

PLAICE – SKARKOLI

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 longer 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 2011-2019, as reported by mandatory logbooks, are shown in Figure 1.

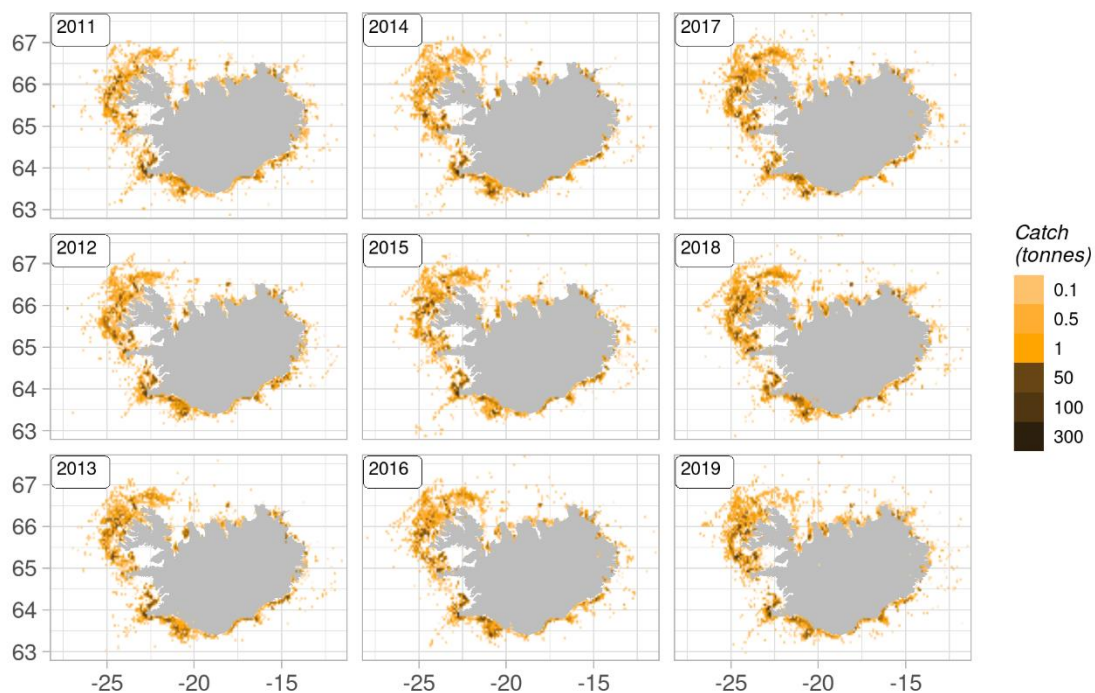


Figure 1. Plaice. Geographical distribution of the Icelandic fishery since 2011. Reported catch from logbooks.

Mynd 1. Skarkoli. Útbreiðsla veiða á Íslandsmiðum frá 2011 samkvæmt afladagbókum.

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 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 part of the shelf in 2019.

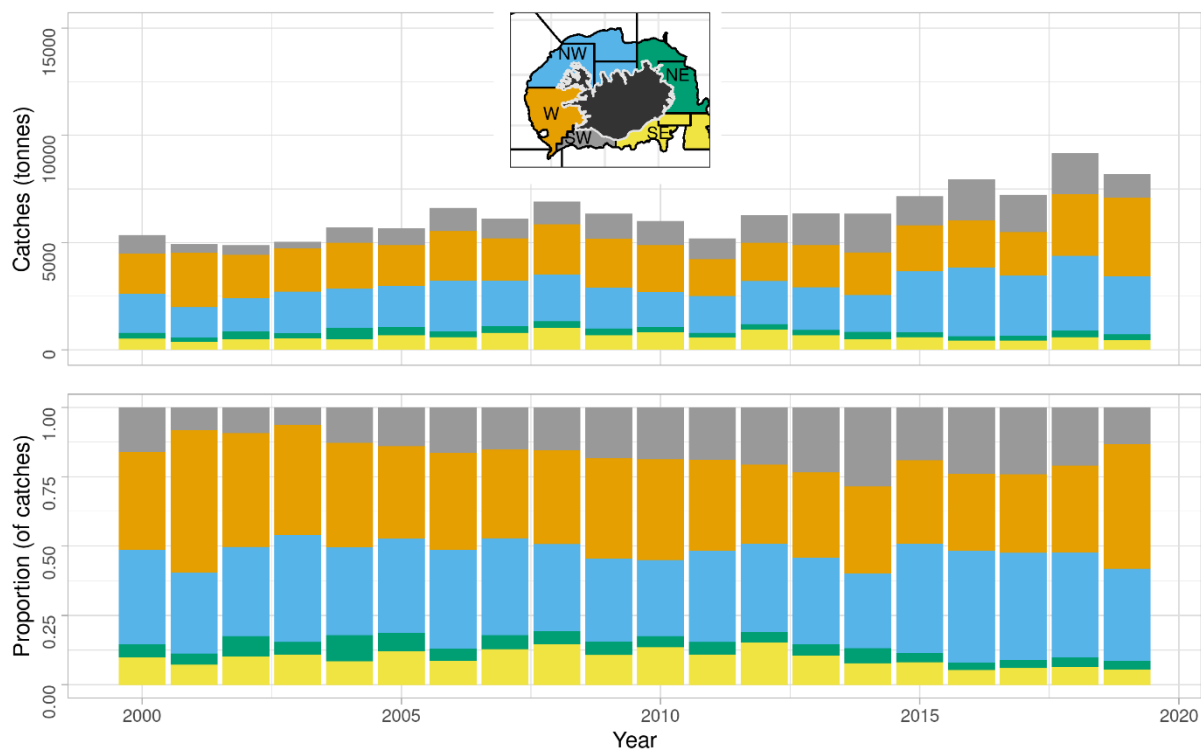


Figure 2. Plaice. Spatial distribution of the Icelandic fishery by fishing area from 2000 according to logbooks. All gears combined.

