine. Discards are therefore assumed to be negligible.

Measures in the management system such as converting quota share from one species to another are used by the fleet to a large extent and this is thought to discourage discarding in mixed fisheries. In addition to prevent high grading and quota mismatch the fisheries are allowed to land fish that will not be accounted for in the allotted quota, provided that the proceedings when the landed catch is sold will go to the Fisheries Project Fund (*Verkefnasjóður sjávarútvegsins*). A more detailed description of the management system can be found on https://www.responsiblefisheries.is/seafood-industry/fisheries-management/statement-on-responsible-fisheries.

AGE DISTRIBUTION OF LANDED PLAICE

Sampling of biological data from main gears (demersal seine and bottom trawl) in commercial catches is considered good in general. The sampling covers spatial distribution of catchers to satisfactory extent. Examples of sampling coverage by gear are shown in Figure 7. 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 eight years 27-45 samples from demersal seine and 14-49 samples from bottom trawl were collected, or a total of 550-1125 and 350-1225 otoliths, respectively (Table 2). 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	***Demersal seine***		***Demersal trawl***	
	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	24	550	27	550
2021	36	900	49	1225

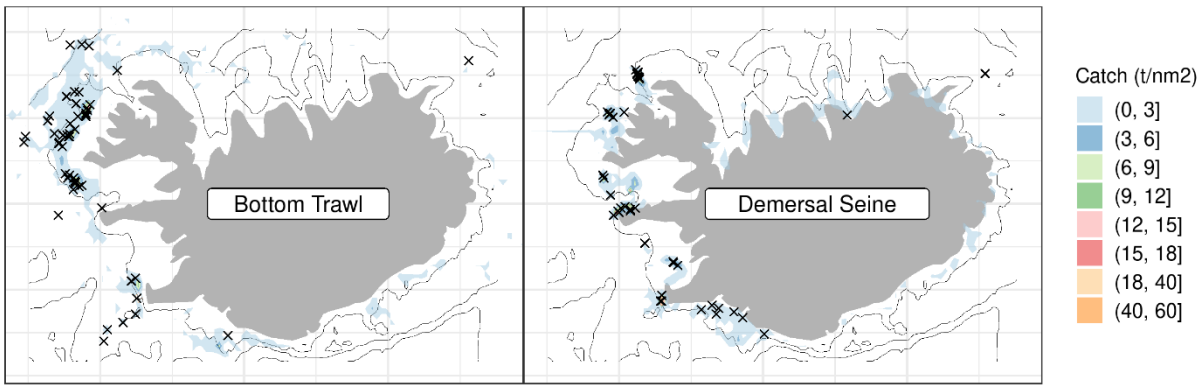

Figure 7. Plaice. Fishing grounds in 2021 as reported in logbooks (colours) by gear and positions of samples taken from landings (x).

In 2002-2005, most of the 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%. Plaice in the catch have gradually become older, and in recent years the largest cohorts have been 6-8-year-old fish. Catches in 2021 are mainly composed of the 2011-2016 year-classes.

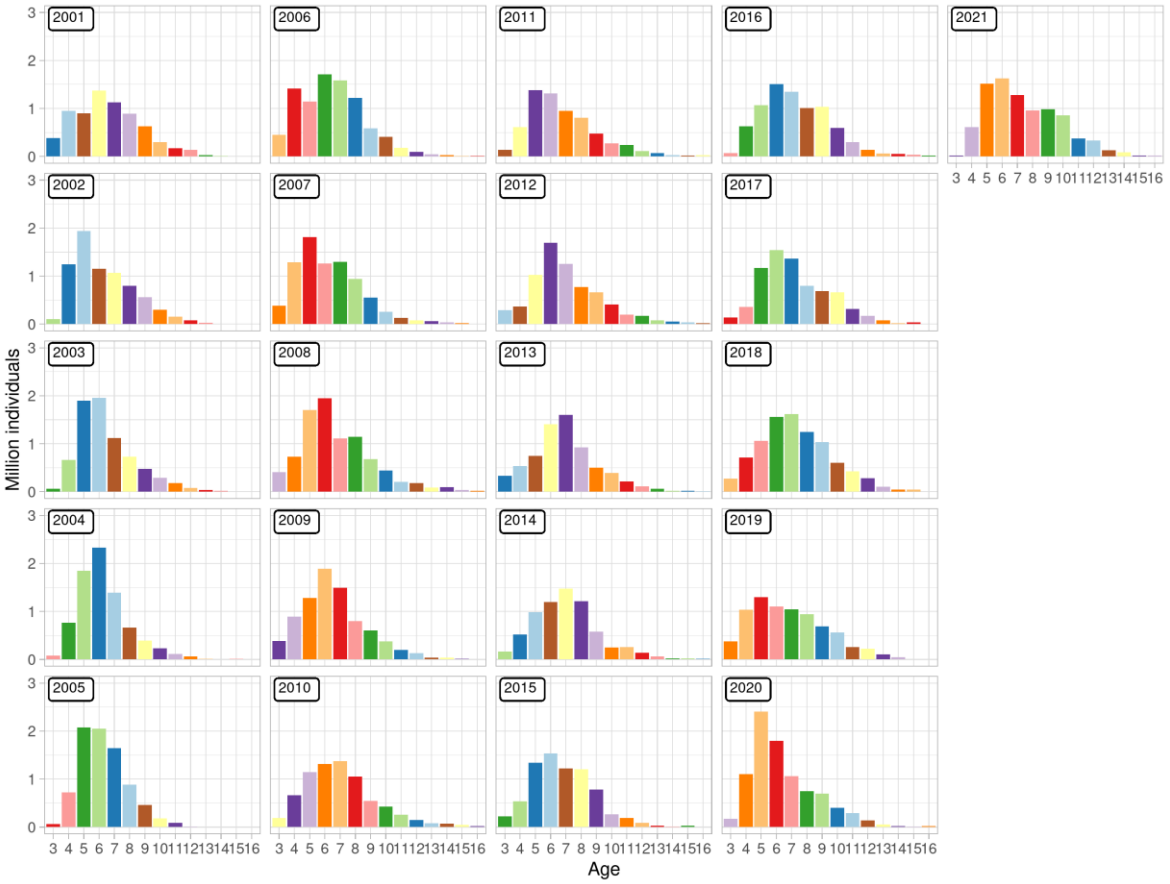

Figure 8. Plaice. Estimated age distribution of landed catch based on landings and otoliths collected from landed catch.

LENGTH DISTRIBUTION OF LANDED PLAICE

There has been a shift towards larger fish in the relative length distribution of landed catch (Figure 9). As a result, the average length in the samples taken from commercial catch has increased from 38.5 cm in 2001 to 44 cm in 2021.

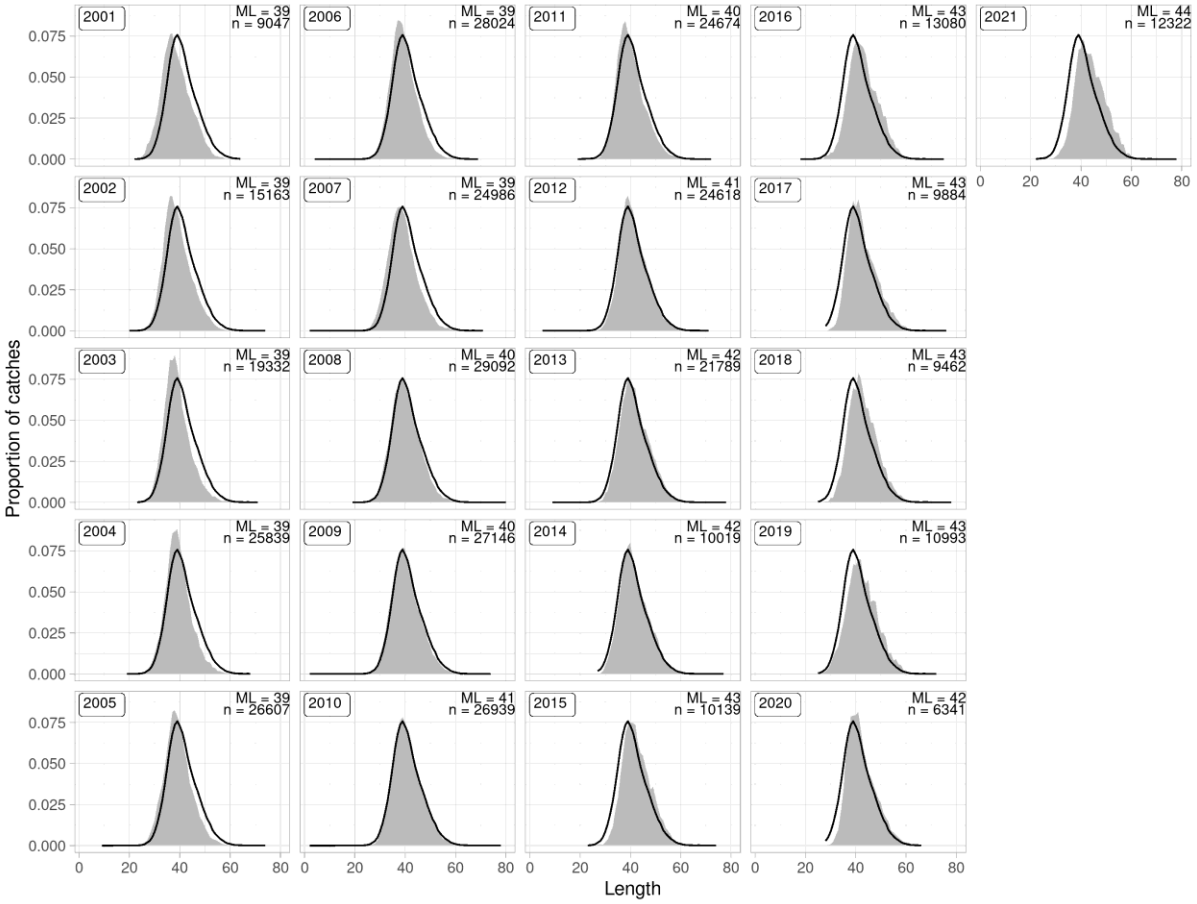

Figure 9. Plaice. Relative length distribution from landed catch in 2001-2020. The dotted line represents the mean length distribution for the period.

WEIGHT AT AGE

Mean weight at age in commercial catches is shown in Figure 10. Mean weight at age has been increasing in all age groups since 1995.

