

24 Icelandic plaice in 5.a

24.1 General information

Icelandic 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 (Jónsson & Pálsson, 2013).

Sexual dimorphism occurs in plaice, as females grow larger than males and mature at larger size. Only a small proportion of males become longer than 45 cm, but about the same proportion of females grow larger than 55 cm. Size at sexual maturity differs between the sexes, whereas 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 (Sigurðsson, 1989 and Sólmundsson *et al.*, 2005). After metamorphosis, the 0-group juveniles seek bottom in shallow waters and spend the first summer just below the tidemark (Pálsson & Hjörleifsson, 2001).

24.2 Fishery

Plaice fishery has been considered stable in last two decades and annual landings have been between 5 and 8 thousand tonnes (Figure 24.2.1 and Figure 24.2.3). Main fishing grounds for plaice are in the west and southwest of Iceland, with smaller fishing areas in the southeast and several fjords in the north (Figure 24.2.4 and Figure 24.2.5). Demersal seine is the main fishing gear for plaice (65–71% since 2011) in Iceland followed by demersal trawl (23–30%), while a small proportion of the catch is taken in gillnets and longline (Figure 24.2.3). 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 24.2.5.

Since 2000, the main fishing grounds of plaice have been on the southwestern, western and north-western part of the Icelandic shelf (Figure 24.2.2). Spatial distribution of the Icelandic plaice fishery has been relatively stable, with around 60% of the plaice caught on the western and north-western part of the shelf. In the last decade, reported catches have increased in the southwestern part but decreased again last year to previous proportions. On the contrary, an increase in reported catches was observed in western and north-western part of the shelf in 2020. Plaice is caught in relatively shallow water, with most of the catch (60–80%) taken at depths of 21–80 m (Figure 24.2.2). Plaice is primarily caught in demersal seine and demersal trawl or around 95% of the total catch (Figure 24.2.3). 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.

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. The number of trawlers has remained relatively stable since 2010 (Table 24.1.1). Total annual catch of plaice has been relatively stable (4900–8300 t) over the last 20 years. In 2020, a total of 7505 t of plaice were caught, about 675 t more than in 2019.

24.2.1 Landing trends

Landings of Icelandic plaice in 2020 are estimated to have been 7.5 thousand tonnes, see Figure 24.2.1 and Table 24.1.1. Landings in Division 5.a. have decreased from around 14.5 thous. tonnes in 1985, which historically was the maximum level observed to the current level which are almost the half of the highest landed catch.

Landings by foreign vessels were considerable before the Icelandic EEZ was expanded to 200 nautical miles 1975, afterwards landings were primarily by the Icelandic fleet. Foreign vessels were the most significant with regards to landed plaice before WW2, but during the war period the Icelandic fleet picked up and took over the majority of fisheries in Icelandic waters. Through years 1946–1973 the landings were divided between both foreign and Icelandic fleet.

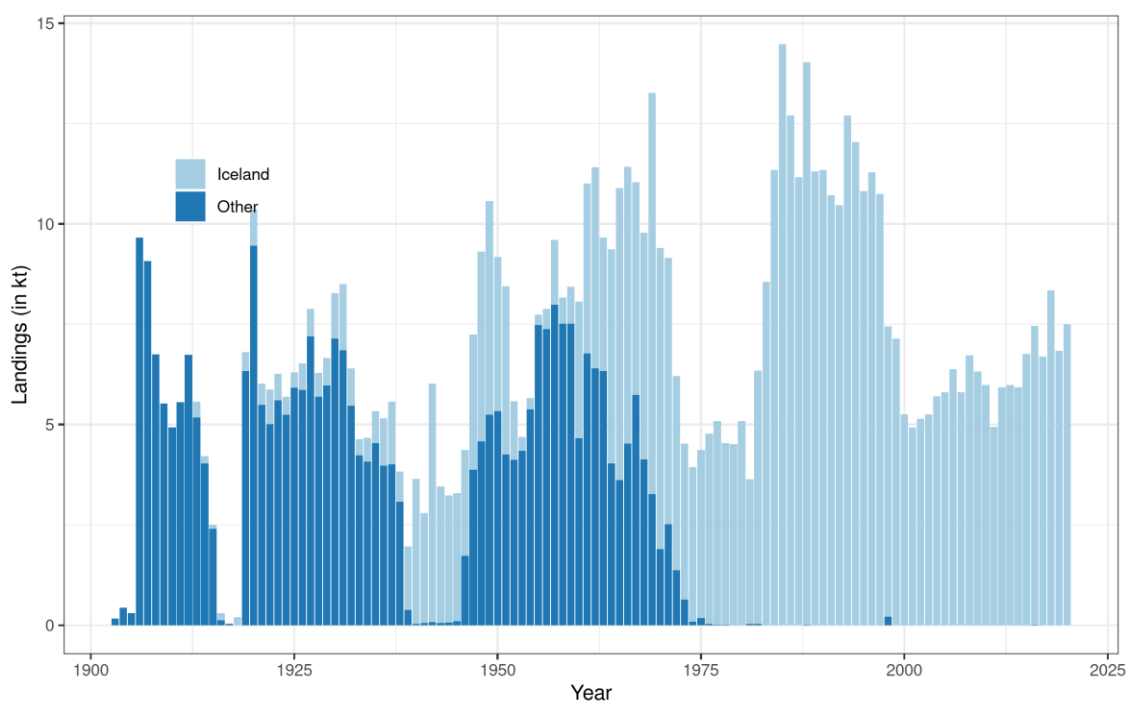


Figure 24.2.1: Plaice in Division 5.a. Recorded landings 1903–2020.

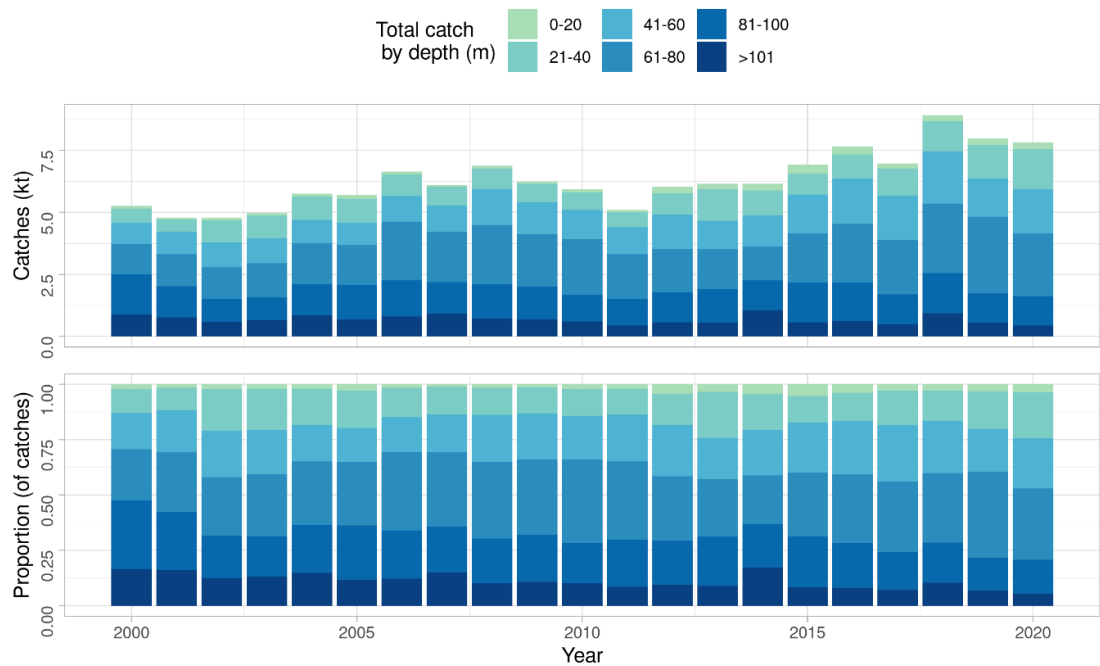


Figure 24.2.2: Plaice in 5.a. Depth distribution of plaice catches from bottom trawls and demersal seine according to Icelandic logbooks.

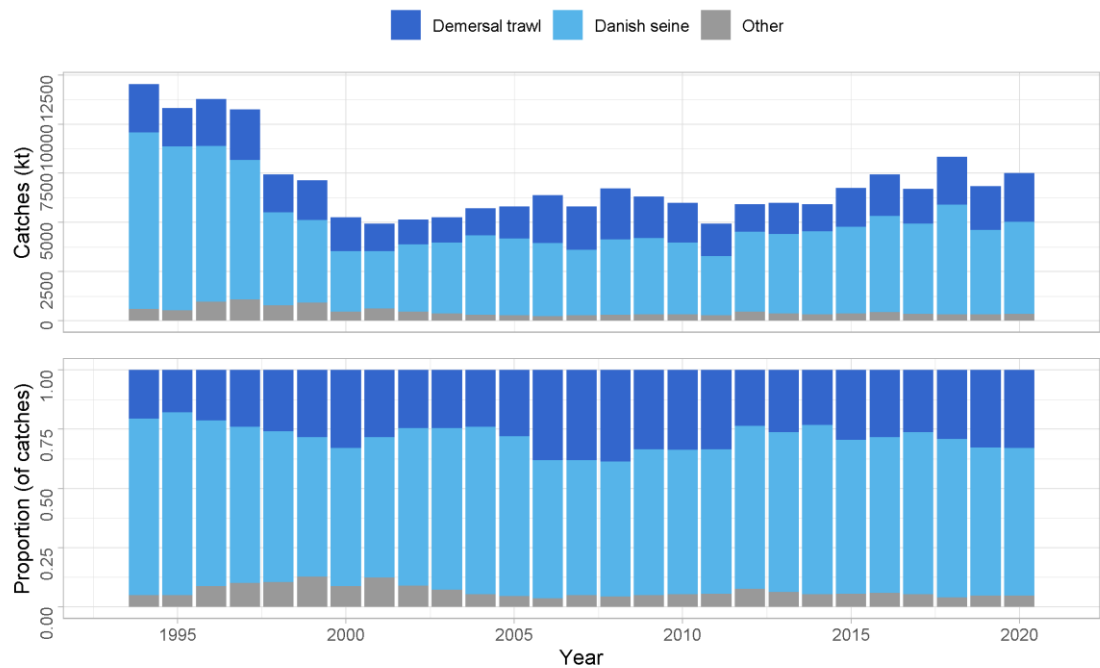


Figure 24.2.3: Plaice in Division 5.a. Landings in tons and percent of total by gear and year.