Mynd 2. Skarkoli. Útbreiðsla veiða við Ísland frá árinu 2000 samkvæmt afladagbókum. Öll veiðarfæri samanlagt.

Plaice is caught in relatively shallow water, with most 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.

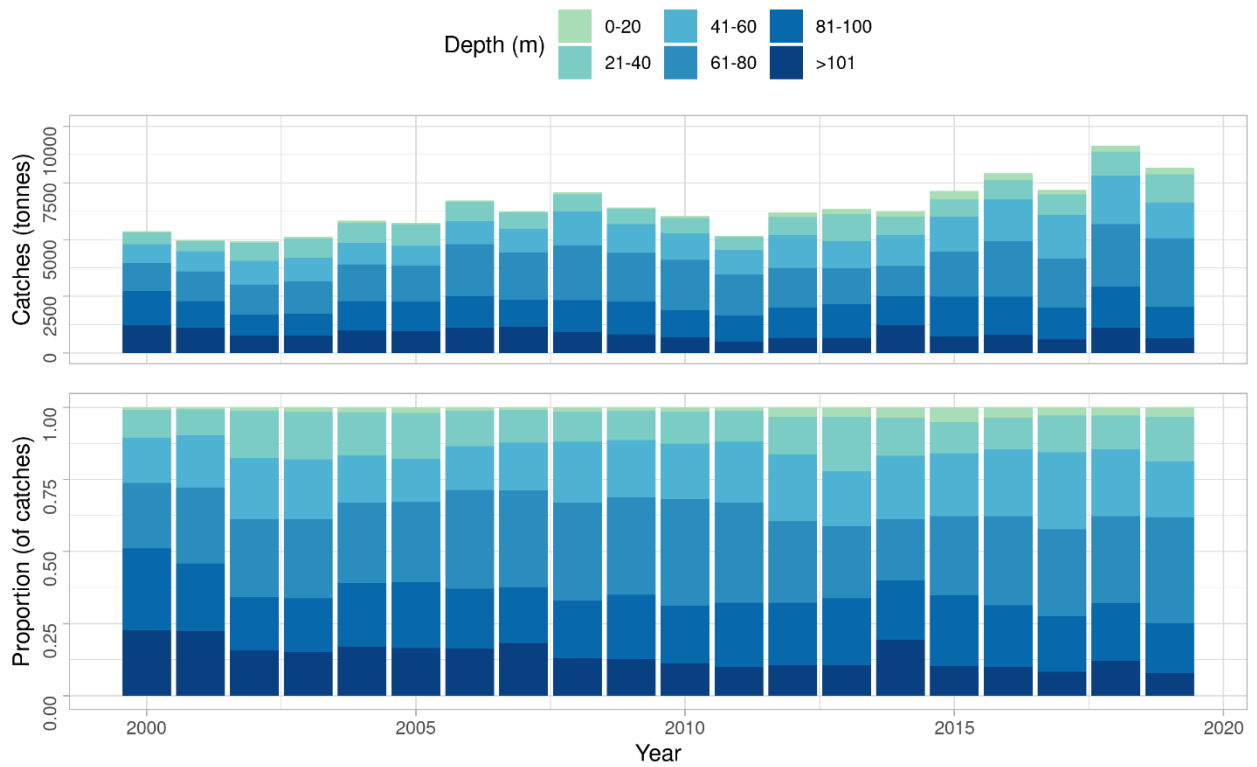


Figure 3. Plaice. Depth distribution of demersal seine and trawl catches according to logbooks.

Mynd 3. Skarkoli. Afli í dragnót og botnvörpu samkvæmt afladagbókum, skipt eftir dýpi.