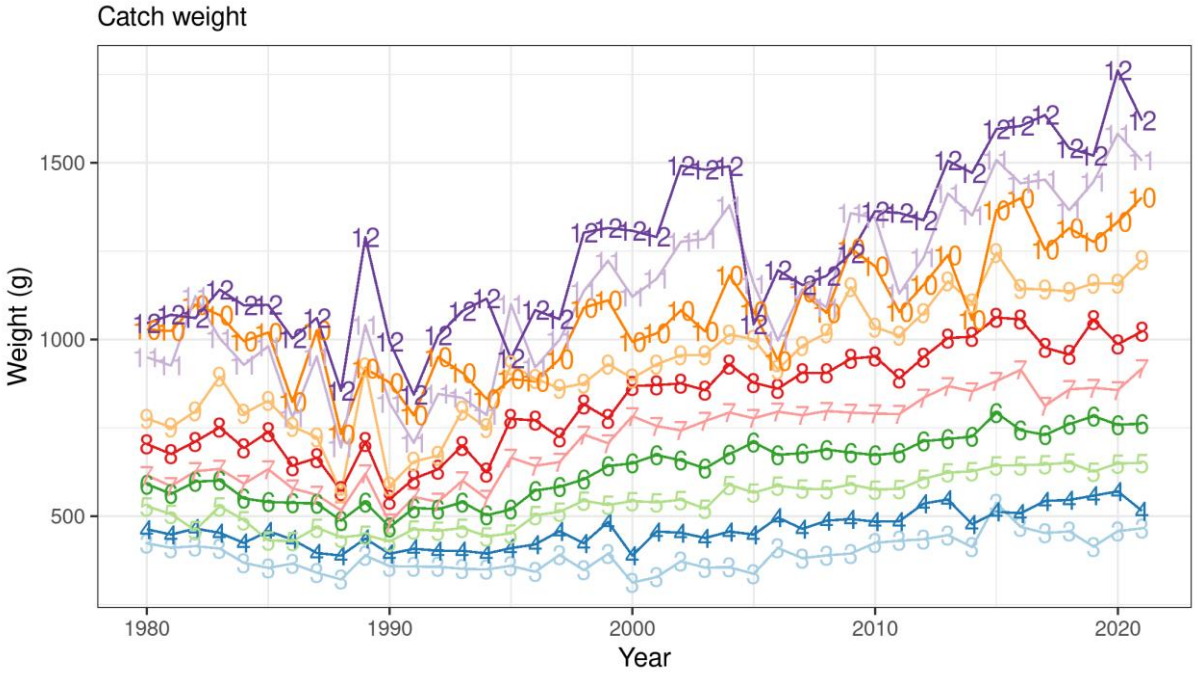

Figure 10. Plaice. Weight at age from the commercial catches.

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 11 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 12 and 13, and abundance and changes in spatial distribution in SMB in Figures 15-16 and SMH in Figures 19-20.

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. Since 2001, the biomass index increased and has been stable since with minor fluctuations. This year's spring survey biomass index is in correspondence with biomass from early 1990. The index of plaice larger than 47 cm in the spring survey also decreased to lowest levels in 1997-2002 but increased since 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. However, in the last 8 years autumn survey indices for total and harvestable biomass indices are well above the spring survey but standard deviations in the measurements are also very high indicating that they are few stations with large catch in the autumn survey.

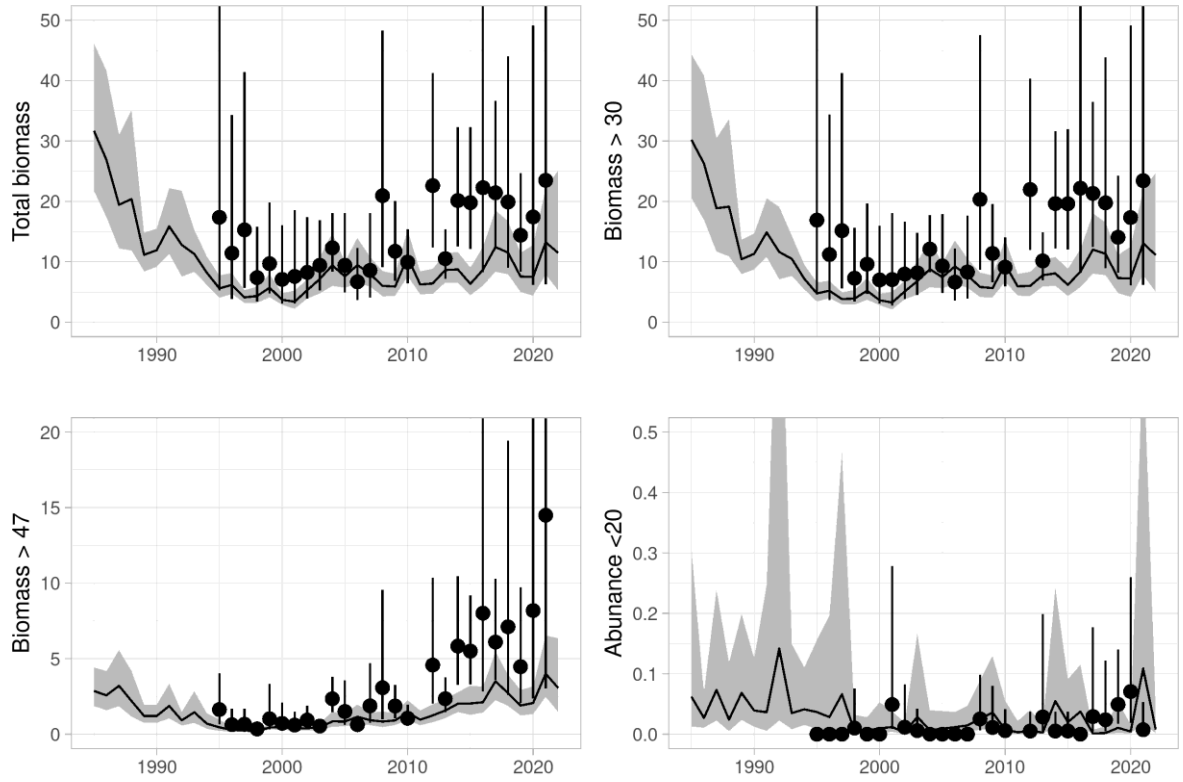

Figure 11. Plaice. Total biomass indices (upper left), harvestable biomass indices (≥30 cm, upper, right), biomass indices of larger individuals (≥47 cm, lower left) and juvenile abundance indices (≤20 cm, lower right) from the spring survey (blue) from 1985 and autumn survey (red) from 1996, along with the standard deviation.

Like in the commercial catch, there has been a shift towards larger fish in the relative length distribution from the spring survey (Figure 12). The average length of plaice has increased from 33.5 cm in 1995 to 41 cm in 2021-2022. Data from the autumn survey tells a similar story, with a marked increase in average size of plaice caught (Figure 13). In Figure 14, 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.

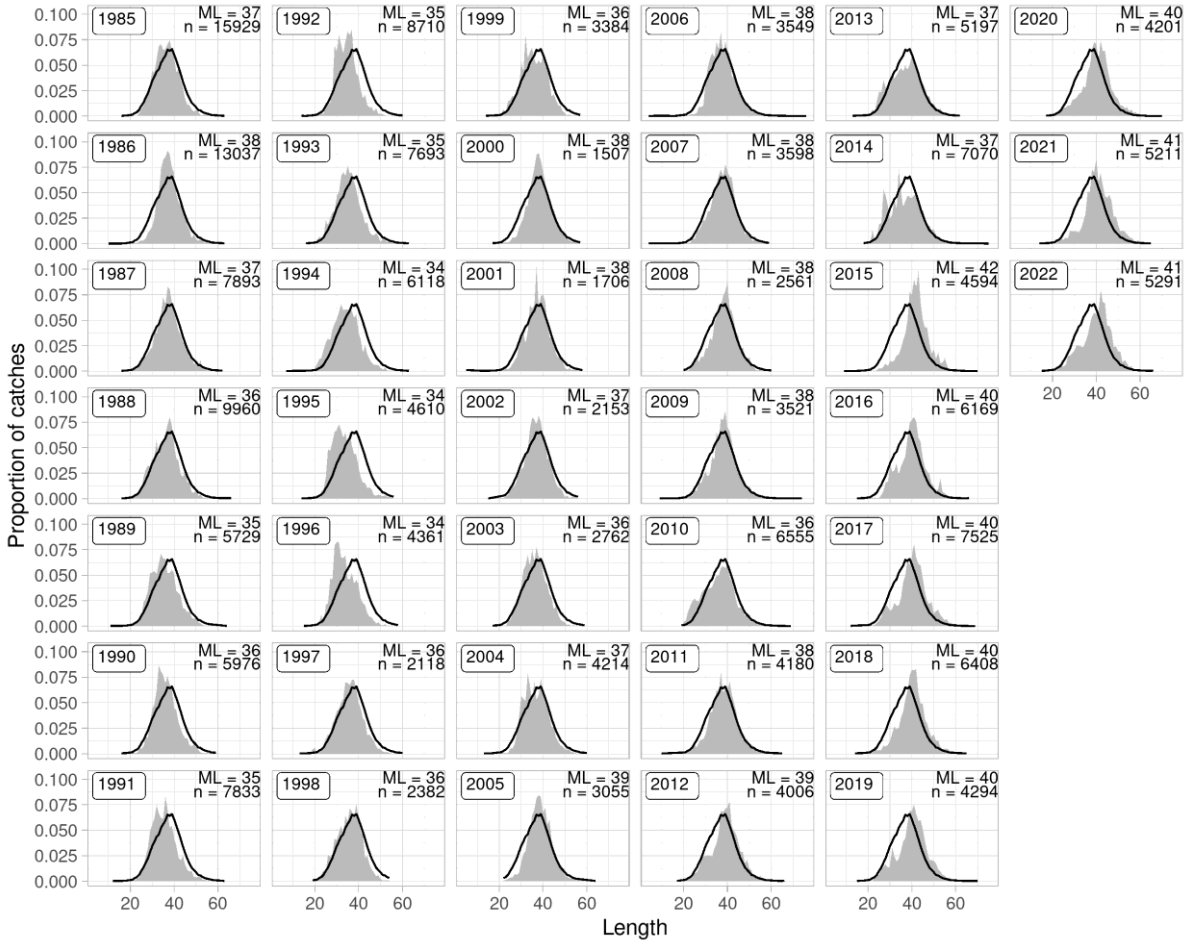

Figure 12. Plaice. Relative length-disaggregated abundance indices from the spring survey. The black line shows the mean for all years. Note different scale on y-axes.