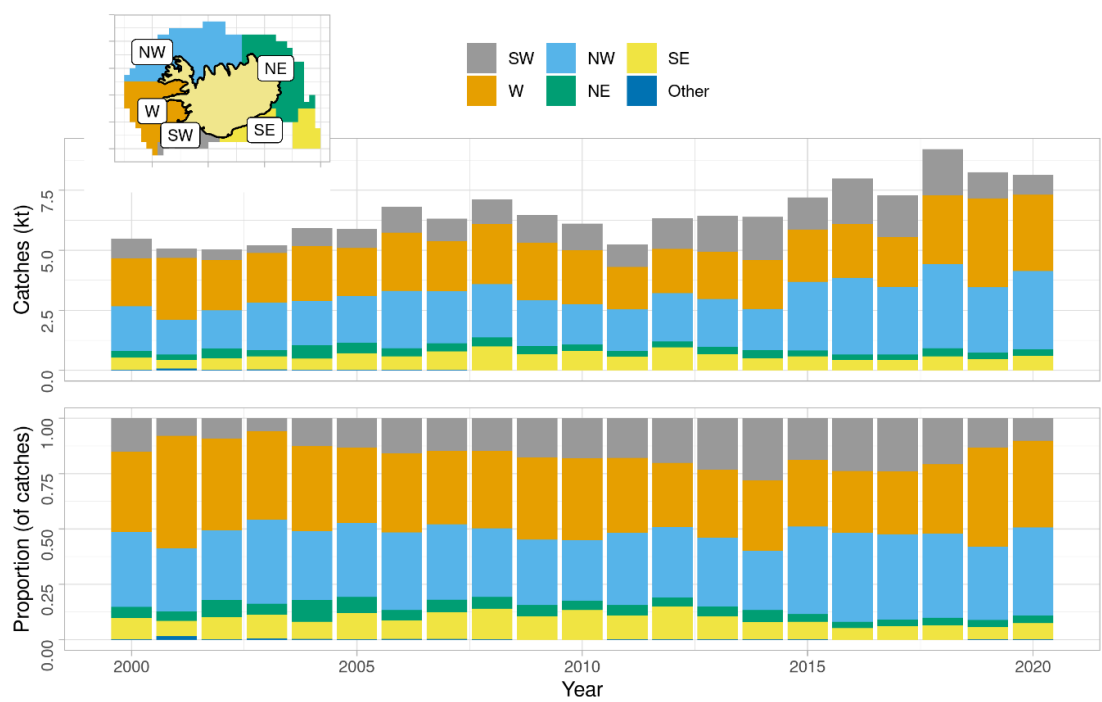


Figure 24.2.4: Plaice in 5.a. Changes in spatial distribution of plaice catches as recorded in Icelandic logbooks.

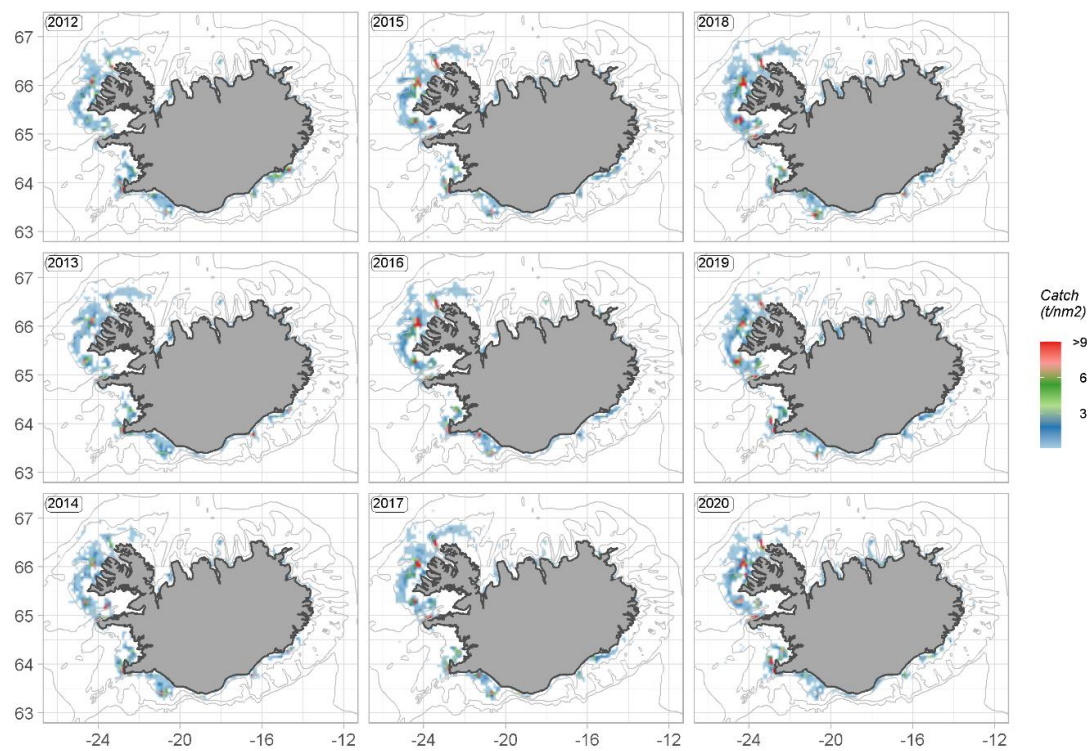


Figure 24.2.5: Plaice in 5.a. Spatial distribution of catches by all gears.

24.3 Management

The Ministry of Industries and Innovation (MII) 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 24.1.4). One reason is that no formal harvest rule exists for this stock. Through this time period the landings have been fluctuating between the over- or undershoot the set TAC and this is related to the management system that allow 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 24.3.1.

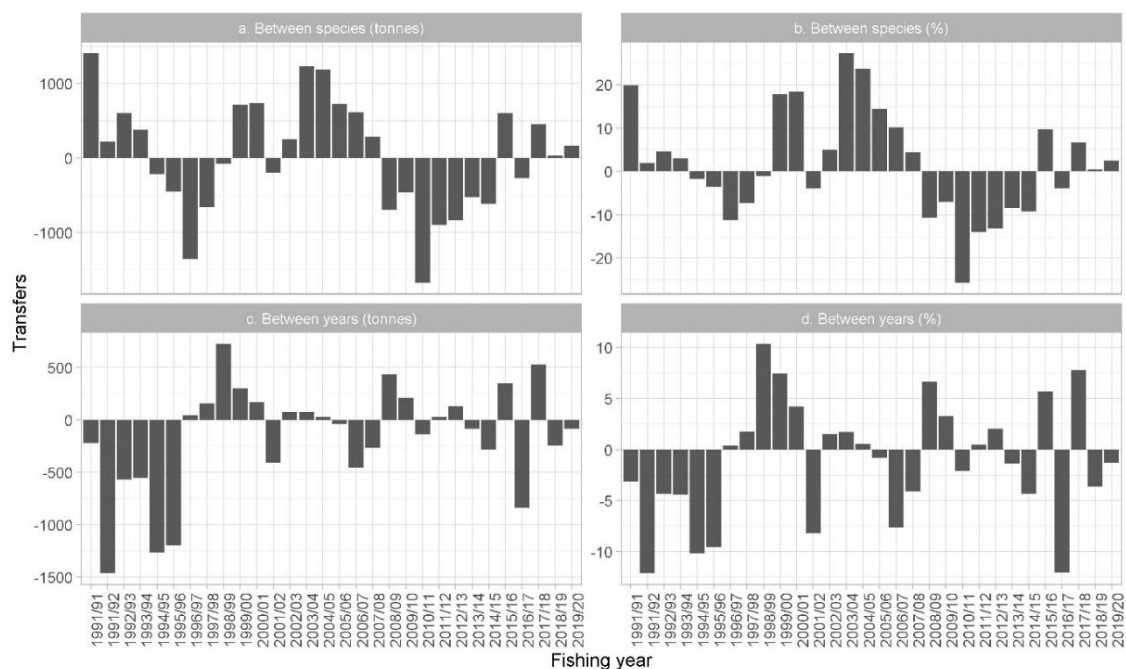


Figure 24.3.1: Plaice in 5.a. An overview of the net transfers of quota between years and species transformations in the fishery in 5.a.