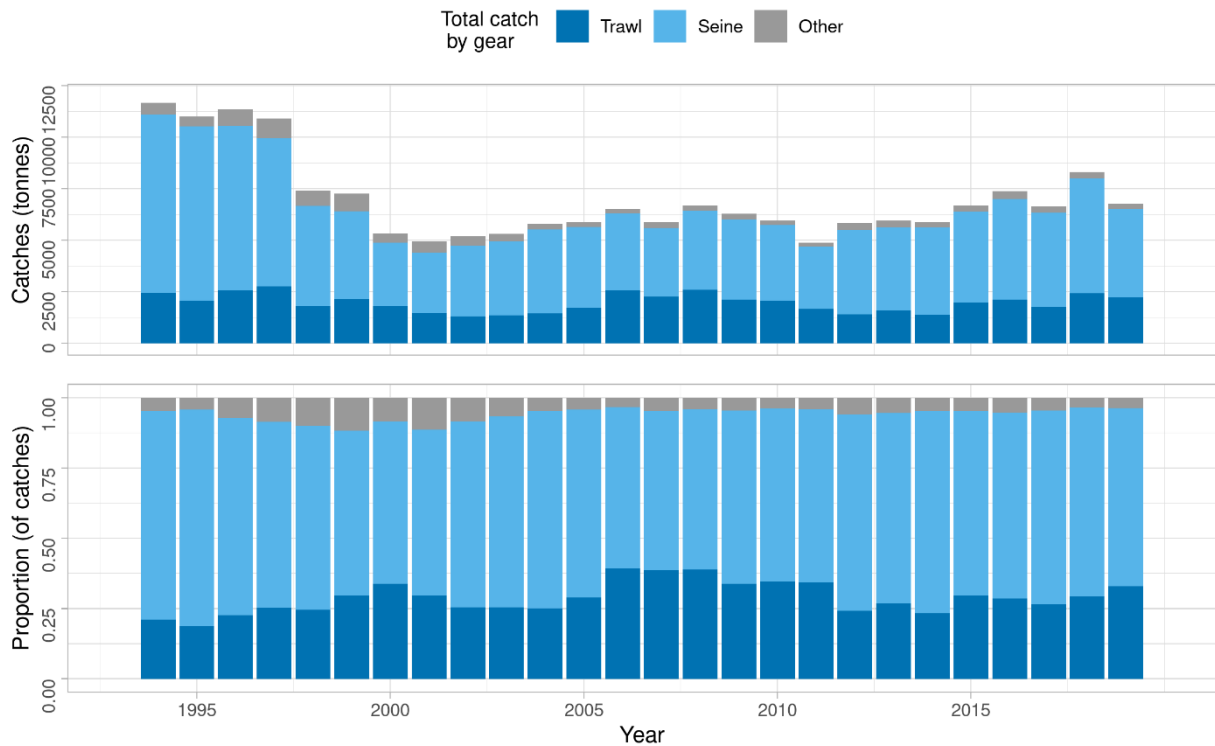


Figure 4. Plaice. Total catch (landings) by fishing gear since 1994, according to statistics from the Directorate of Fisheries.

Mynd 4. Skarkoli. Landaður afli eftir veiðarfærum frá árinu 1994, samkvæmt aflaskráningarkerfi Fiskistofu.

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 1). Total annual catch of plaice has been relatively stable (4900-8300 t) over the last 20 years. In 2019, a total of 6834 t of plaice were caught, about 1500 t less than in 2018.

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

Tafla 1. Skarkoli. Fjöldi íslenskra skipa sem landað hafa yfir 1000 kg af skarkola og allur landaður afli eftir veiðarfærum.

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

The number of vessels accounting for 95% of the catch of plaice in Icelandic waters was relatively constant around 160-200 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.

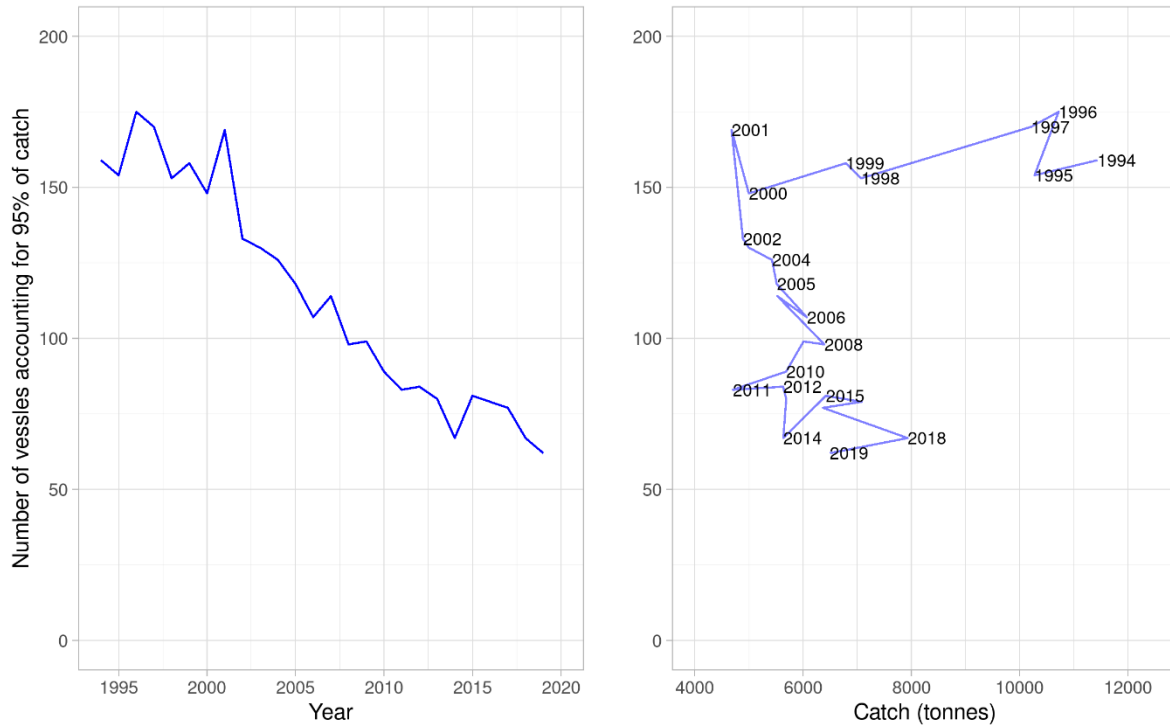


Figure 5. Plaice. Number of vessels (all gear types) accounting for 95% of the total catch annually since 1994. Left: Plotted against year. Right: Plotted against total catch. Data from the Directorate of Fisheries.

Mynd 5. Skarkoli. Fjöldi skipa og báta (öll veiðarfæri) sem veiddu 95% heildaraflans hvert ár frá 1994. Vinstri: Sýnt eftir árum. Hægr: Sýnt í samanburði við heildarafla. Gögn frá aflaskráningarkerfi Fiskistofu.

CATCH PER UNIT 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 at 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 in trawl, like in the demersal seine fishery, gradually increased from 120 kg/hour in 2000 to about 300 kg/hour in 2019.

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 but since then it decreased continuously to lowest level in 2015 (Figure 6). Since then the demersal seine effort has increased and was in 2018 and 2019 about half of what it was when it peaked in 2007. This is both because fewer seiners are fishing and CPUE is higher. Effort in the demersal trawl fishery (number of tows where plaice was 10% or more of the total catch) has gradually decreased from the peak in 2004 to the lowest value in 2015 (about half of what it was in 2004) and has been at that level since then (Figure 6).