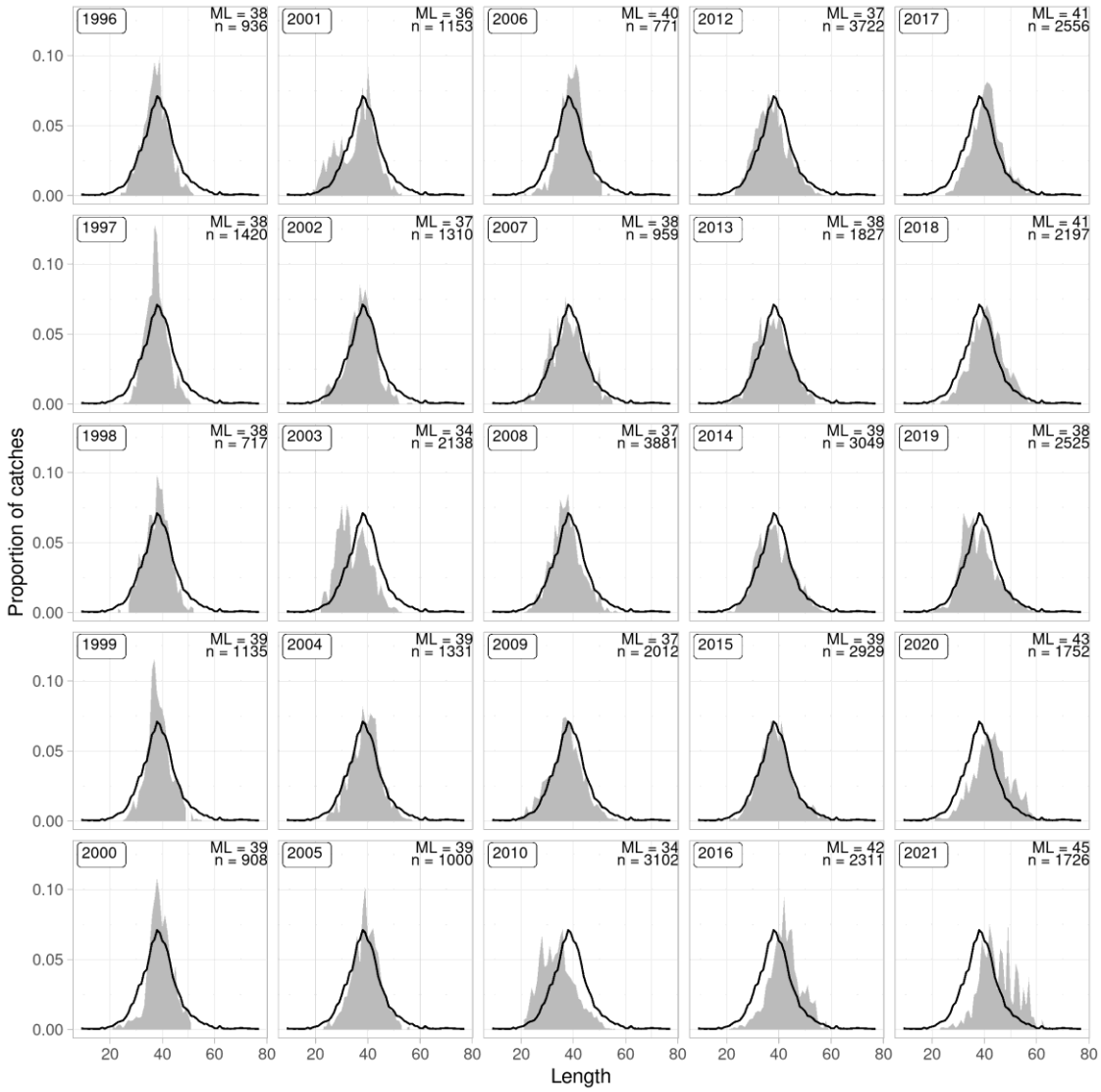

Figure 13. Plaice. Relative length-disaggregated abundance indices from the autumn survey. The black line shows the mean for all years. Note different scale on y-axes.

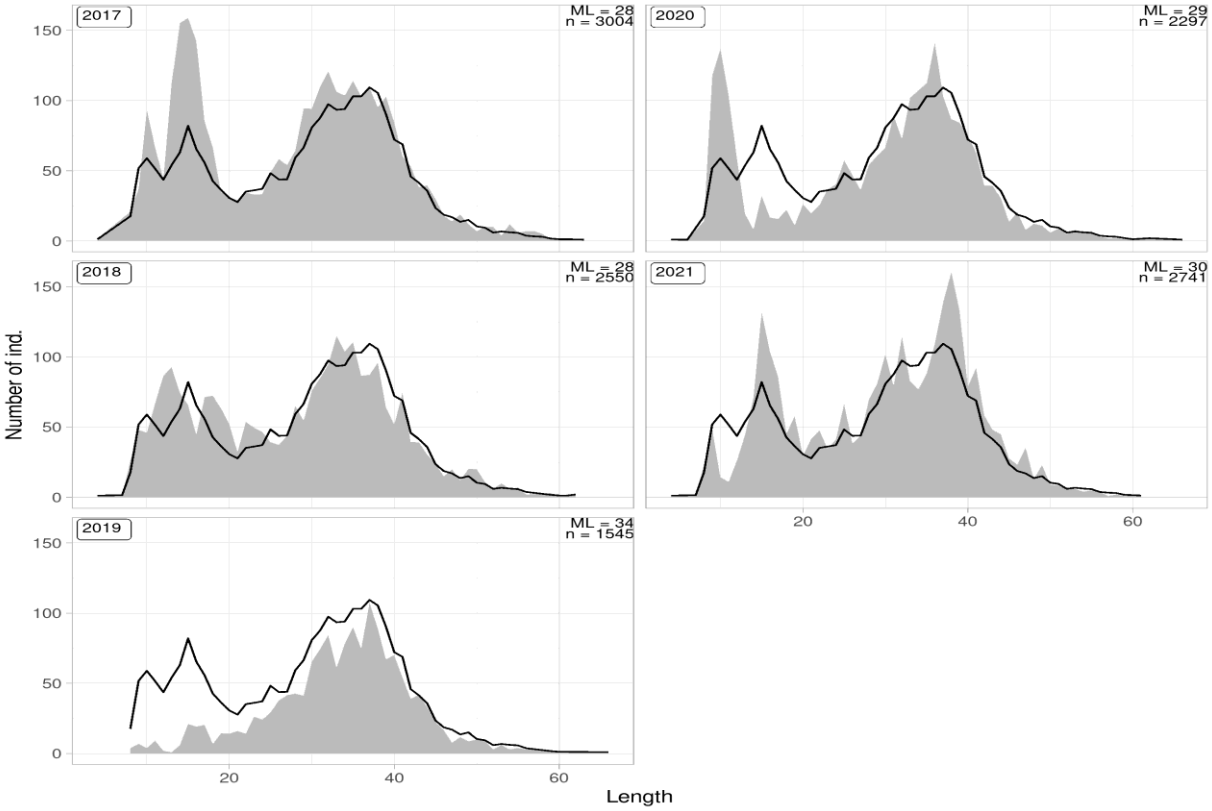

Figure 14. Plaice. Length distribution from beam trawl survey. The black line shows the mean for all years.

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 2022 (Figure 15). Spatial distribution of plaice catch in the spring survey shows some temporal changes, particularly between catches taken in the west and northwest areas (Figure 16). 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. There was also a noticeable increase in plaice abundance in south-east area in 2022.

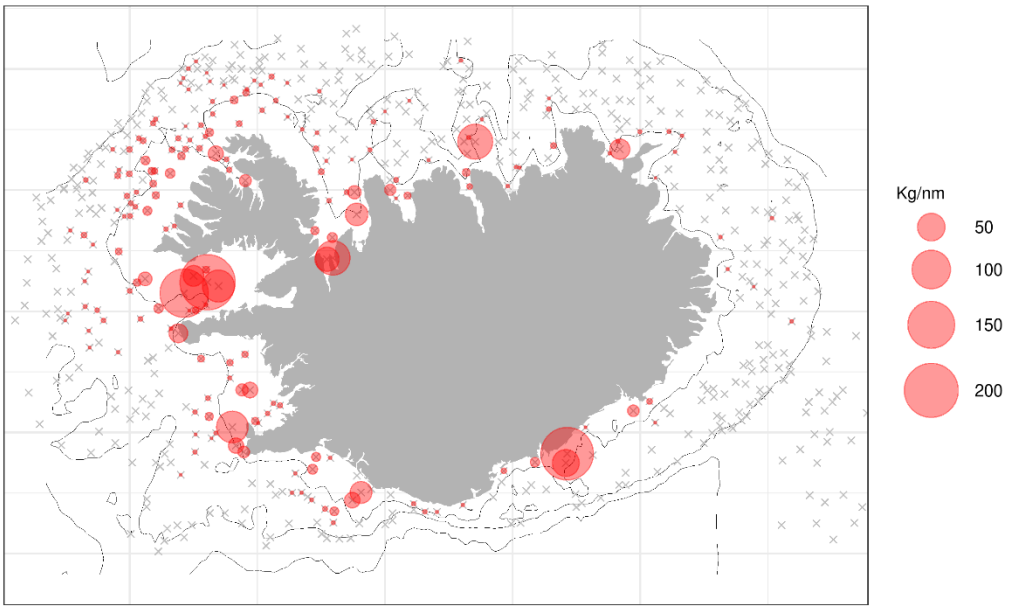

Figure 15. Plaice. Spatial distribution in the spring survey in 2022.

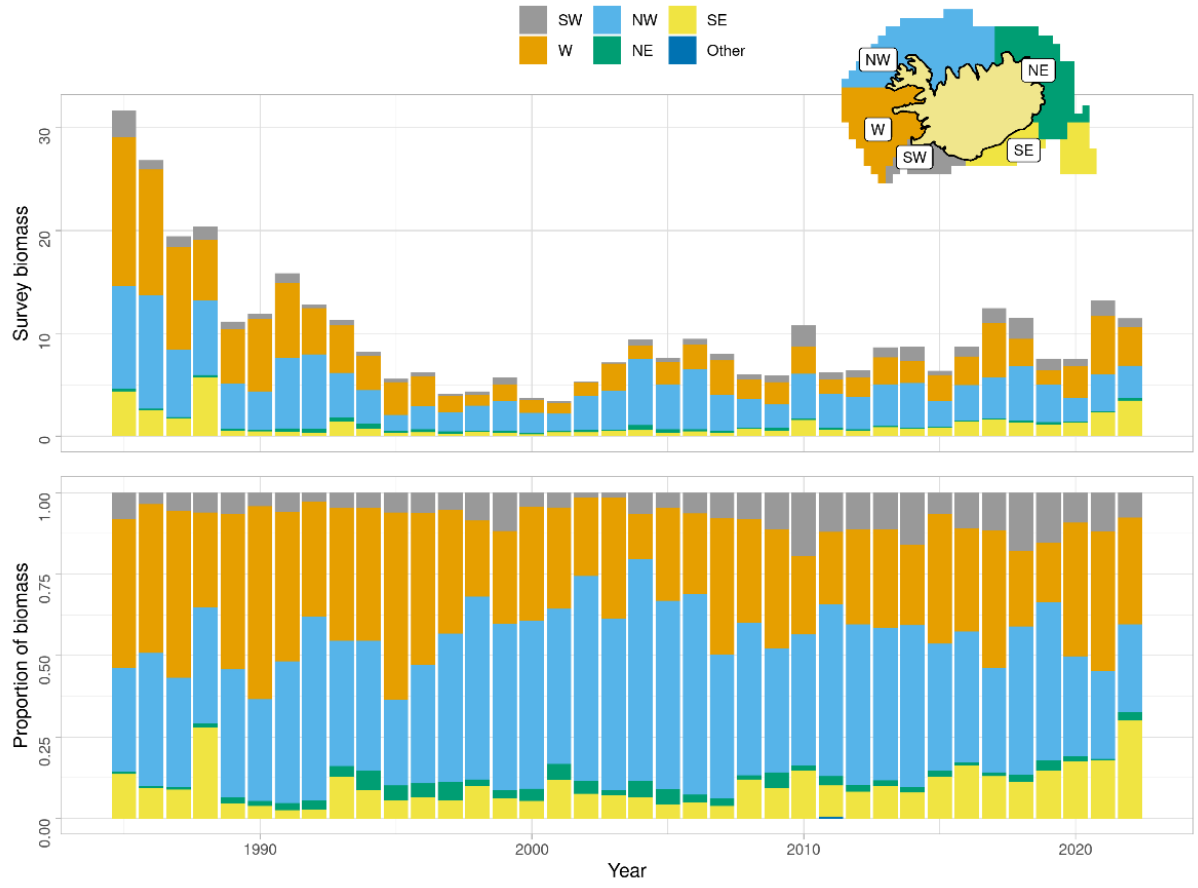

Figure 16. Plaice. Spatial distribution of biomass index from the spring survey.