24.4 Data available

Sampling of biological data from main gears (Danish seine and bottom trawl) in commercial catches is considered good in general. The sampling does cover the spatial distribution of catches to a satisfactory extent. The sampling coverage by gear in 2020 is shown in Figure 24.4.1. Due to the COVID-19 pandemic in 2020, researchers from MRFI and inspectors from Directorate of Fisheries in Iceland had difficult time obtaining necessary samples for biological measurements from the fisheries, therefore sampling locations and numbers were fewer than usual during this year.

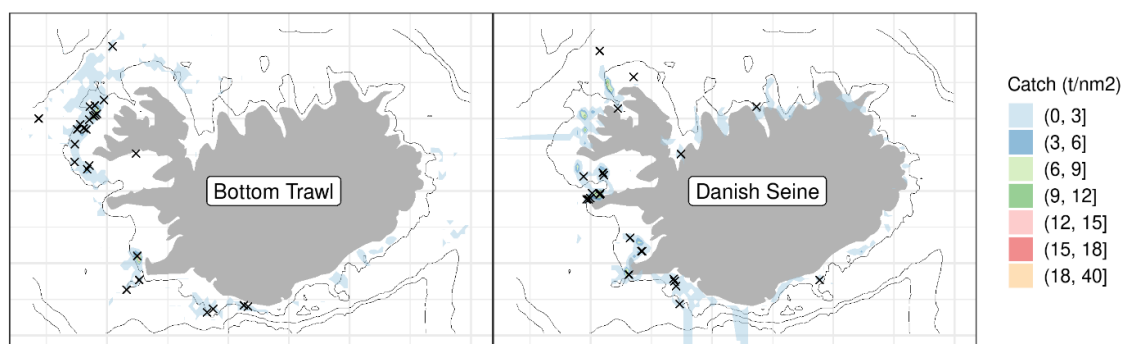


Figure 24.4.1: Plaice in 5.a. Fishing grounds in 2020 as reported in logbooks (colours) and positions of samples taken from landings (asterisks) by main gear types.

24.4.1 Landings and discards

All landings in 5.a before 1982 are derived from the STATLANT database, and also all foreign landings in 5.a to 2005. The years between 1982 and 1993 landings by Icelandic vessels were collected by the Fisheries Association of Iceland (Fiskifélagið). Landings after 1994 by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Landings of foreign vessels (mainly Norwegian and Faroese vessels) are given by the Icelandic Coast Guard prior to 2014 but after 2014 this are also recorded by the Directorate (Figure 24.2.1). Discarding is banned by law in the Icelandic demersal fishery. Discard rates in the Icelandic fishery for plaice are estimated negligible at least since 2001. 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>.

24.4.2 Length compositions

An overview of available length measurements from 5.a is given in Table 24.1.2. Most of the measurements are from the two main fleet segments, i.e. trawls and demersal seine.

Length distributions from the main fleet segments are shown in Figure 24.2.2. The sizes caught by the main gear types (bottom trawl and Danish seine) appear to be fairly stable, primarily catching plaice in the size range between 35 and 55 cm. There has been a shift towards larger fish in the length distribution. As a result, the average length in the samples taken from commercial catch has increased from 35 cm in 1991 to 43.1 cm in 2016 and was 42 cm in 2020.

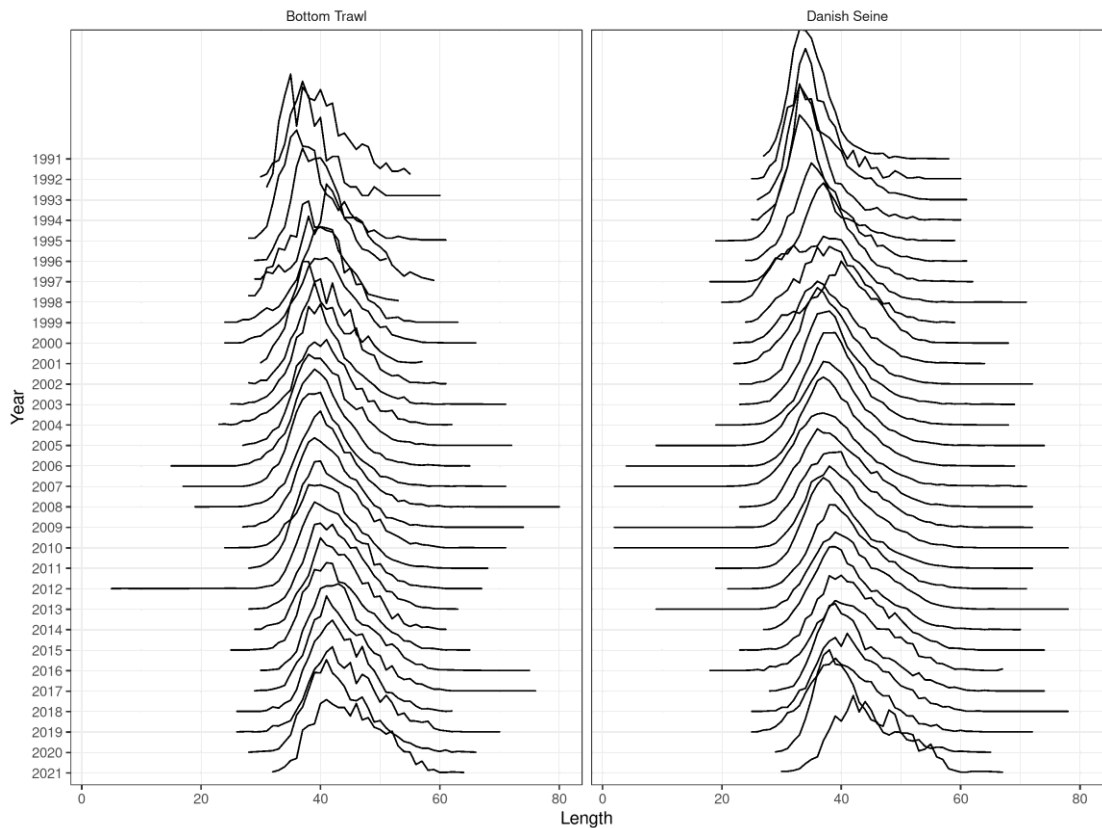


Figure 24.4.2: Plaice in 5.a. Commercial length distributions by gear and year.

24.4.3 Age compositions

Table 24.1.3 gives an overview of otolith sampling intensity by gear types in 5.a. In 2002–2005 the majority of the catch was 4–7 years old plaice, or about 60% of landings in terms of estimated numbers (Figure 24.4.2). 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. In recent years, 2017–2019, the largest cohorts have been 6–8-year-old fish, however in last two years 4–7-year-old fish were most common, similar to 2001–2007.

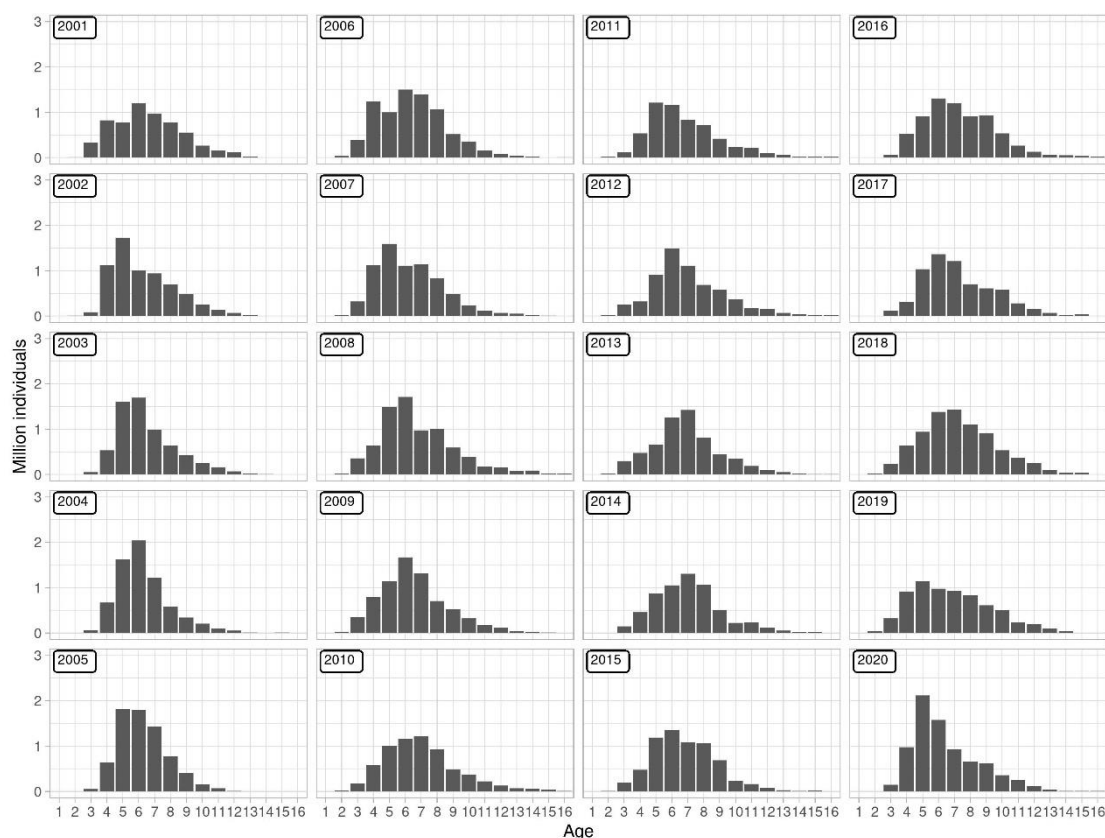


Figure 24.4.2: Plaice in 5.a. Estimated age distribution of landed catch based on landings and otoliths collected from landed catch.