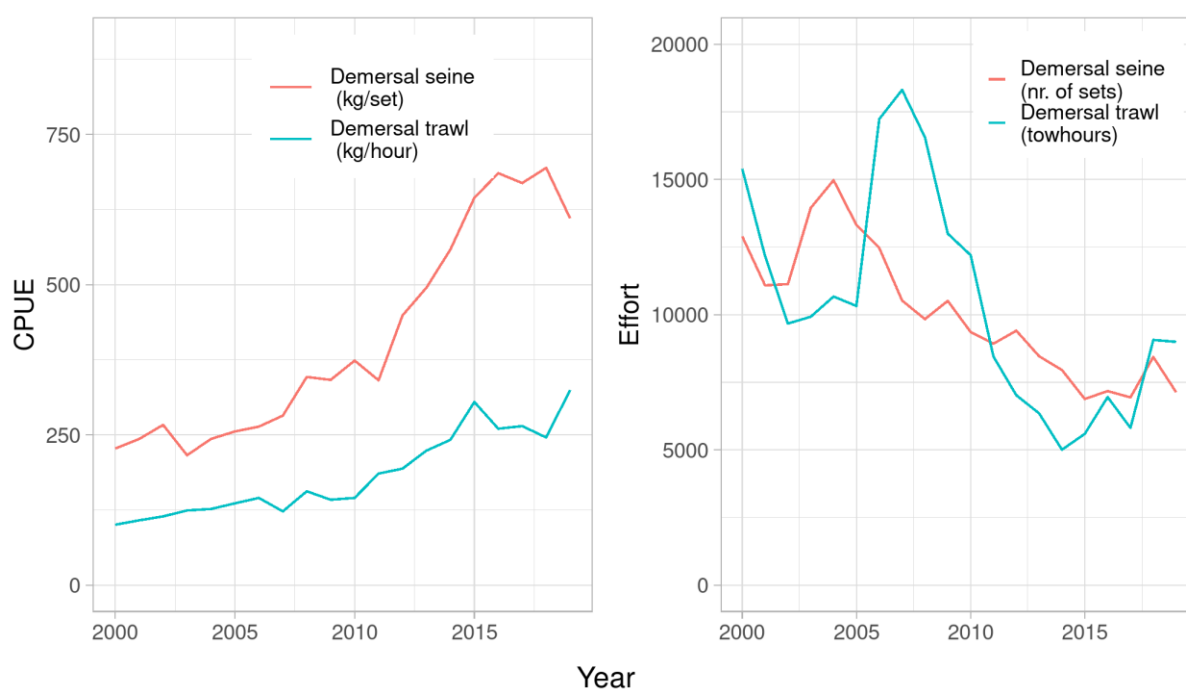


Figure 6. Plaice. Non-standardised estimates of CPUE (left) and fishing effort (right) from demersal seine (kg/set or nr. of sets) in red and demersal trawl (kg/hour or towhours) in blue.

Mynd 6. Skarkoli. Afli á sóknareiningu (vinstri) og sókn (hægri) með dragnót (kg í kasti eða fjöldi kasta, rautt) og botnvörpu (kg/klst eða togtímar, blátt).

AGE DISTRIBUTION OF LANDED PLAICE

Analysis done in 2013 suggested that excessive amounts of otoliths were being taken from commercial catches of plaice, and as a result the number of samples taken have been greatly reduced. Before this change, around 6000-7000 otoliths were being sampled yearly, but for last five years 33-45 samples from demersal seine and 14-27 samples from bottom trawl were collected, or a total of 800-1125 and 350-670 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.

Tafla 2. Skarkoli. Fjöldi sýna og aldursgreindra fiska úr lönduðum afla.

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

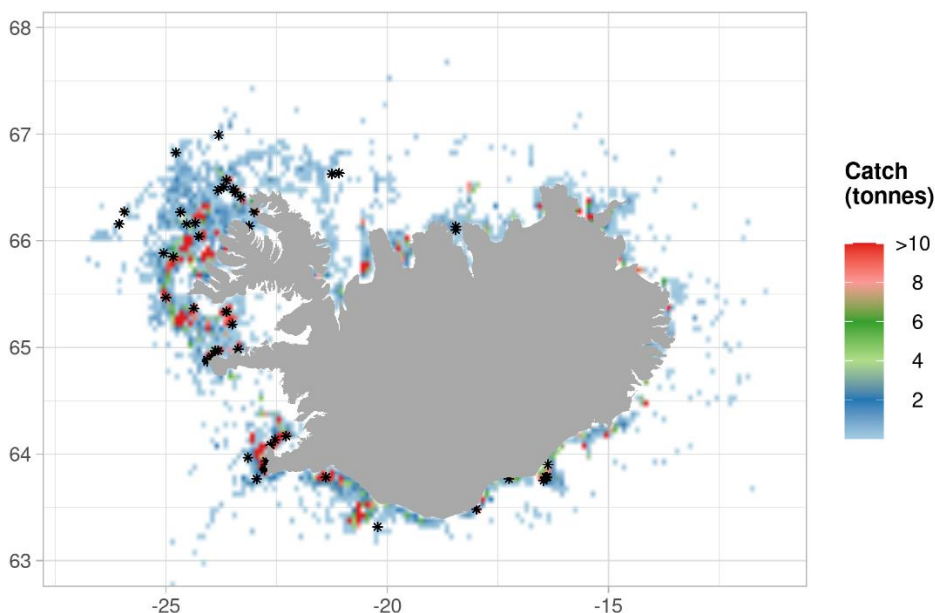


Figure 7. Plaice. Fishing grounds in 2019 as reported in logbooks and positions of samples taken from landings (asterisks).