Mean weight at age in SMB is shown in Figure 17. Mean weights at age from SMB are also used as mean weight at age in the spawning stock, approximated from lengths. For stock weights for age 9 are smoothed using a running 3-year average. Prior to 1985 the stock weights are assumed fixed at 1985 levels.

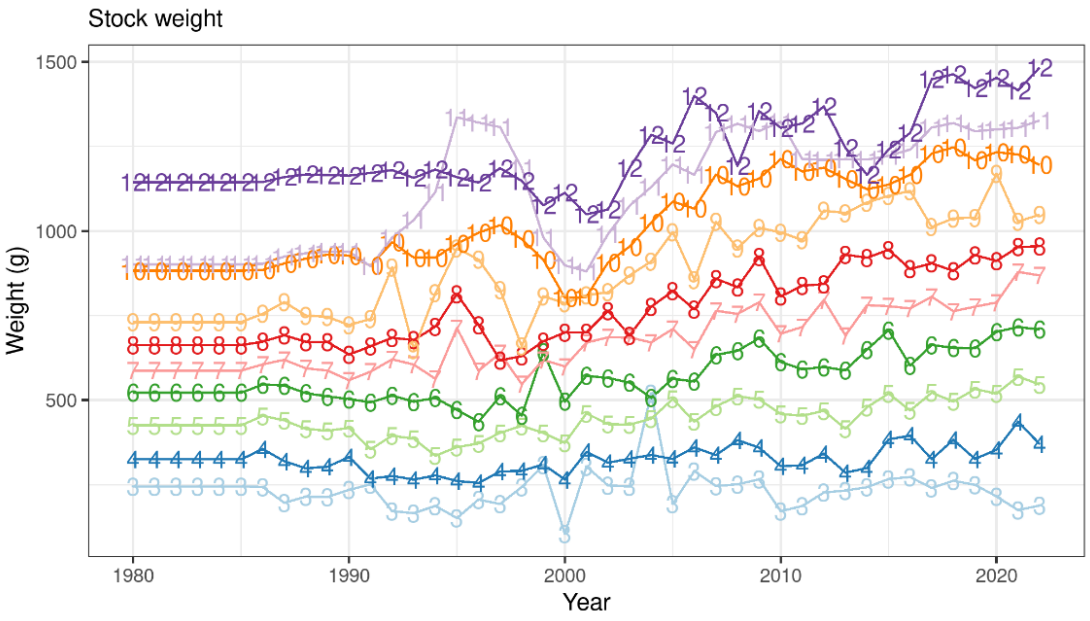

Figure 17. Plaice. Weight at age observed in the spring survey.

Maturity-at-age data from SMB are given in Figure18. Based on guidelines from PGCCDBS (ICES, 2017) it was decided to use mature females as the basis for maturity at age. Prior to 1985 the proportion mature is assumed fixed at 1985 levels. Maturity at age is estimated from yearly maturity at length ogives estimated using logistic regression treating individuals as fixed effects. Maturity at age was smoothed with a 3-year running average.

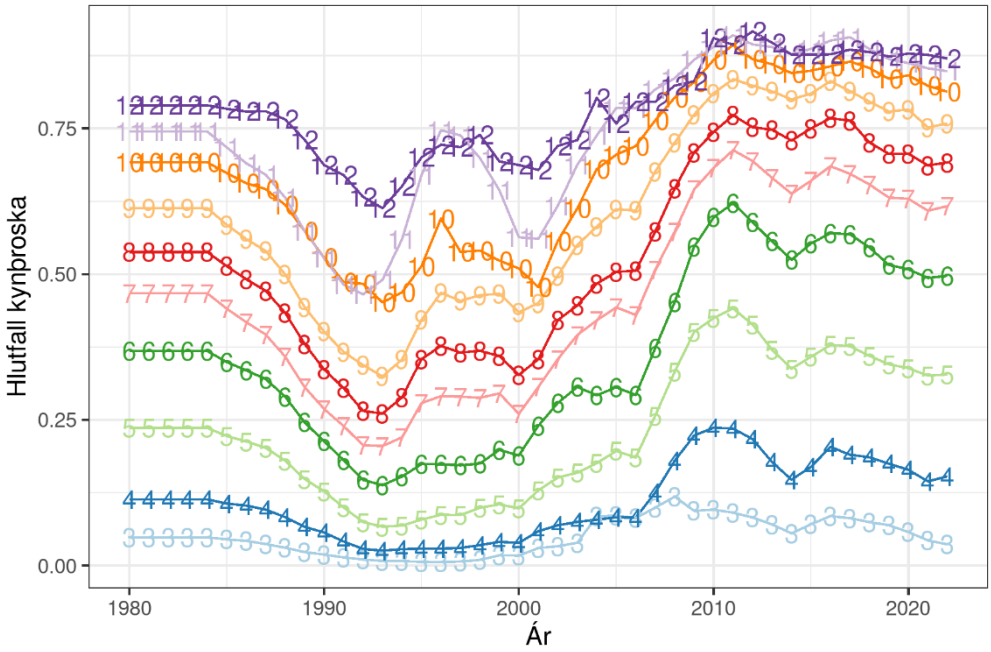

Figure 18. Plaice. Proportion mature females at age from SMB.

Plaice was mainly caught on species main feeding grounds in the northwest of the country in the autumn survey 2020 (Figure 19). 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 20). However, in the last two years, almost 90% of the plaice was caught in the NW area.

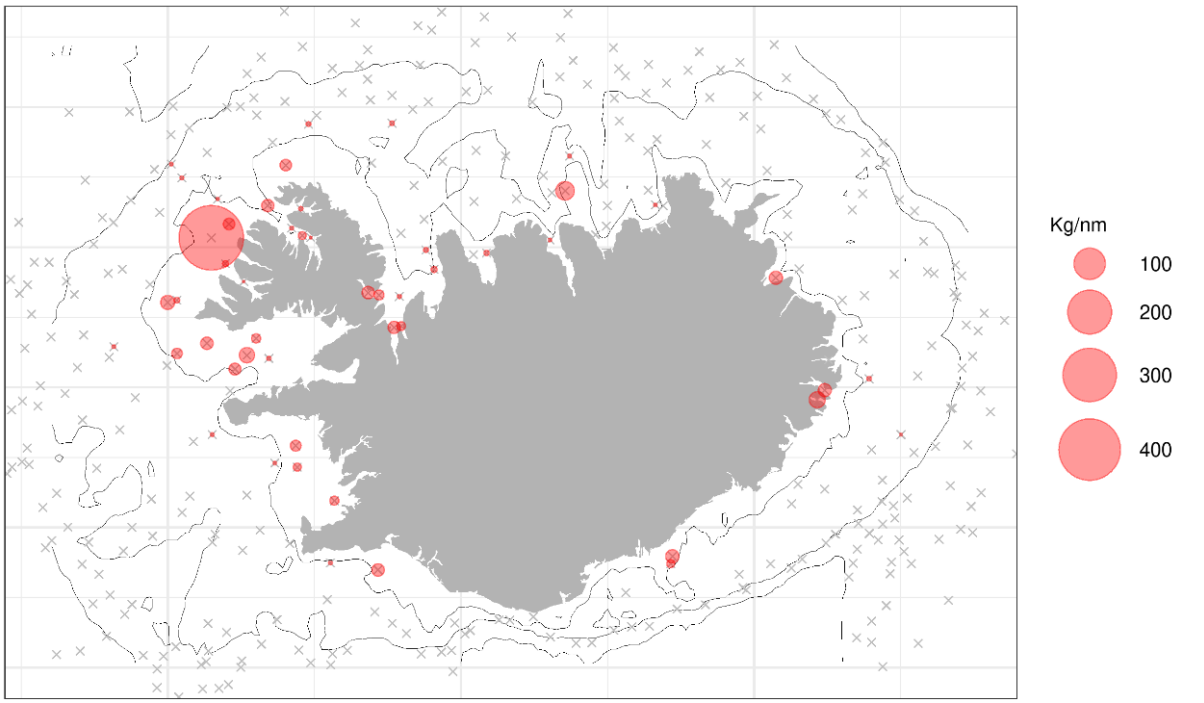

Figure 19. Plaice. Spatial distribution in the autumn survey in 2021.

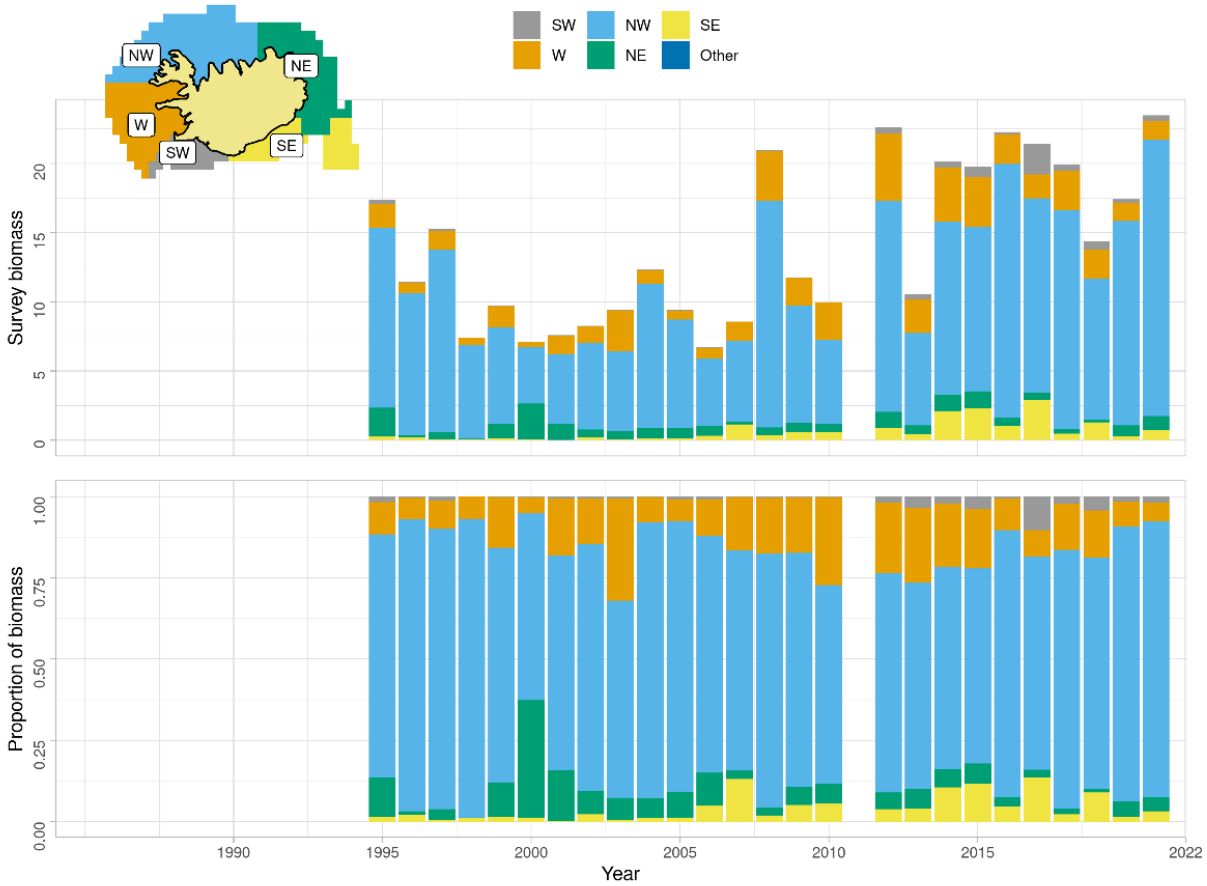

Figure 20. Plaice. Spatial distribution of biomass index from the autumn survey.