24.4.4 Natural mortality

No information is available on natural mortality. For assessment and advisory purpose, the natural mortality is set to 0.2 for all age groups.

24.4.5 Catch, effort and research vessel data

24.4.5.1 Catch per unit of effort (CPUE) and effort data from commercial fisheries

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 24.4.3). CPUE of plaice in demersal seine has been around that level since then with some fluctuations in last two years.

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, like in the demersal seine fishery, gradually increased from 120 kg/hour in 2000 to about 300 kg/hour in 2019 and stayed at that level in 2020.

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 2020 (Figure 24.4.3). 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 2020 (Figure 24.4.3).

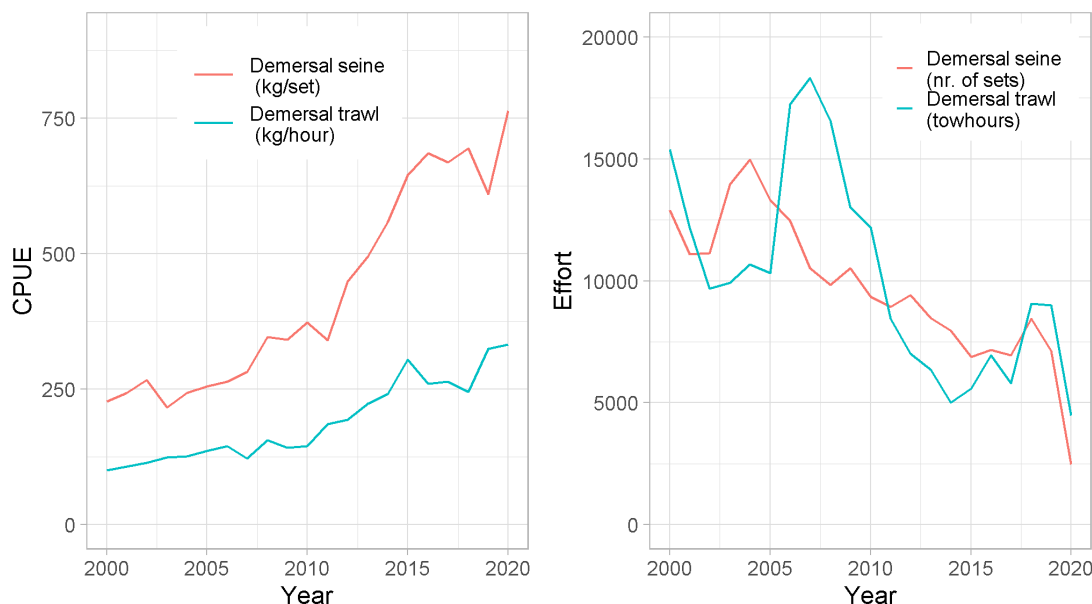


Figure 24.4.3: Plaice in 5.a. Non-standardised estimates of CPUE (left) and fishing effort (right) from demersal seine (kg/set or nr. of sets) in red and demersal trawl (kg/hour or towhours) in blue.

24.4.5.2 Icelandic survey data

Information on abundance and biological parameters from plaice in 5.a is available from two surveys, the Icelandic groundfish spring survey and the Icelandic groundfish autumn survey.

The Icelandic spring groundfish survey, 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 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 plaice, as recruitment takes place in shallow water in habitats unsuitable for demersal trawling. In addition to these two major surveys, there is 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 24.4.4 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 Figure 24.4.5 and Figure 24.4.6, and abundance and changes in spatial distribution in Figures 24.4.7–24.4.9. Results from the beam trawl survey are shown in Figures 24.4.10–24.2.12.

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 and stabilized. Since 2017 there have been minor annual fluctuation in the indices, but they are still fairly stable. 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 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.

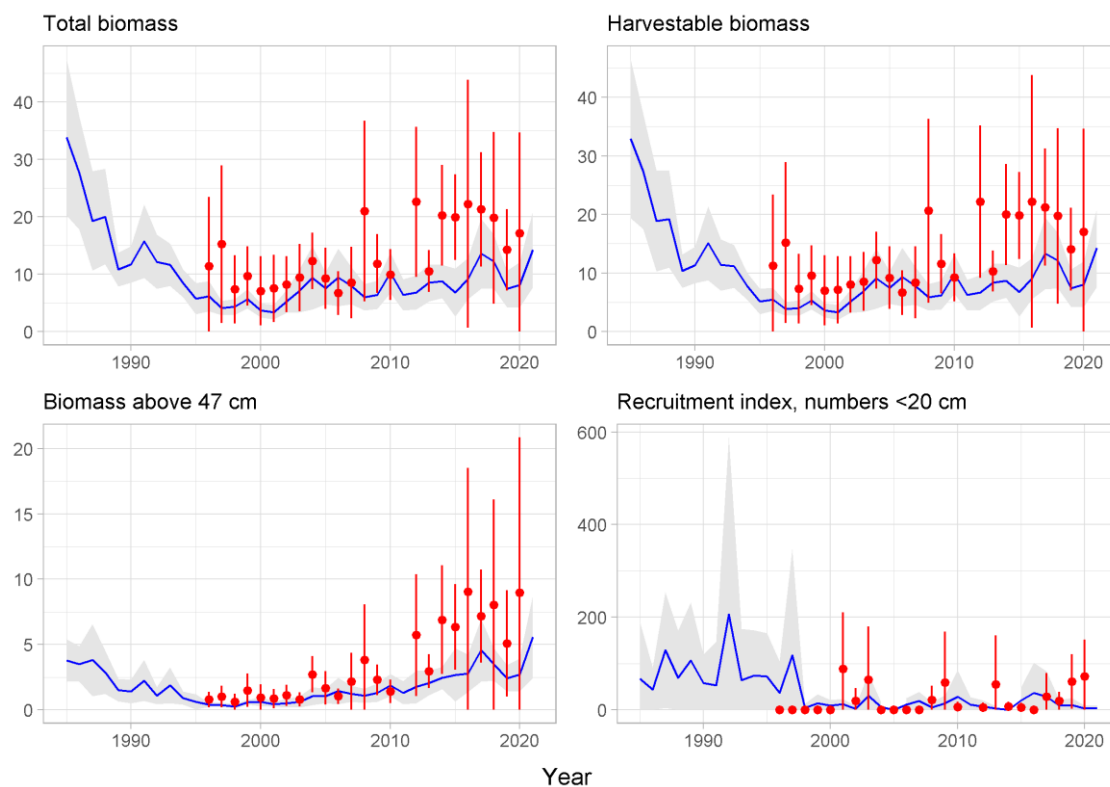


Figure 24.4.4: Plaice in 5.a. Indices in the Spring Survey (March) 1985 and onwards (blue line shaded area) and the autumn survey (red point ranges).