Mynd 7. Skarkoli. Veiðisvæði við Ísland árið 2019 samkvæmt afladagbókum og staðsetningar sýna úr lönduðum afla (stjörnur).

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 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. The largest cohorts have been 6-8 year old fish in the last 5 years, with the exception of last year, whereas 4-7 year old fish were most common in 2001-2007.

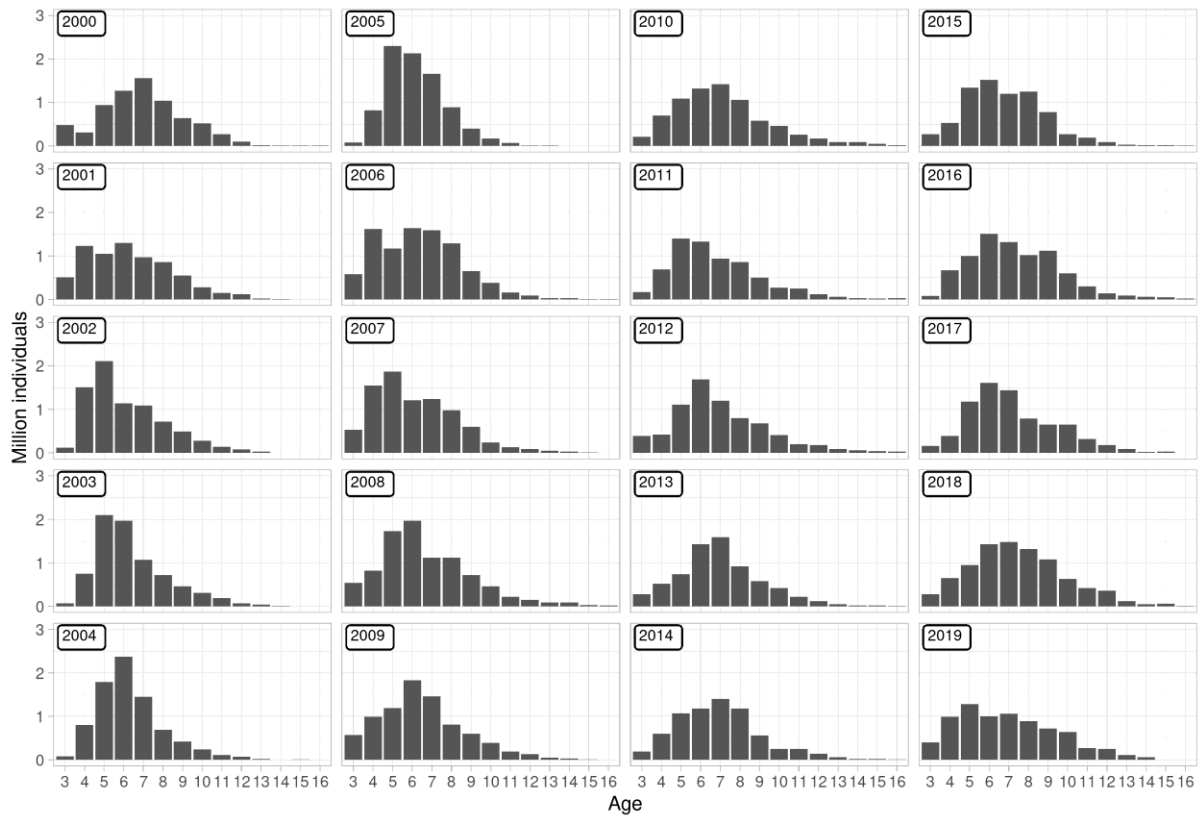


Figure 8. Plaice. Estimated age distribution of landed catch based on landings and otoliths collected from landed catch.

Mynd 8. Skarkoli. Áætluð aldursdreifing landaðs afla byggð á aldursgreiningum á fiskum úr afla.

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 42.6 cm in 2019.