Figures 21 and 22 show spatial distribution of plaice in the beam trawl survey, which is usually conducted in July-August at very shallow depth (10-30 m).

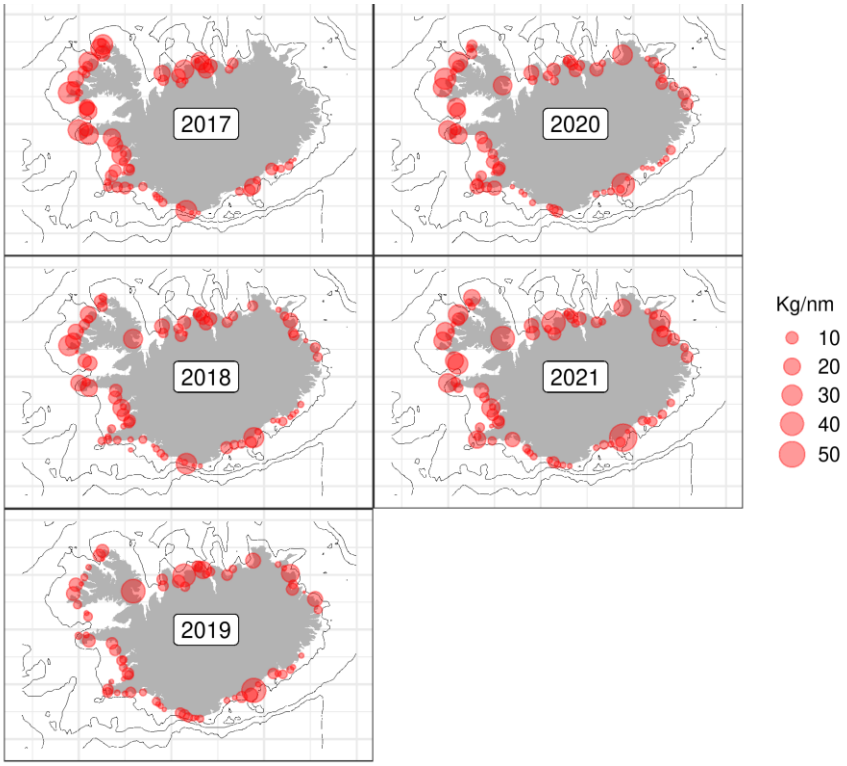

Figure 21. Plaice. Spatial distribution in the beam trawl survey since 2017. The NE area was not sampled in 2017.

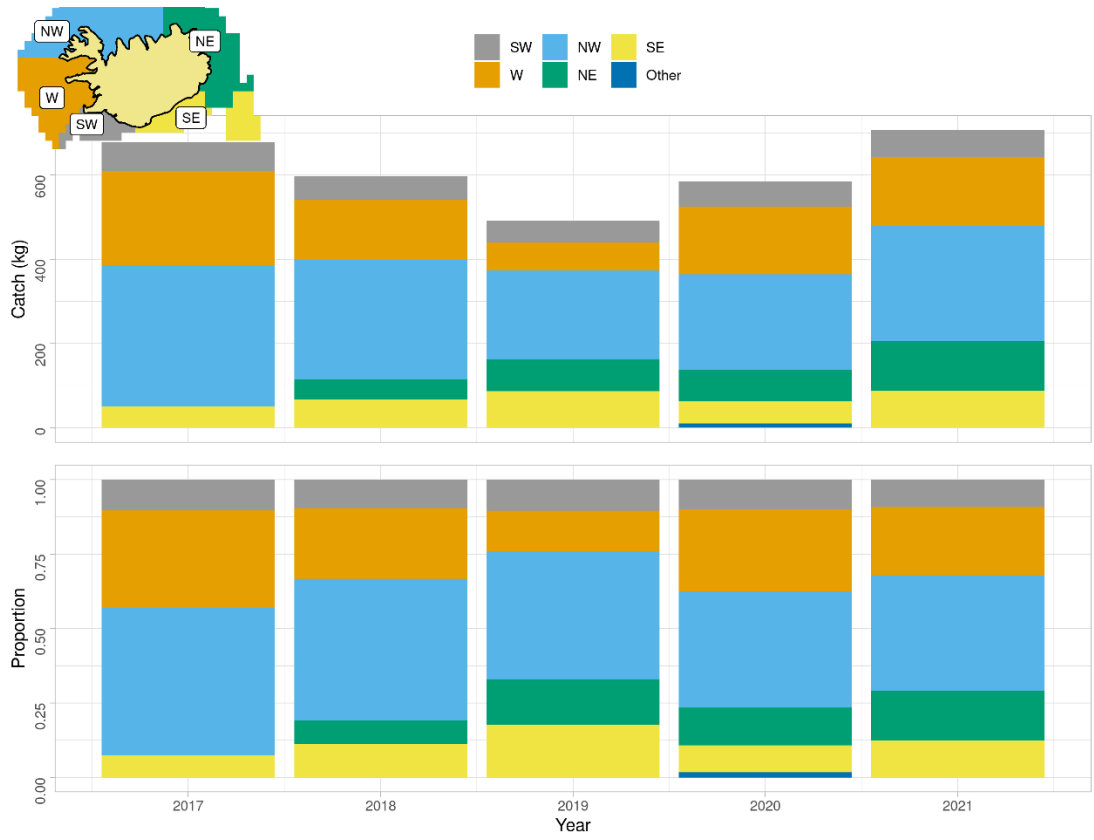

Figure 22. Plaice. Spatial distribution in the beam trawl survey since 2017. The NE area was not sampled in 2017.

STOCK ASSESSMENT

Assessment on plaice in Icelandic waters using SAM

Plaice in Iceland grounds is new to ICES where it became a part of the ICES assessment process after an MoU between Iceland and ICES was signed on December 1st, 2019.

During the harvest control rule evaluation in April 2022, a SAM model (State-space stock assessment model) was agreed upon for use in the assessment (ICES, 2022a; ICES, 2022b).

The new assessment model is a statistical catch at age model based on:

- commercial catch-at-age data from 1979 onwards
- the Icelandic spring groundfish survey from 1985
- Recruitment estimated at age 3 every year.

Model setup and settings are described in the Stock Annex (ICES, 2022c). The maximum age of the model is 12, which is considered a plus group.

For assessment and advisory purpose, the natural mortality is set to 0.15 for all age groups. During the workshop, a wide range of estimates for natural mortality were tested and none showed a significant improvement in terms of model fit. It was therefore decided to use a M of 0.15.

Figure 23. Plaice. Estimated numbers of 3–12-year-old fish in the commercial catch (1980-2021) and age-disaggregated survey indices from the spring survey (1991-2022). Input data for the stock assessment.

MODEL FIT

The model fit to survey indices and catch at age data are shown in Figures 24 and 25. Generally, except for the youngest age classes, the SAM model follows the catch-at-age and spring survey data, which are in good agreeance.

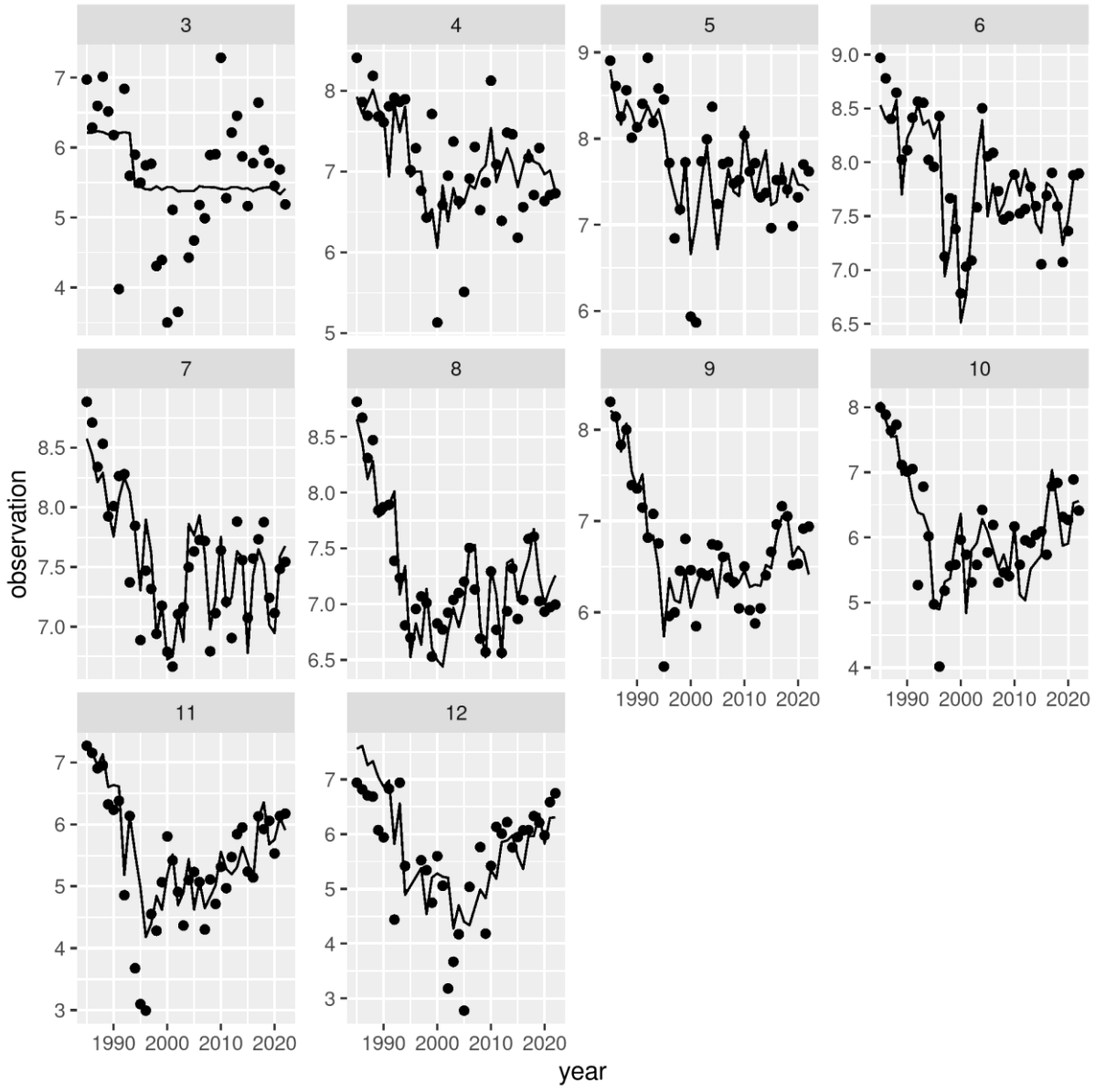

Figure 24. Plaice. Illustration of the SAM model fit to the survey data by age. Points indicate the log observation while the solid lines the model fit.