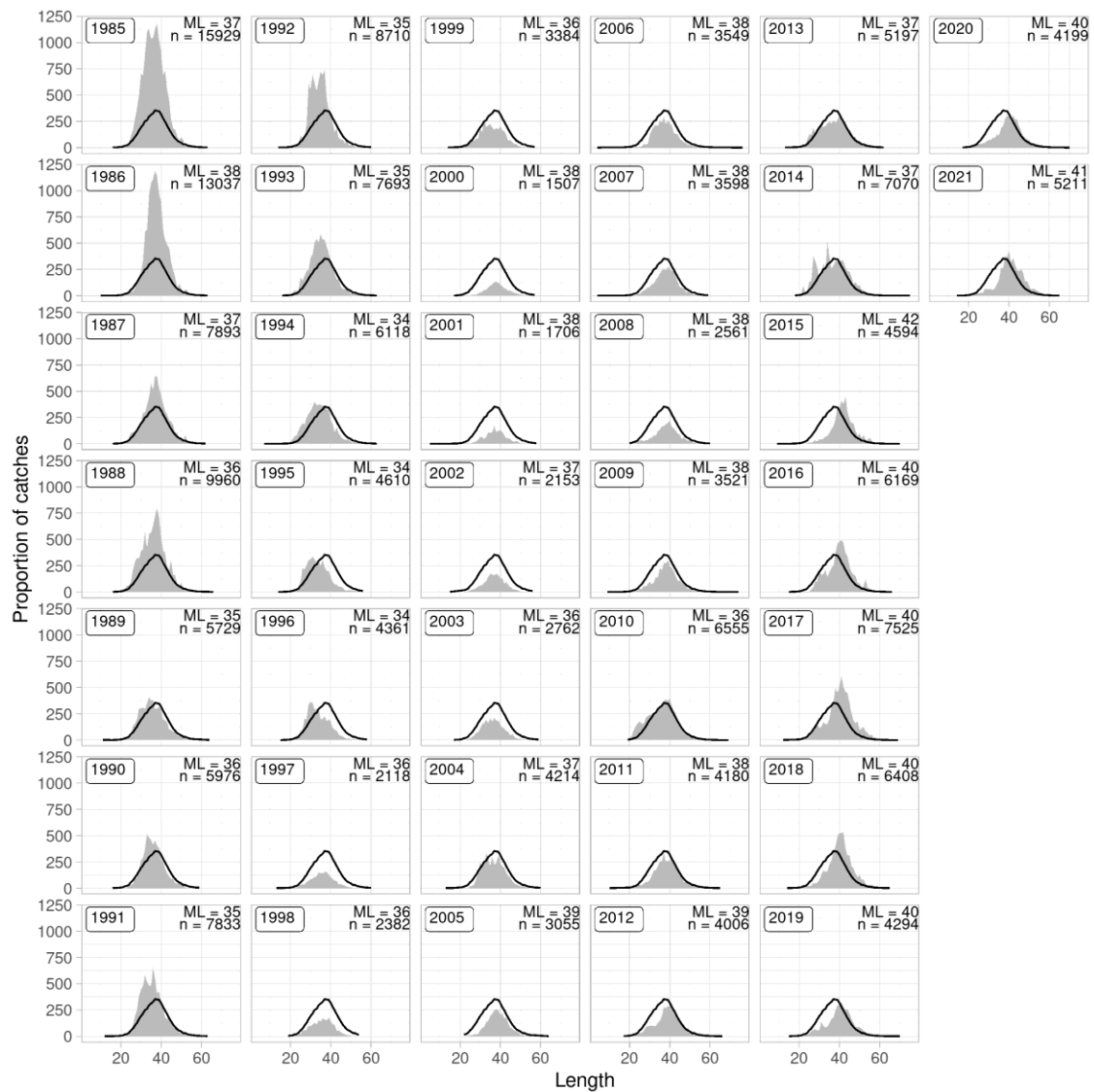


Figure 24.4.5: Plaice in 5.a: Length disaggregated abundance indices from the spring survey (March) 1985 and onwards.

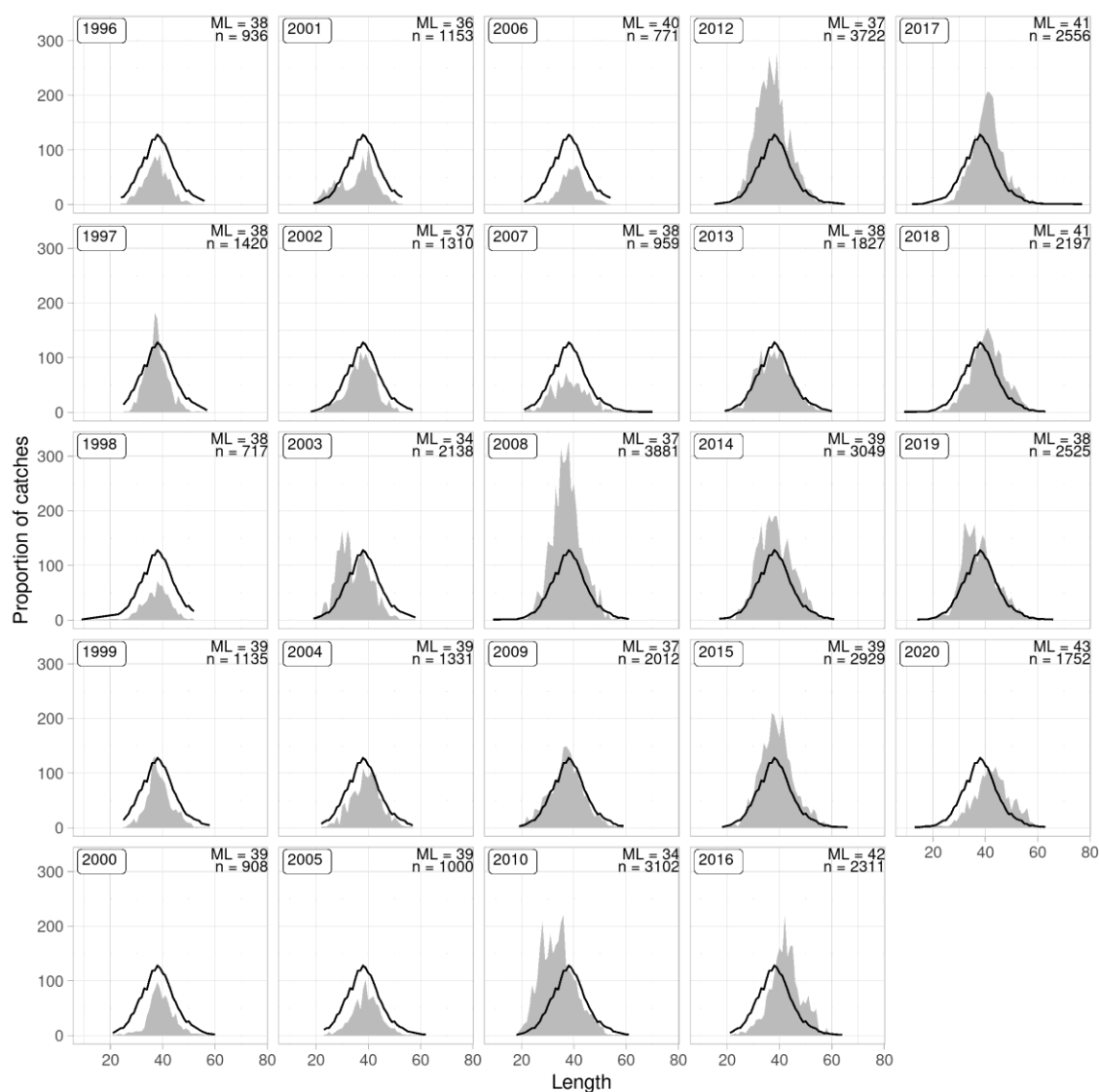


Figure 24.4.6: Plaice in 5.a: Length disaggregated abundance indices from the autumn survey (October) 1996 and onwards, except 2011.

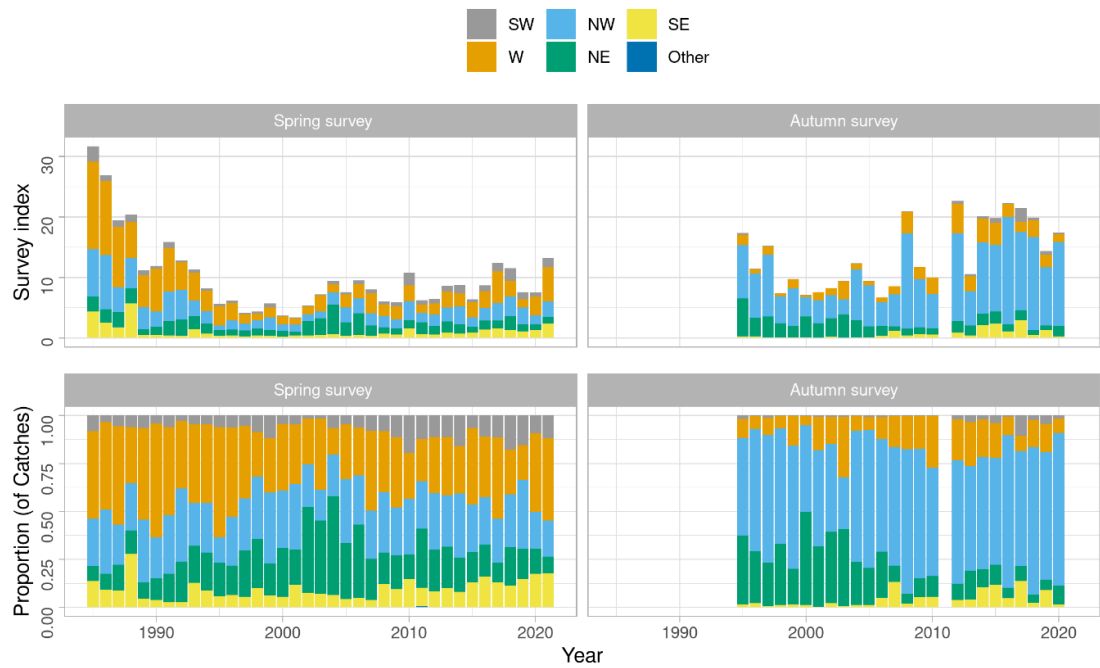


Figure 24.4.7: Plaice in 5.a. Changes in geographical distribution of the survey biomass.