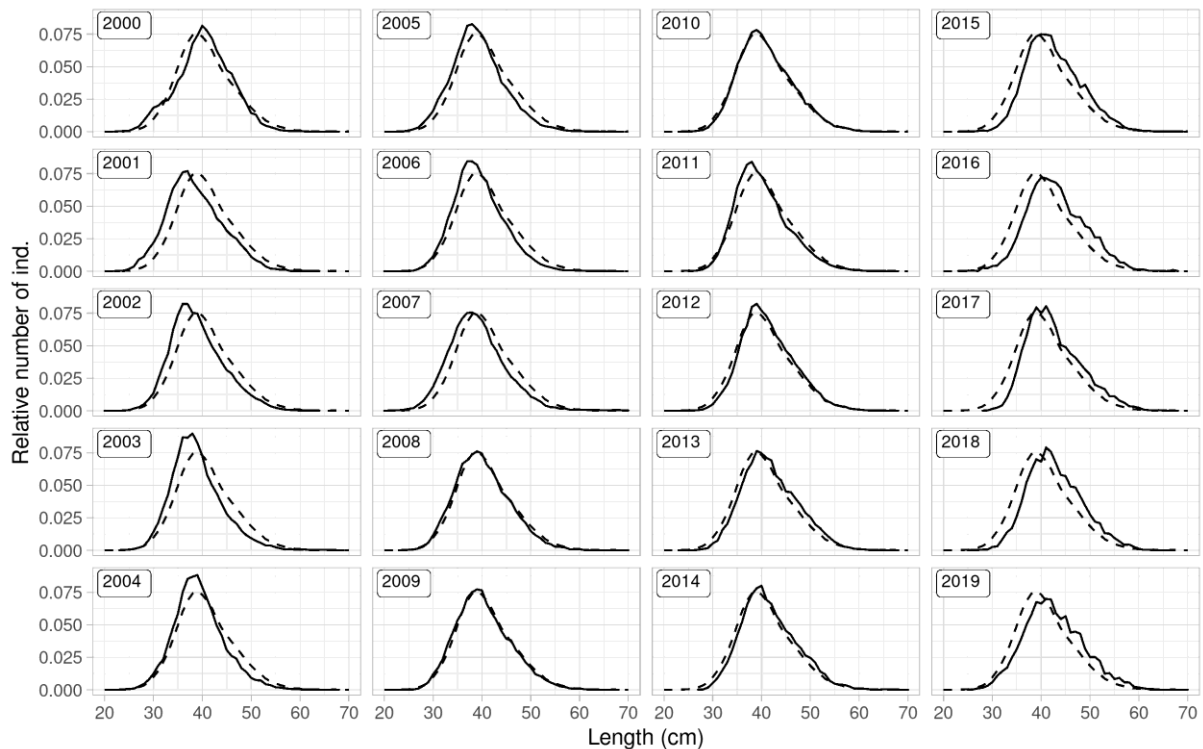


Figure 9. Plaice. Length distribution from landed catch in 2000-2019. The dotted line represents the mean length distribution for the period.

Mynd 9. Skarkoli. Lengdardreifing aflasýna árin 2000-2019 ásamt meðallengdardreifingu fyrir öll árin (punktalína).

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. 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, 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 2003-2017 the

indices gradually increased but have decreased again in the last three years. 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.

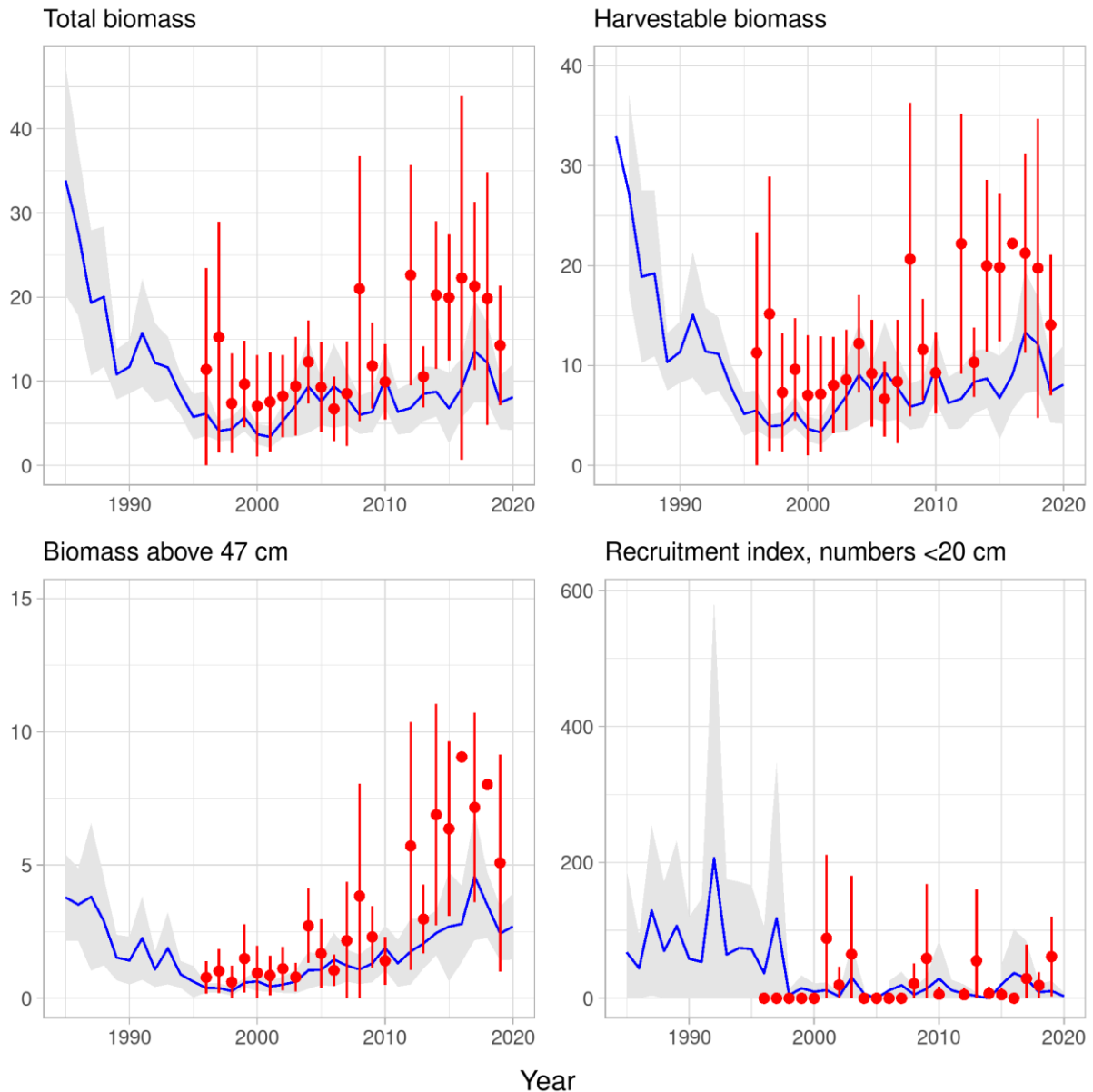


Figure 10. Plaice. Total biomass indices (upper left), harvestable biomass indices (≥ 30 cm, upper, right), biomass indices of larger individuals (≥ 47 cm, lower left) and juvenile abundance indices (≤ 20 cm, lower right) from the spring survey (blue) from 1985 and autumn survey (red) from 1996, along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

Mynd 10. Skarkoli. Stofnviðisitala (efri til vinstri), viðisitala veiðistofns (≥ 30 cm og stærri, efri til hægri) og viðisitala stærri einstaklinga (≥ 47 cm, neðri til vinstri) og nýliðunarviðisitala (≤ 20 cm, neðri til hægri), úr stofnmælingu botnfiska að vori (blátt) frá árinu 1985 og hausti (rautt) frá árinu 1996, ásamt staðalfrávik.