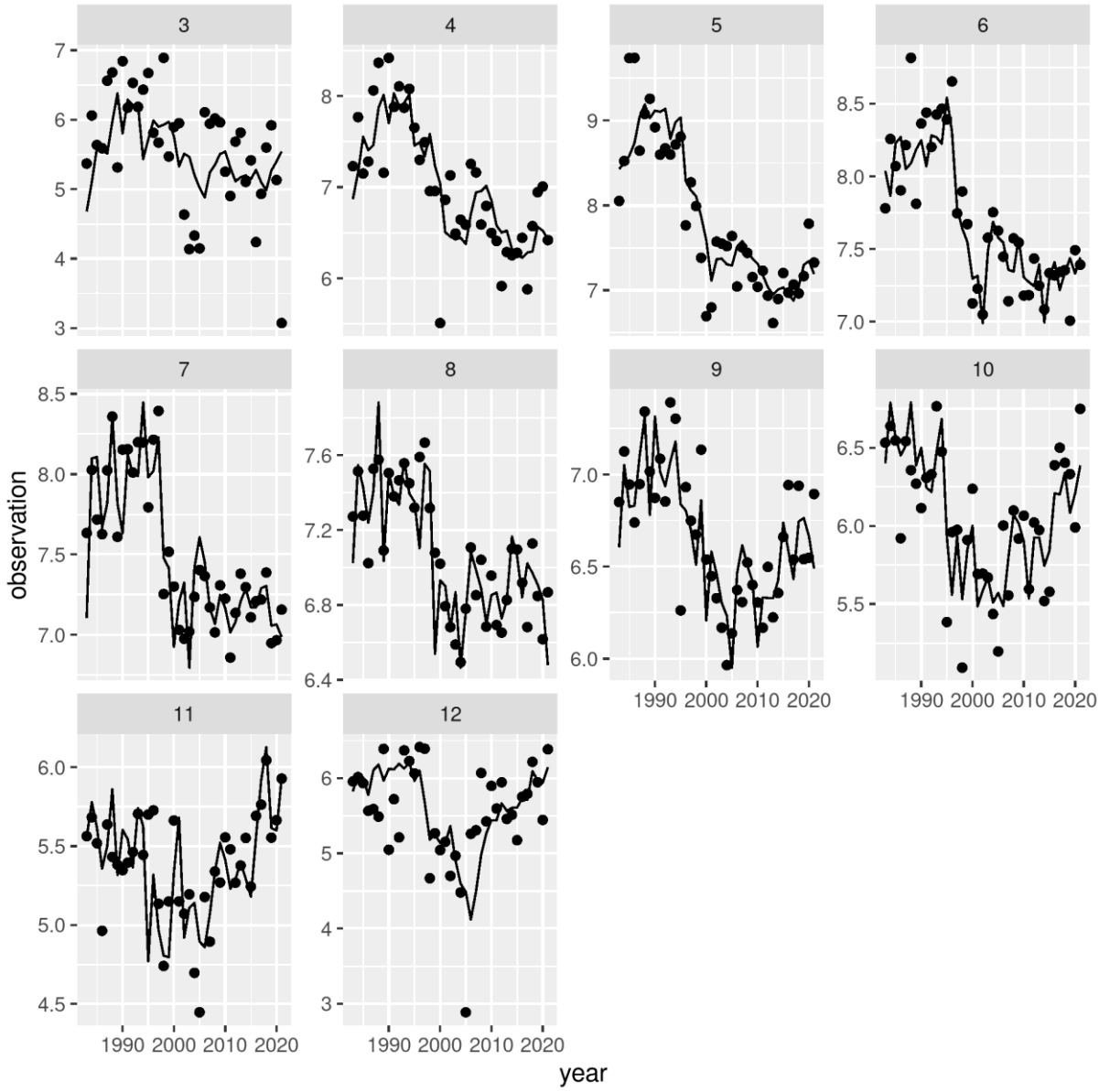

Figure 25. Plaice. Illustration of the SAM model fit to the catch data by age. Points indicate the log observation while the solid lines the model fit.

MODEL RESULTS

Model results have shown spawning stock biomass gradually decline prior to 2000, historical low was reached then (Figure 26). Steep increase followed in SSB in period 2001-2015 which has levelled in most recent years. Excluding biomass values earlier than 1985, which are highly uncertain because SMB data begins in 1985, current biomass levels are at historical highest. Fishing mortality decreased gradually after 1999 and remained stable in most recent years. Recruitment displays two productivity regimes, high in the 1980s with rapid drop in mid-1990s and stable period since. Therefore, with stable recruitment and moderate fishing levels spawning stock biomass is expected to remain at current levels.

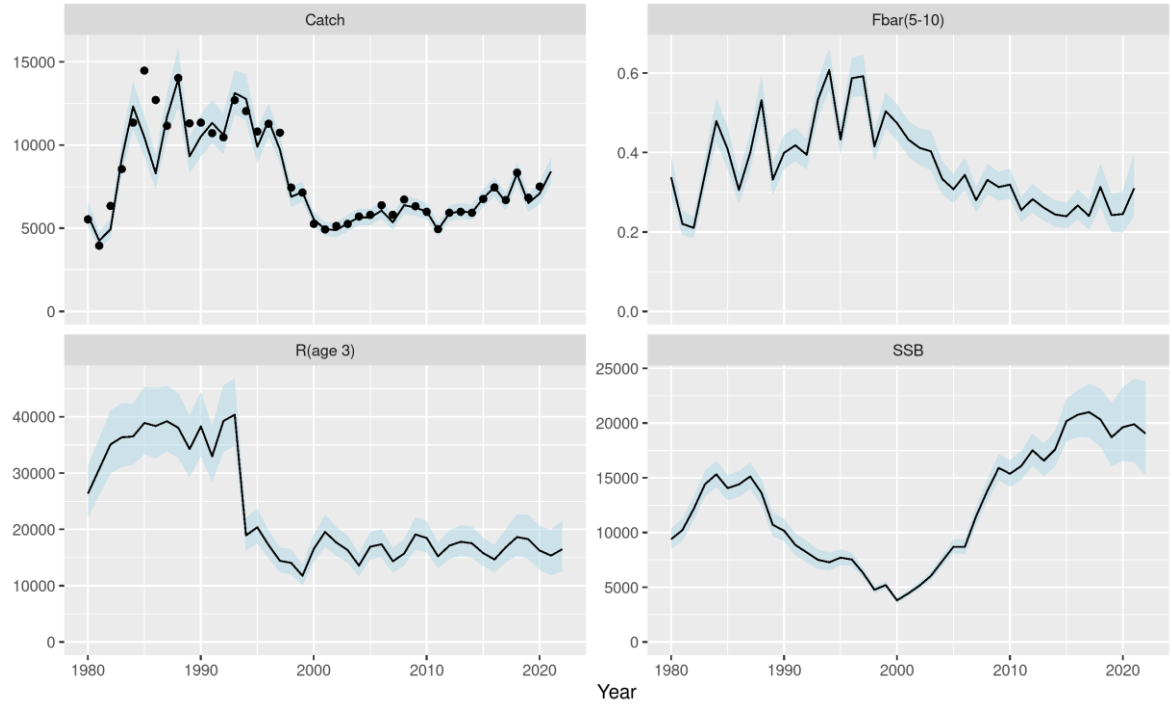

Figure 26. Plaice. Summary from the assessment 2022. Estimates of catch, fishing mortality (Fbar5-10), recruitment (age 3) and spawning stock (SSB) are shown. Black line represents the point estimates as the blue ribbon the 95% confidence intervals.

RETROSPECTIVE ANALYSIS

The results of an analytical retrospective analysis indicate a generally consistent model results over the 5-year peel (Figure 27). Mohn's rho was estimated to be -0.0773 for SSB, 0.0675 for F, and -0.0231 for recruitment.

The proposed model had low Mohn's ρ statistic values for spawning stock biomass, fishing mortality, and recruitment. Analytical retrospective plots do not indicate any substantial deviations in assessment (Figure 27). These Mohn's ρ values are well within the acceptable ranges (Carvalho et al. 2021).

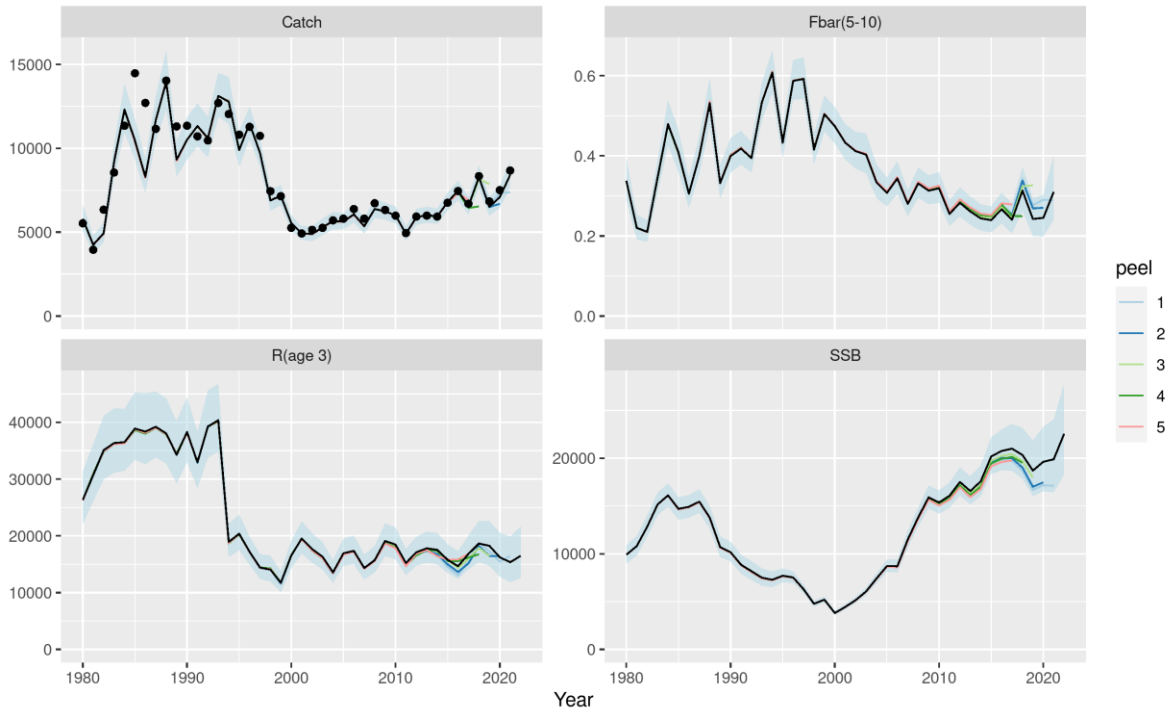

Figure 27. Plaice. Analytical retrospective estimates illustrating stability in model estimates over a 5-year 'peel' in data. Results of catch, fishing mortality (Fbar5-10), recruitment (age 3) and spawning stock (SSB) are shown.

Observation and process log(N) and log(F) residuals show no concerning patterns, shown in Figures 28 and 29, respectively.