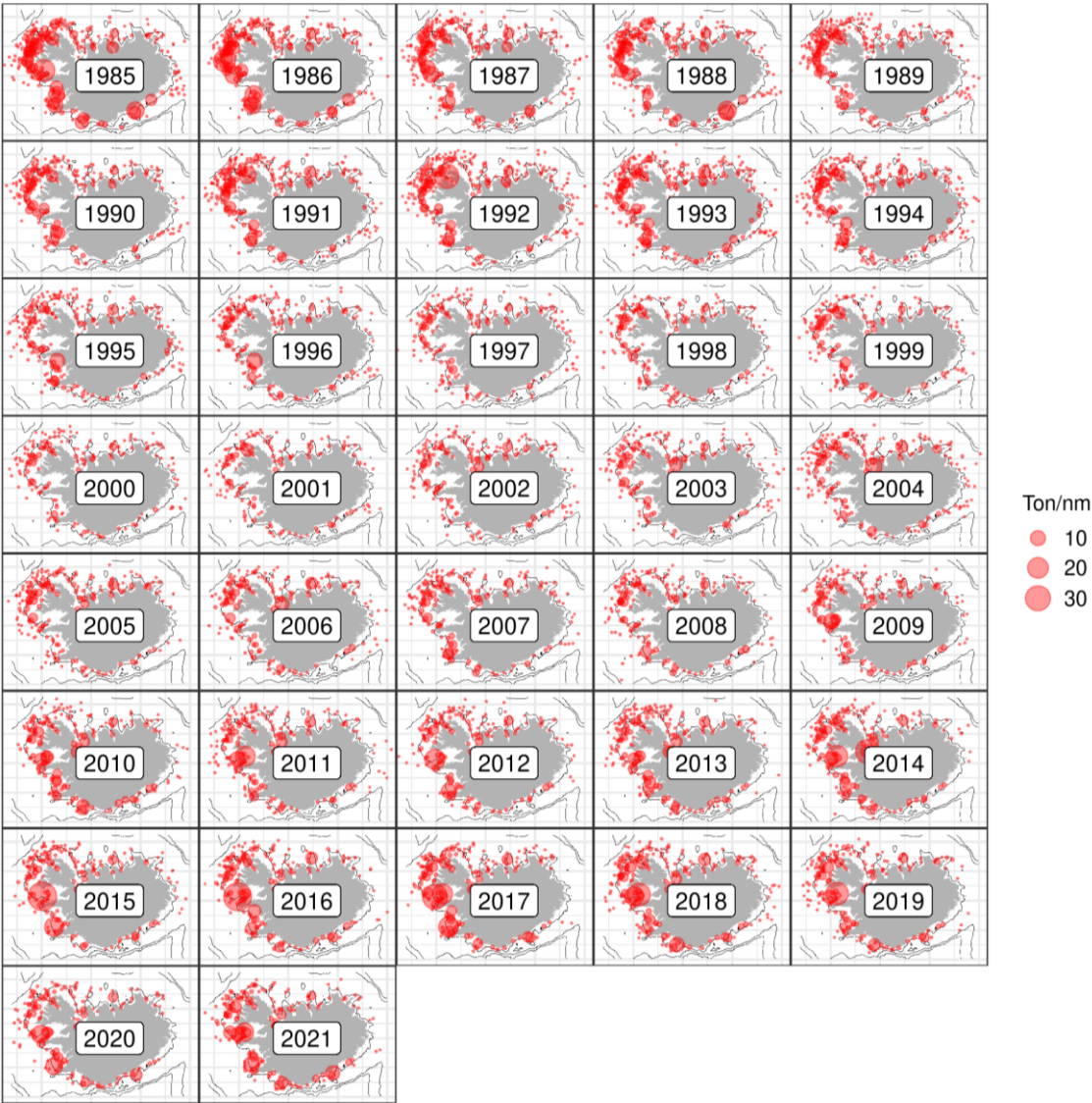


Figure 24.4.8: Plaice in 5.a. Location of plaice in the spring survey, bubble sizes are relative to catch sizes.

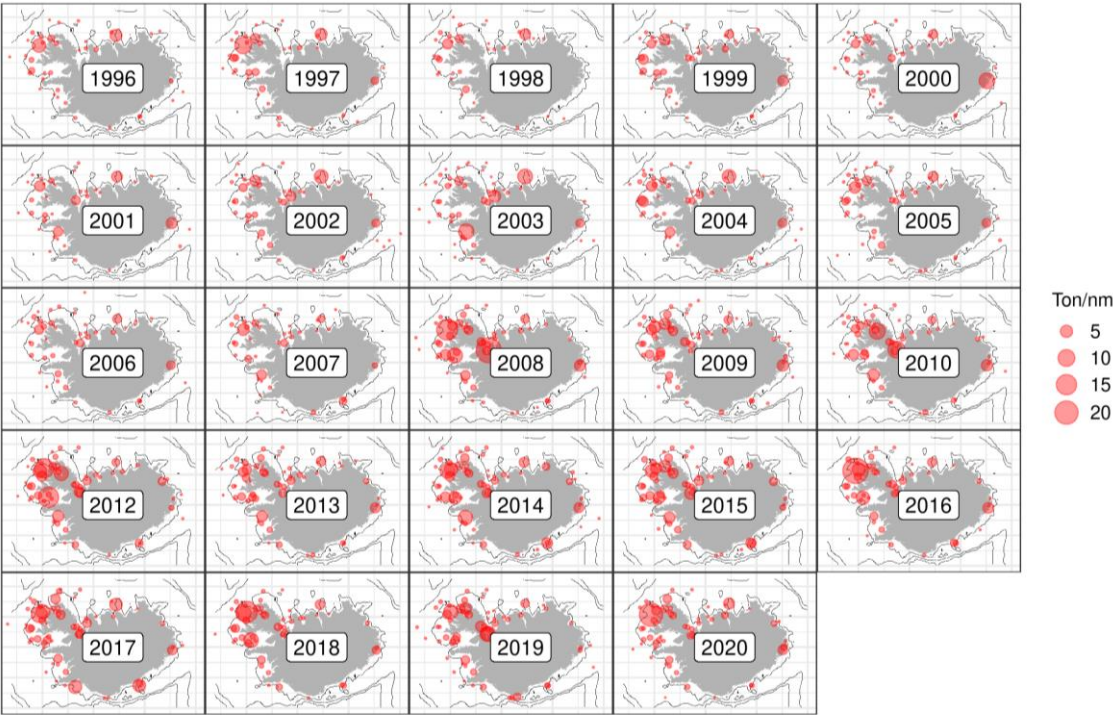


Figure 24.4.9: Plaice in 5.a. Location of plaice in the autumn survey, bubble sizes are relative to catch sizes.

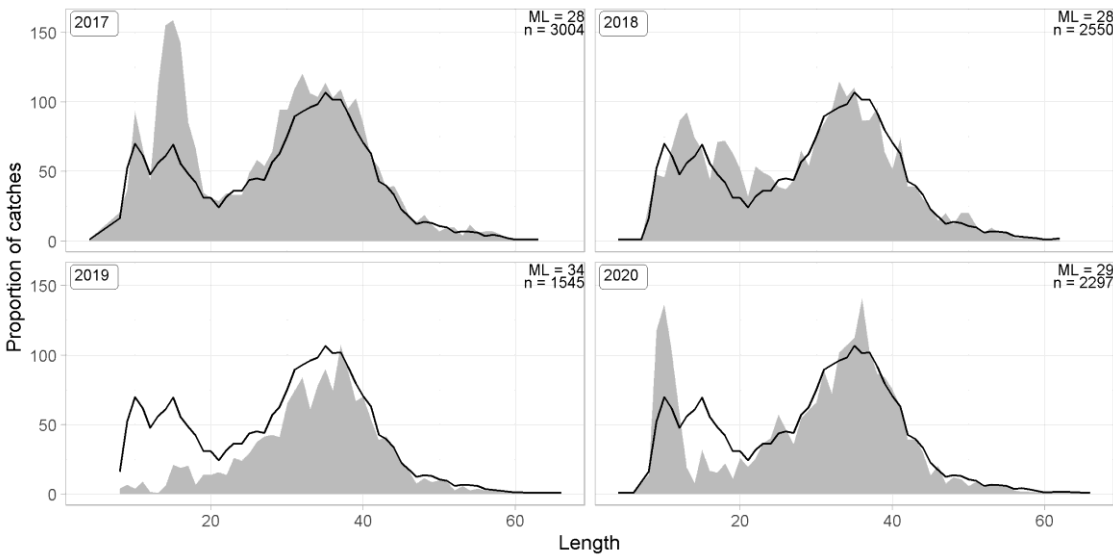


Figure 24.4.10: Plaice in 5.a. Length distribution from beam trawl survey. The black line shows the mean for all years.

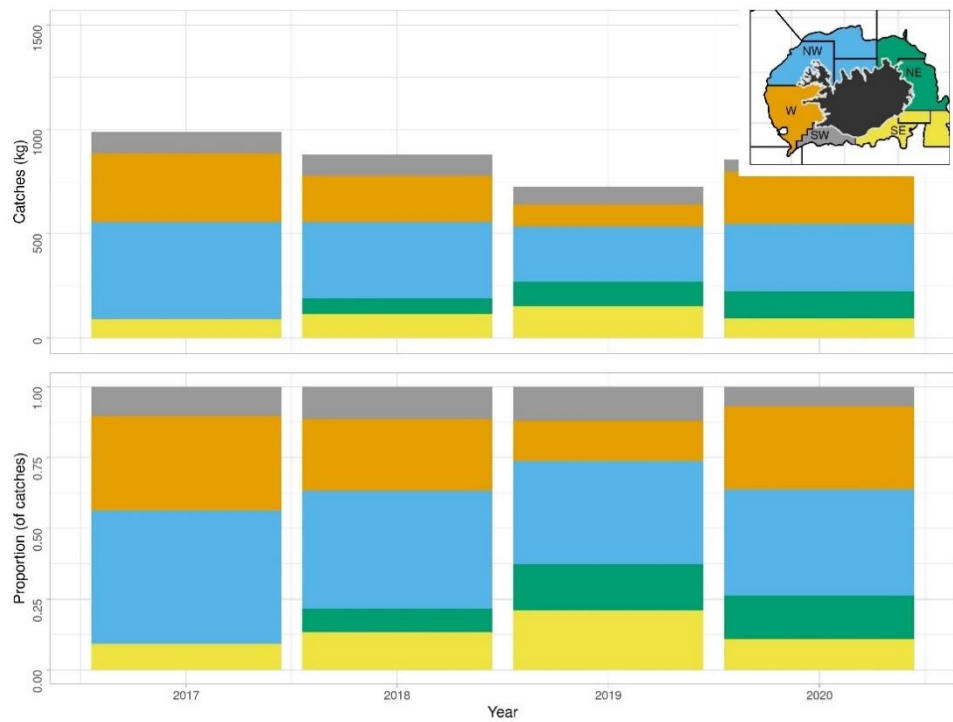


Figure 24.4.11: Plaice in 5.a. Changes in geographical distribution in the beam trawl survey.