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 40 cm in 2020. 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.

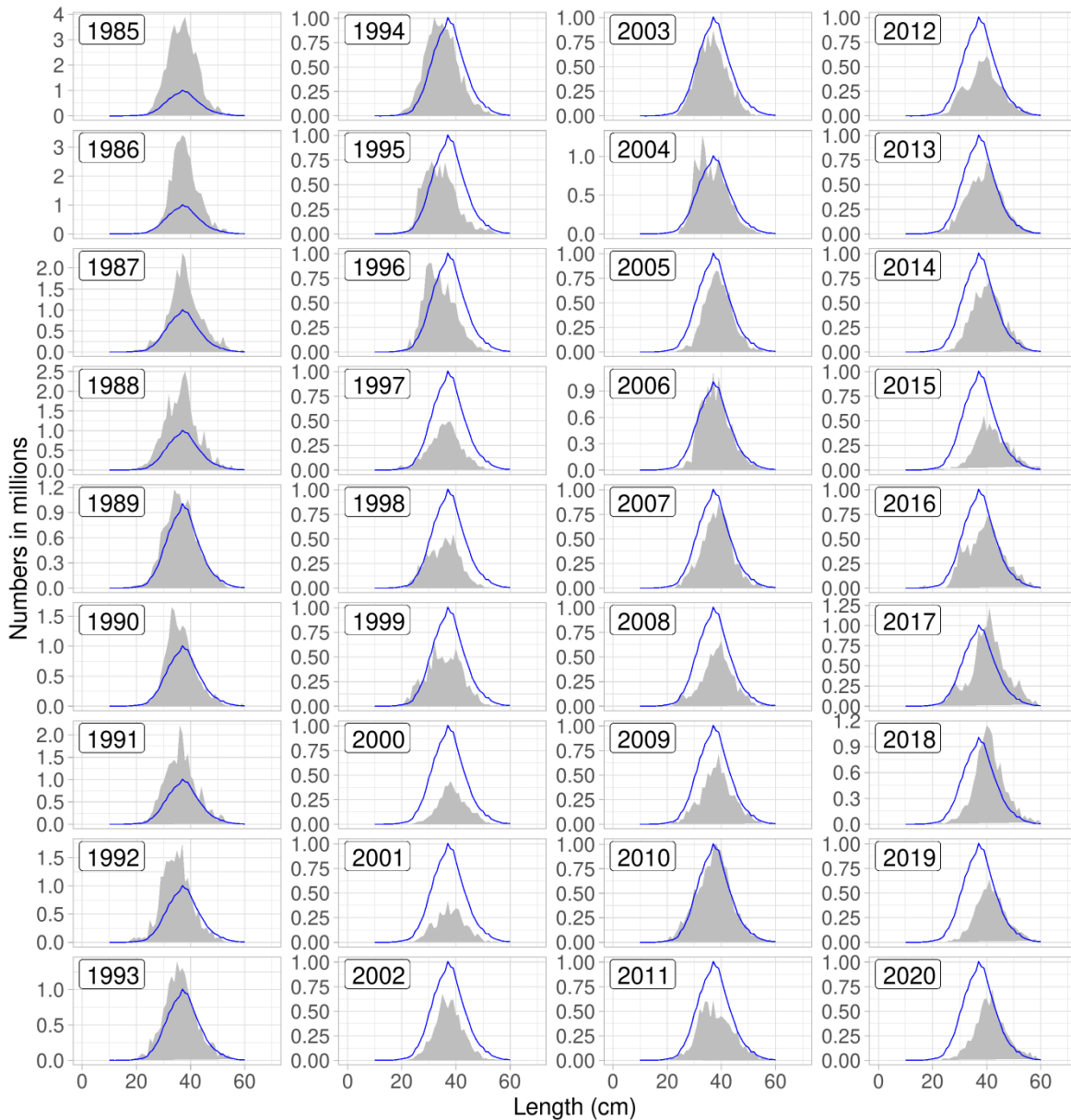


Figure 11. Plaice. Length-disaggregated abundance indices from the spring survey. The blue line shows the mean for all years. Note different scale on y-axes.

Mynd 11. Skarkoli. Lengdarskiptar vísitölur úr stofnmælingu botnfiska að vori frá 1985 ásamt meðaltali allra ára (blá lína). Ath. Mismunandi skali á y-ásum.