Figure 30 shows the estimated model parameters. Observation variances are lowest for the spring survey and commercial catches for ages 5 to 8 and 7 to 8 respectively, with the highest variances at either ends of the age range. Survey variances are in general higher than that of the commercial catches. Strong positive correlations were estimated between ages for the commercial catches, less for survey catches. Process variances were fixed across all ages for both log(N) and log(F), with populations variances estimated at 0.06.

Survey catchability showed an increasing trend with age, peaking at the age of 10.

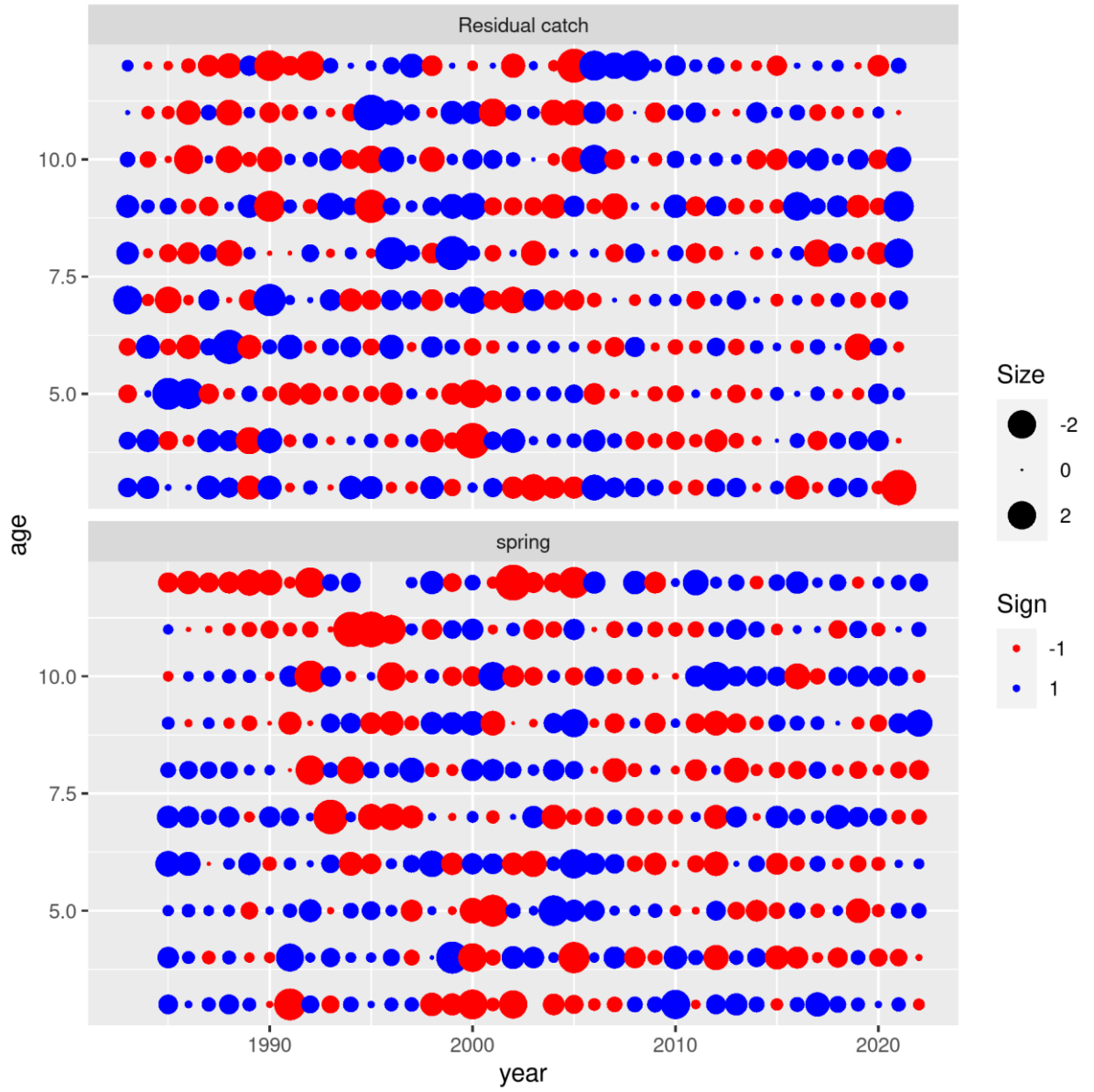

Figure 28. Plaice. Residuals of the model fit to spring survey indices and catch data by age. Red circles indicate where the model estimates are lower than the observed while blue indicate model estimates lower that the observed.

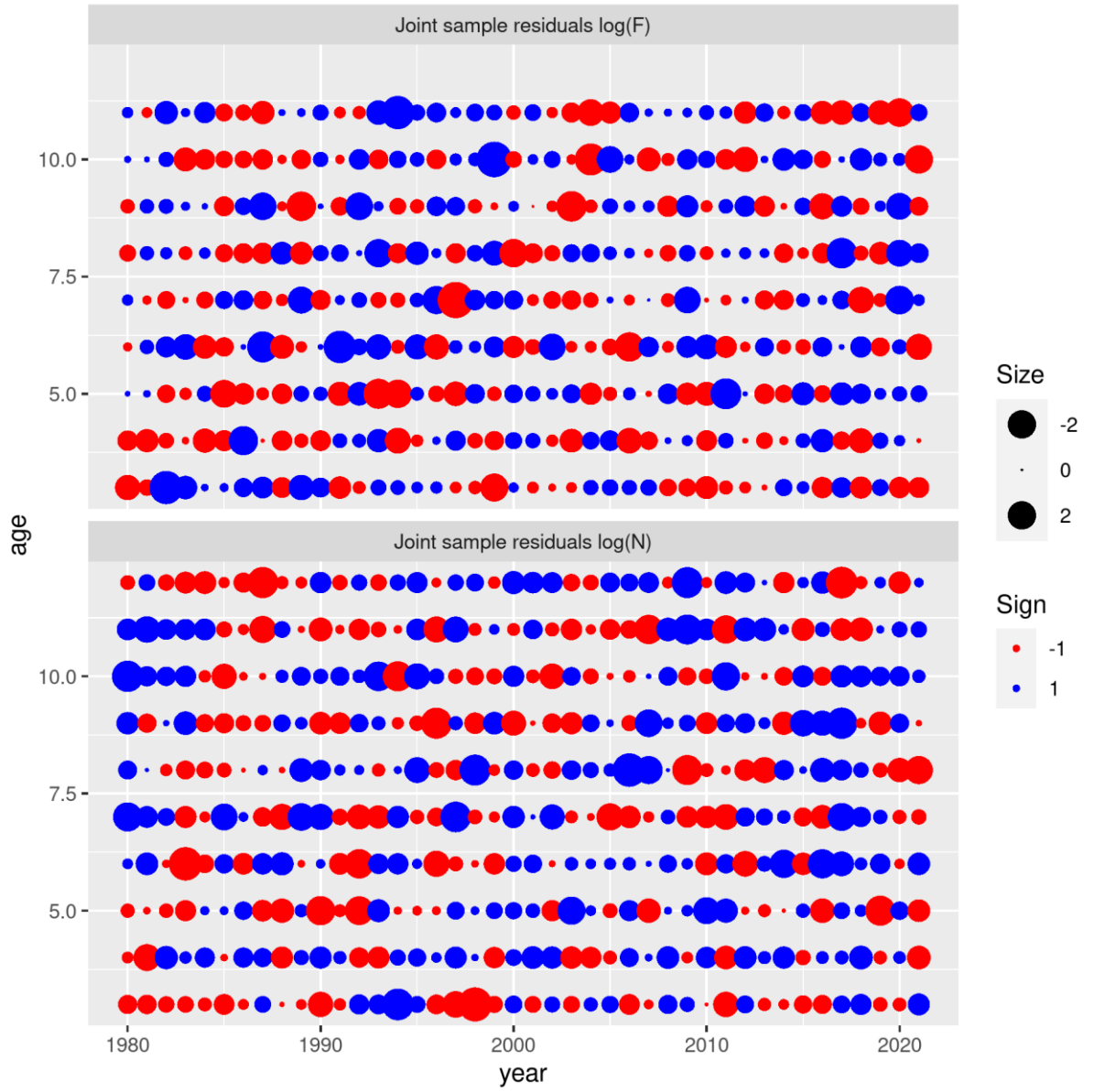

Figure 29. Plaice. Process residuals from the assessment model.

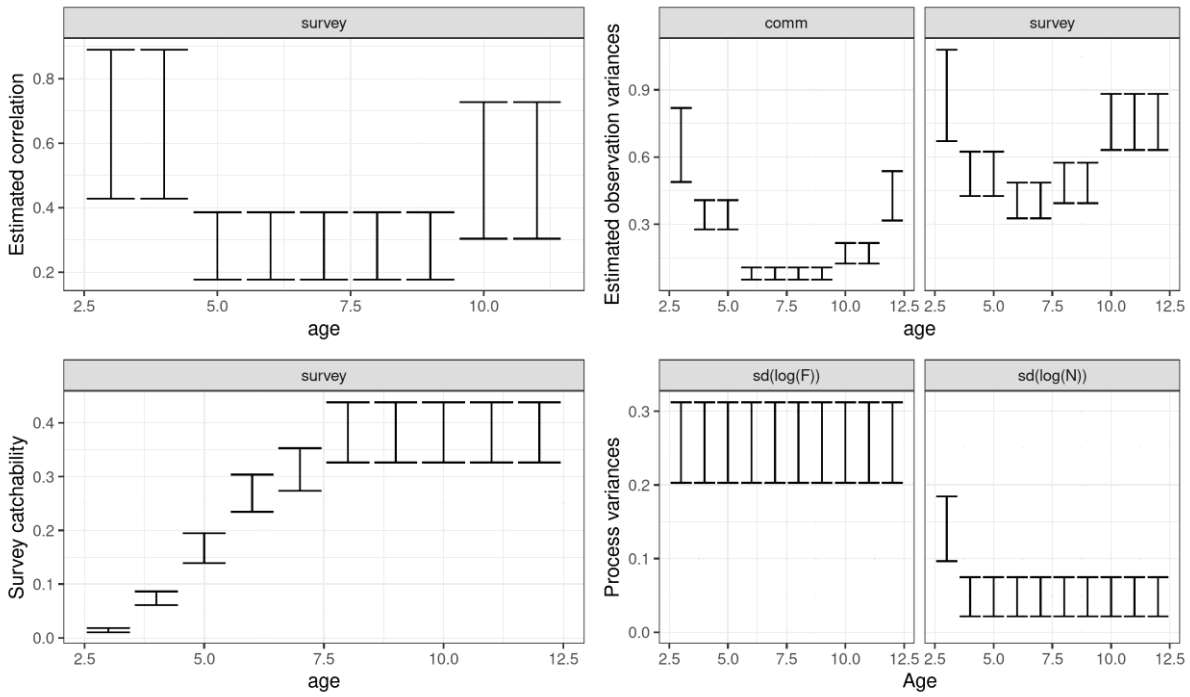

Figure 30. Plaice. Illustration of estimated model parameters.

Table 3. Plaice. Assessment summary. Weights are in tonnes. High and low refer to 95% confidence intervals.