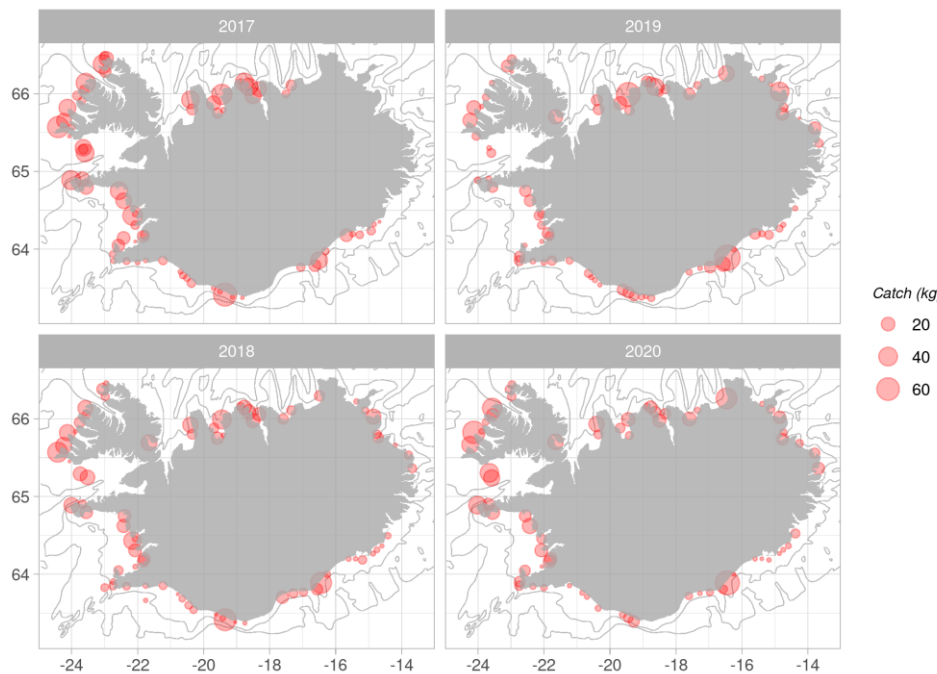


Figure 24.4.12: Plaice in 5.a. Spatial distribution in the beam trawl survey since 2017. The NE area was not sampled in 2017.

24.5 Data analyses

24.5.1 Analytical assessment

Analytical age-based stock assessment model using catch in numbers and age-disaggregated indices from the spring survey has been used since 2016. Input data for the stock assessment are shown in Figure 24.5.1. 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, in particular for the survey data (Figure 24.5.2). The result of the assessment indicate that the stock is stable (Figure 24.5.3 and 24.5.4). Maximum sustainable yield is the basis for the advice, and the reference point is set as $F = 0.22$.

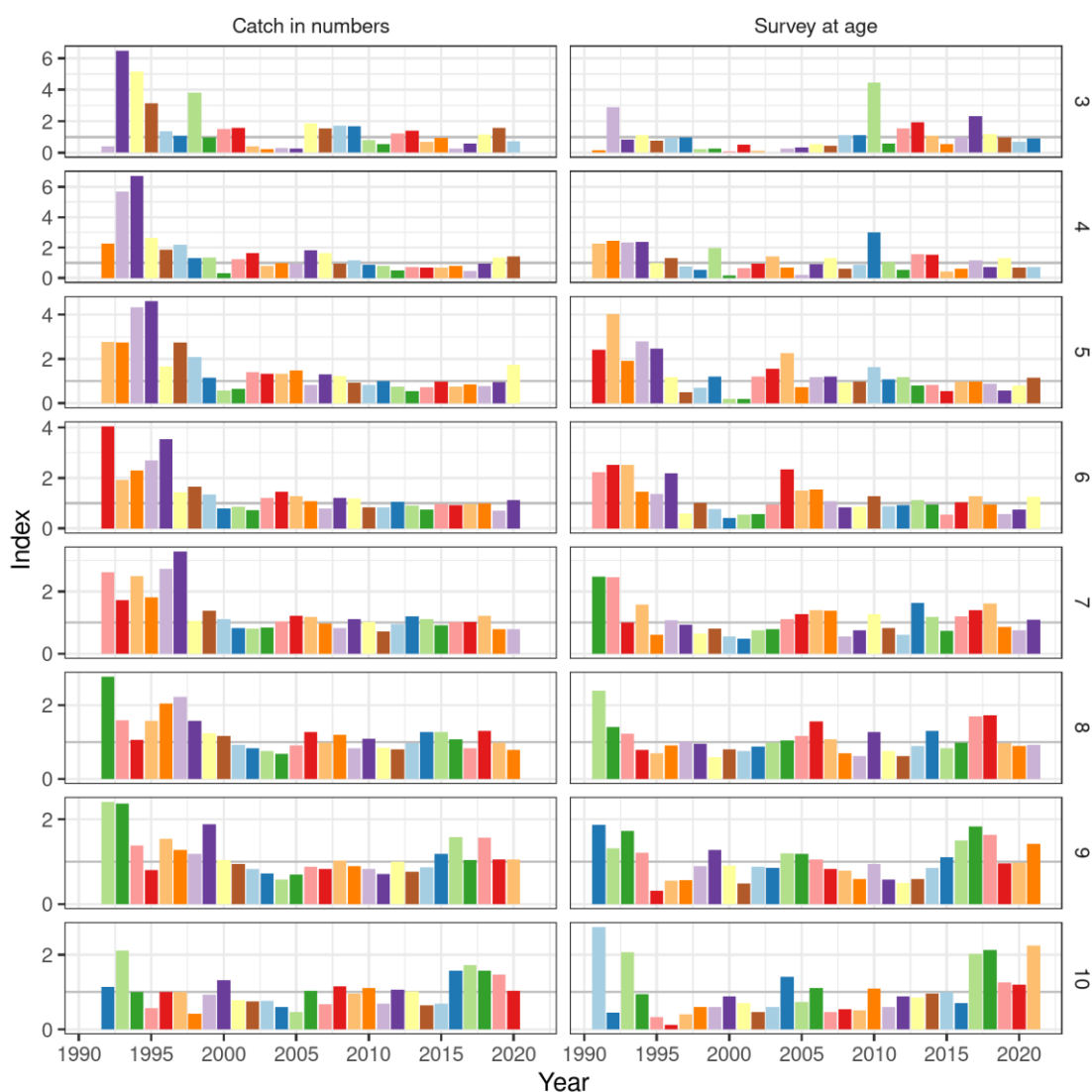


Figure 24.5.1: Plaice in 5.a. Estimated numbers of 3–10-year-old fish in the commercial catch (1992–2020) and age-disaggregated survey indices from the spring survey (1991–2021). Input data for the stock assessment.

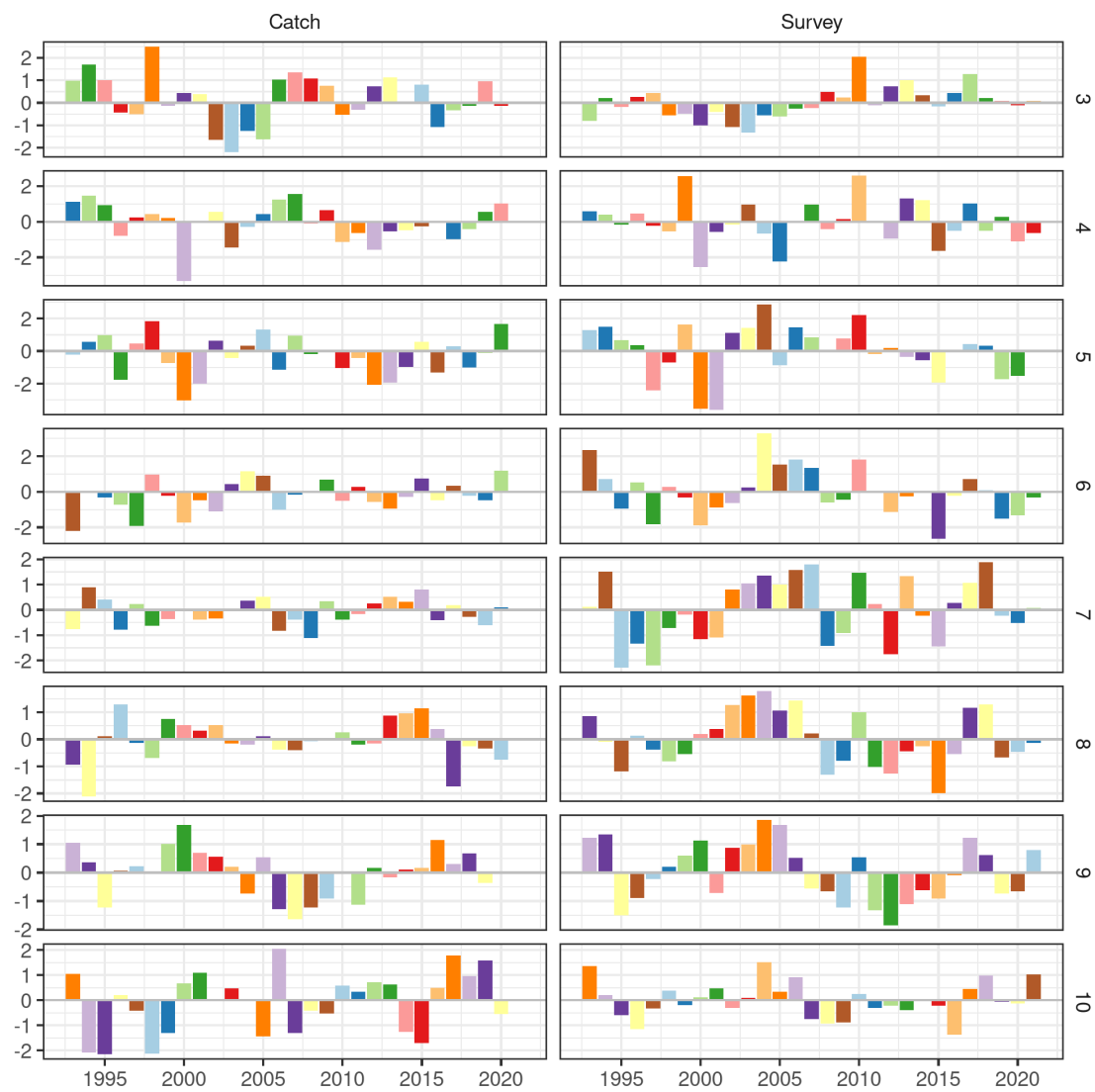


Figure 24.5.2: Plaice in 5.a. Residuals of the model fit to spring survey indices and catch data by age.

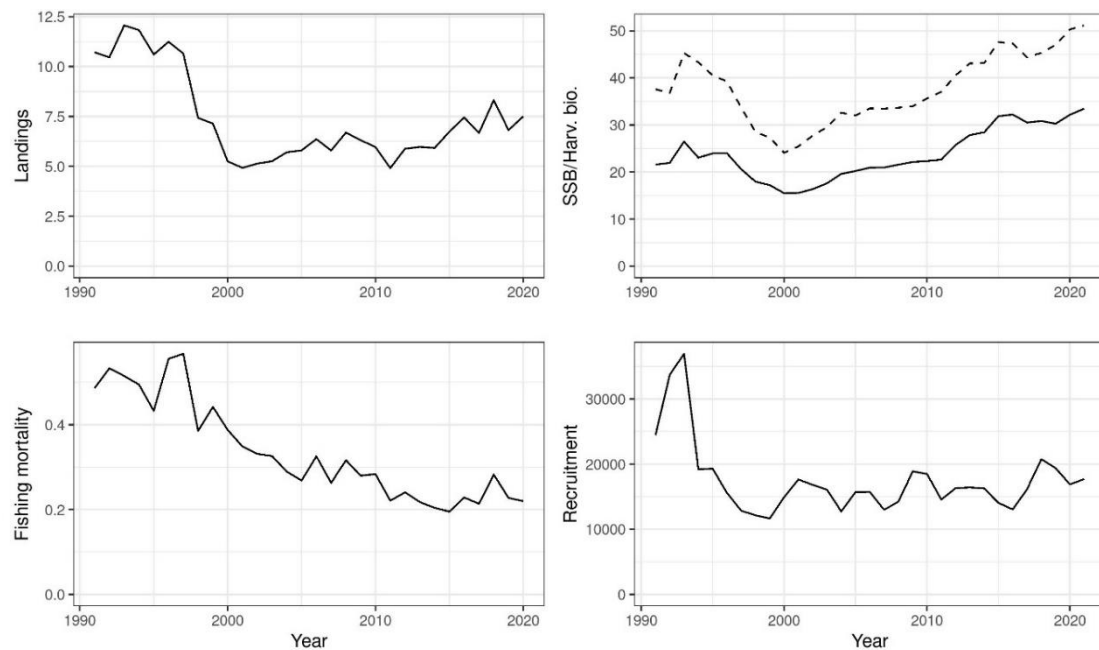


Figure 24.5.3: Plaipe in 5.a. Summary from the assessment 2021. Results of spawning stock (SSB) and harvestable stock biomass, fishing mortality, and recruitment (age 3) are shown.

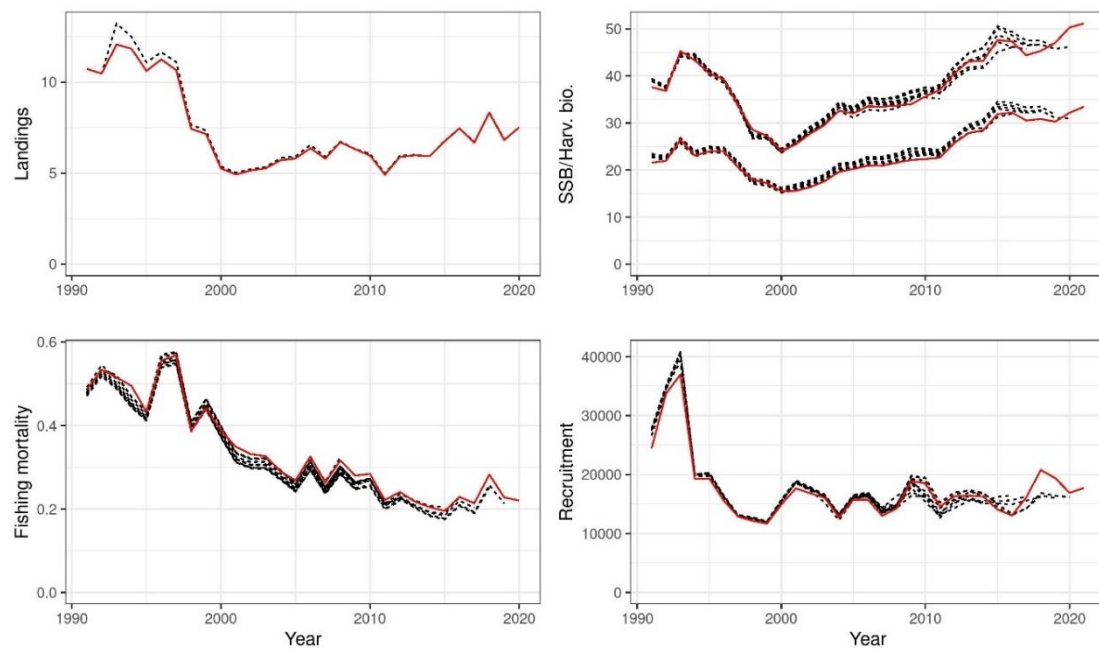


Figure 24.5.4: Plaipe in 5.a. Analytical retrospective plots illustrating stability in model estimates over a 9-year 'peel' in data. Results of spawning stock (SSB) and harvestable stock biomass, fishing mortality, and recruitment (age 3) are shown.

Table 24.1.1: Plaice in 5.a. Number of Icelandic vessels landing catch of 1000 kg or more and all landed catch by fleet segment participating in the plaice fishery in 5.a.

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	7505

Table 24.1.2: Plaice in 5.a. Number of available length measurements and samples from Icelandic commercial catches.

Year	Bottom Trawl	Danish Seine	Long Line
2000	4261/33	7185/49	0/0
2001	1003/9	7517/51	234/4
2002	2392/18	11263/69	3/1
2003	3278/21	13804/96	3/1
2004	3834/28	21216/150	0/0
2005	5251/35	20583/139	33/1
2006	8102/60	19222/135	108/1
2007	6837/49	17073/124	83/1
2008	11359/77	17471/129	0/0
2009	7201/50	19106/136	100/1
2010	9608/62	17387/126	0/0
2011	7609/55	16857/110	99/1
2012	5723/39	18329/129	0/0
2013	4688/31	16647/115	150/1
2014	2531/21	7271/53	217/1
2015	4142/33	5997/44	0/0
2016	4757/32	8075/58	0/0
2017	3527/28	6231/52	0/0
2018	3506/27	5666/46	0/0
2019	4838/36	5990/47	0/0
2020	2788/27	3031/24	0/0

Table 24.1.3: Plaice in 5.a. Number of available age measurements and samples from Icelandic commercial catches.

Year	Bottom Trawl	Danish Seine	Long Line
2000	1507/33	2400/49	0/0
2001	350/9	2250/51	50/4
2002	599/18	2424/69	0/1
2003	550/21	3149/96	0/1
2004	820/28	3701/150	0/0
2005	1000/35	3036/139	0/1
2006	1450/60	3200/135	0/1
2007	1500/49	3199/124	0/1
2008	1850/77	3099/129	0/0
2009	1250/50	3180/136	0/1
2010	2016/62	3951/126	0/0
2011	2452/55	4200/110	0/1
2012	1835/39	5199/129	0/0
2013	1350/31	5010/115	50/1
2014	575/21	900/53	0/1
2015	670/33	800/44	0/0
2016	573/32	1125/58	0/0
2017	550/28	974/52	0/0
2018	400/27	880/46	0/0
2019	476/36	750/47	0/0
2020	550/27	550/24	0/0

Table 24.1.4: Plaice in 5.a. Recommended TAC, national TAC set by the Ministry and official landings. All weights are in tonnes.

Fishing year	Rec. TAC	National TAC	Catch
1991/92	10000	11000	10200
1992/93	10000	13000	12400
1993/94	10000	13000	12300
1994/95	10000	13000	11100
1995/96	10000	13000	11000
1996/97	10000	12000	10345
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	
2021/22	7805		

24.6 References

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