Year	Recruitment (Age 3)			SSB			Landings	F (Ages 5-10)		
	Median	*High*	*Low*	*Median*	*High*	*Low*		*Median*	*High*	*Low*
1980	26339	31388	22103	9390	10373	8500	5530	0.34	0.39	0.29
1981	30714	36128	26111	10227	11283	9271	3951	0.22	0.25	0.191
1982	35091	41132	29937	12165	13297	11130	6340	0.21	0.24	0.185
1983	36352	42452	31128	14416	15617	13307	8553	0.35	0.39	0.31
1984	36502	42376	31443	15323	16560	14178	11342	0.48	0.54	0.43
1985	38904	45308	33406	14061	15256	12959	14473	0.41	0.46	0.36
1986	38365	45132	32613	14399	15618	13274	12705	0.31	0.35	0.27
1987	39217	45447	33840	15129	16393	13963	11157	0.40	0.45	0.36
1988	38049	44206	32749	13626	14849	12504	14032	0.53	0.59	0.48
1989	34276	40182	29239	10702	11831	9681	11307	0.33	0.38	0.29
1990	38297	44443	33002	10172	11255	9193	11343	0.40	0.44	0.36
1991	32971	38302	28383	8864	9909	7929	10713	0.42	0.46	0.38
1992	39256	45620	33780	8184	9218	7266	10464	0.39	0.43	0.36
1993	40369	46775	34840	7505	8461	6657	12702	0.53	0.58	0.49
1994	18934	22074	16241	7286	8158	6507	12040	0.61	0.66	0.56
1995	20374	23744	17482	7708	8463	7020	10813	0.43	0.47	0.39
1996	17204	19865	14900	7532	8167	6946	11281	0.59	0.64	0.54
1997	14424	16790	12392	6300	6768	5865	10743	0.59	0.65	0.54
1998	14046	16497	11959	4771	5106	4459	7443	0.42	0.46	0.38
1999	11756	13767	10040	5202	5524	4899	7145	0.50	0.55	0.46

Year	Recruitment (Age 3)			SSB			Landings	F (Ages 5-10)		
	Median	*High*	*Low*	*Median*	*High*	*Low*		*Median*	*High*	*Low*
2000	16523	19141	14264	3804	4063	3562	5259	0.47	0.52	0.43
2001	19537	22588	16899	4439	4717	4178	4925	0.43	0.48	0.39
2002	17666	20439	15270	5156	5495	4838	5143	0.41	0.46	0.37
2003	16323	18896	14101	6039	6454	5651	5258	0.40	0.46	0.36
2004	13565	15722	11705	7384	7910	6893	5707	0.33	0.38	0.29
2005	16921	19514	14672	8702	9361	8090	5802	0.31	0.35	0.27
2006	17360	20053	15028	8679	9383	8028	6382	0.34	0.39	0.31
2007	14334	16679	12319	11481	12406	10626	5810	0.28	0.31	0.25
2008	15713	18220	13551	13825	14870	12852	6725	0.33	0.37	0.30
2009	19104	22196	16443	15911	17146	14764	6323	0.31	0.35	0.28
2010	18461	21474	15870	15373	16647	14196	5984	0.32	0.36	0.28
2011	15206	17649	13102	16080	17454	14814	4943	0.25	0.29	0.23
2012	17112	19858	14746	17520	19041	16120	5927	0.28	0.32	0.25
2013	17803	20728	15290	16567	18103	15162	5988	0.26	0.30	0.23
2014	17531	20506	14987	17591	19280	16049	5927	0.24	0.28	0.21
2015	15784	18495	13471	20183	22193	18356	6754	0.24	0.27	0.21
2016	14651	17301	12408	20764	23016	18732	7451	0.27	0.31	0.23
2017	16829	20052	14124	21006	23600	18697	6694	0.24	0.28	0.21
2018	18646	22615	15373	20343	23176	17856	8341	0.31	0.37	0.26
2019	18253	22616	14732	18710	21832	16035	6835	0.24	0.29	0.199
2020	16240	20569	12822	19632	23300	16541	7506	0.25	0.30	0.198
2021	15344	19893	11835	19893	24063	16447	8677	0.31	0.40	0.24
2022	16472	21625	12548	19051	23837	15226				

REFERENCE POINTS

As part of the WKICEMP 2022, HCR evaluations requested by Iceland the following reference points were defined for the stock.

Framework	Reference points	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	12 400	B_{pa}	ICES (2022b)
	F_{MSY}	0.41	Fishing mortality that leads to MSY. Estimated using stochastic simulations.	
Precautionary approach	B_{lim}	10 000	Lowest SSB (1990) where large recruitment was observed.	
	B_{pa}	12 400	$B_{lim} \times e^{1.645 * \sigma B}$, using $\sigma_B = 0.12$	
	F_{lim}	0.57	Fishing mortality that in stochastic equilibrium will result in median SSB at B_{lim}.	
	F_{pa}	0.46	F_{p05}, maximum F at which the probability of SSB falling below B_{lim} is <5%	
Management plan	MGT $B_{trigger}$	12 400	MSY $B_{trigger}$	
	F_{MGT}	0.30	From the management plan.	

The management plan proposed by Iceland was:

The proposed HCR for the plaice fishery in Iceland, which sets a TAC for the fishing year y/y+1 (1 September of year y to 31 August of year y+1) based on a fishing mortality F_{mgt} of 0.3 applied to ages 5 to 10 modified by the ratio SSB_y/MGT $B_{trigger}$ when SSB_y < MGT $B_{trigger}$, maintains a high yield while being precautionary as it results in lower than 5% probability of SSB < B_{lim} in the medium and long term. WKICEMSE 2022 (ICES, 2022b) concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

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. 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). One reason for this practice was that no formal harvest rule existed for this stock. The landings have been fluctuating between the over- or undershoot the set TAC and this is related to the management system that allows for transfers of quota share between fishing years and conversion of TAC from one species to another (species transformation). The effect of these species transformations and quota transfers is illustrated in Figure 31. Regulations regarding protection of spawning plaice are also in place in Iceland, where specific spawning grounds in the west and southwest of Iceland are closed to fishing during spawning period in April.

Figure 31 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 trough plaice has been low, except for 2020/2021 when around 1400 t were transferred from quotas of other species to plaice. Net transfer of plaice quota between fishing years has varied between years, and ranges from 10 to -12%.

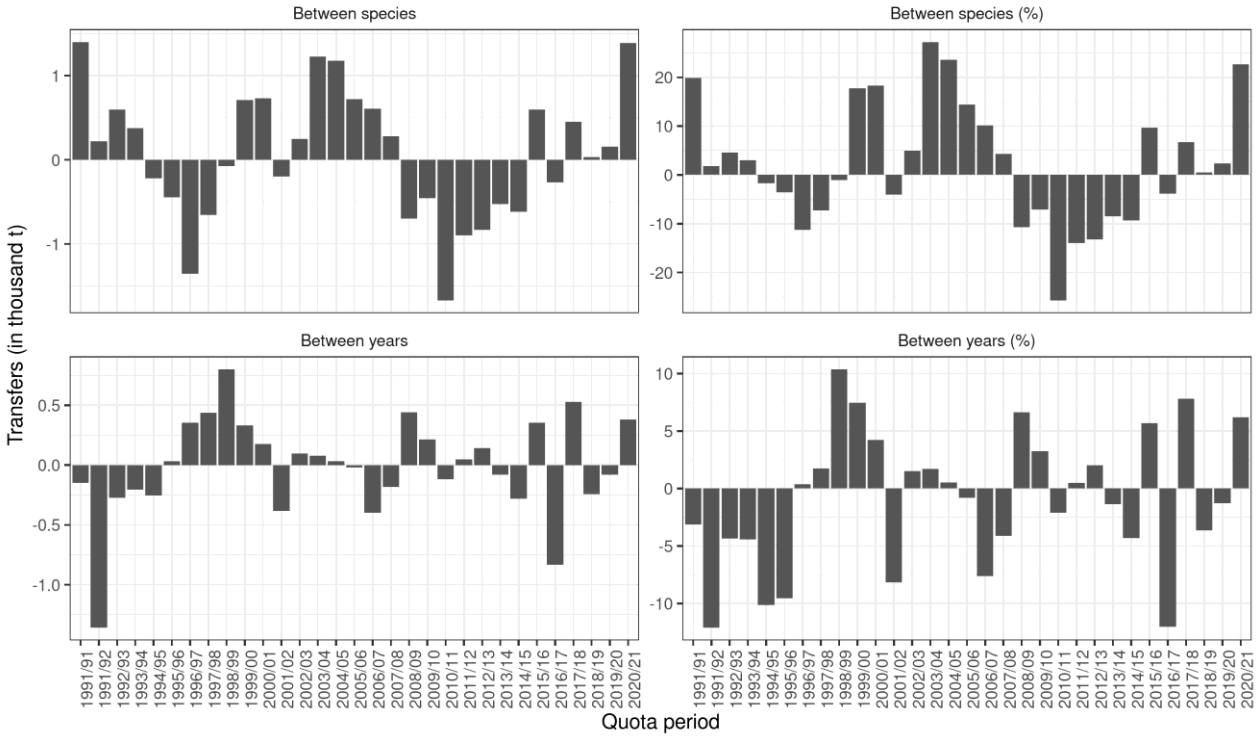

Figure 31. Plaice. Net transfers of quota to and from plaice in the Icelandic ITQ system by quota year. Between species (upper): Positive values indicate a transfer of other species to plaice, but negative values indicate a transfer of plaice quota to other species. Between years (lower): Net transfer of quota for a given fishing year.

Table 4. Plaice. Recommended TAC, National TAC set by the Ministry, and landings (tonnes).

FISHING YEAR	REC. TAC	NATIONAL TAC	CATCH
1991/92	10 000	11 000	10 200
1992/93	10 000	13 000	12 400
1993/94	10 000	13 000	12 300
1994/95	10 000	13 000	11 100
1995/96	10 000	13 000	11 000
1996/97	10 000	12 000	10 345
1997/98	9000	9000	8083
1998/99	7000	7000	7452
1999/00	4000	4000	4907
2000/01	4000	4000	4921
2001/02	4000	5000	4402
2002/03	4000	5000	5402
2003/04	4000	4500	5844
2004/05	4000	5000	6184
2005/06	4000	5000	5647
2006/07	5000	6000	6149
2007/08	5000	6500	6620
2008/09	5000	6500	6361
2009/10	5000	6500	6389
2010/11	6500	6500	4843
2011/12	6500	6500	5822
2012/13	6500	6500	5932
2013/14	6500	6500	6030
2014/15	7000	7000	6237
2015/16	6500	6500	7619
2016/17	7330	7330	6369
2017/18	7103	7103	8208
2018/19	7132	7132	7096
2019/20	6985	6985	7177
2020/21	7037	7037	9082
2021/22	7805	7805	

MANAGEMENT CONSIDERATIONS

All the signals from commercial catch and survey data indicate that plaice in Iceland is at present in a good state. This is also confirmed in the assessment. Considerable uncertainty is present in the model due to limited information on recruitment from spring survey. However, the information on recruitment pulses is present from Icelandic coastal beam trawl survey, which is specially designed to target young plaice, but series is still too short to include in the assessment (ICES, 2022c).

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