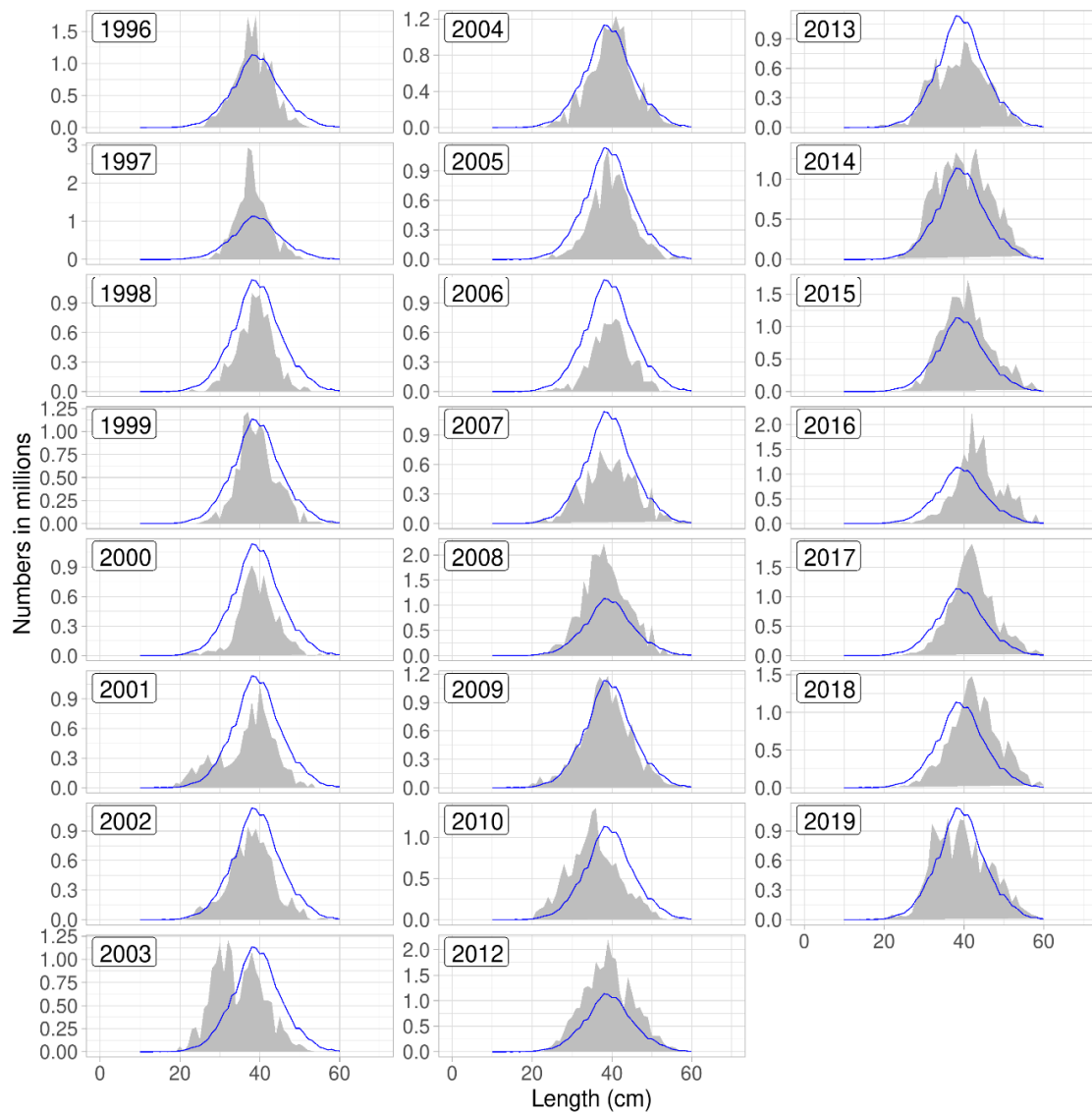


Figure 12. Plaice. Length-disaggregated abundance indices from the autumn survey. The blue line shows the mean for all years. Note different scale on y-axes.

Mynd 12. Skarkoli. Lengdarskiptar vísitölur úr stofnmælingu botnfiska að hausti frá 1996 ásamt meðaltali allra ára (blá lína). Ath. Mismunandi skali á y-ásum.

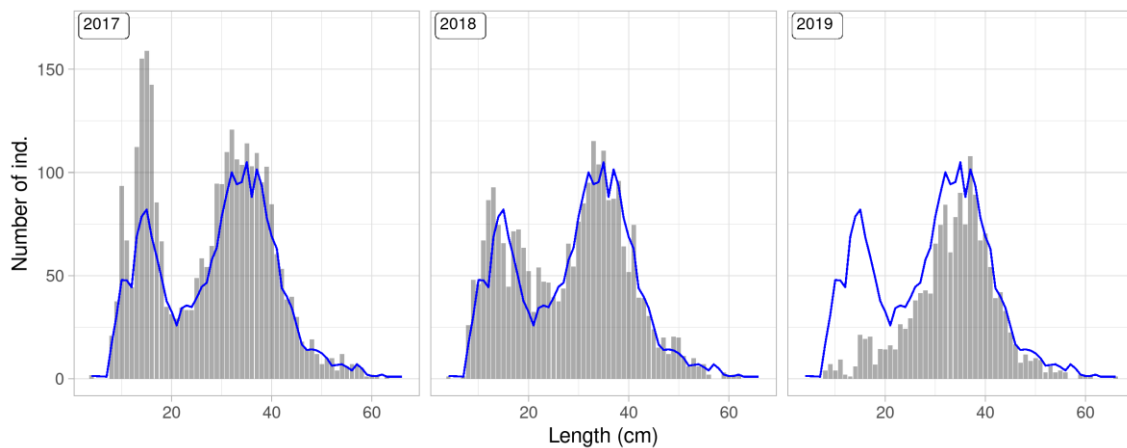


Figure 13. Plaice. Length distribution from beam trawl survey. The blue line shows the mean for all three years.

Mynd 13. Skarkoli. Lengdardreifing veiddra einstaklinga í grunnslóðaralli (BTS) ásamt meðaltali árána þriggja (blá lína).

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 2020 (Figure 14). Spatial distribution of the catch of plaice 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.

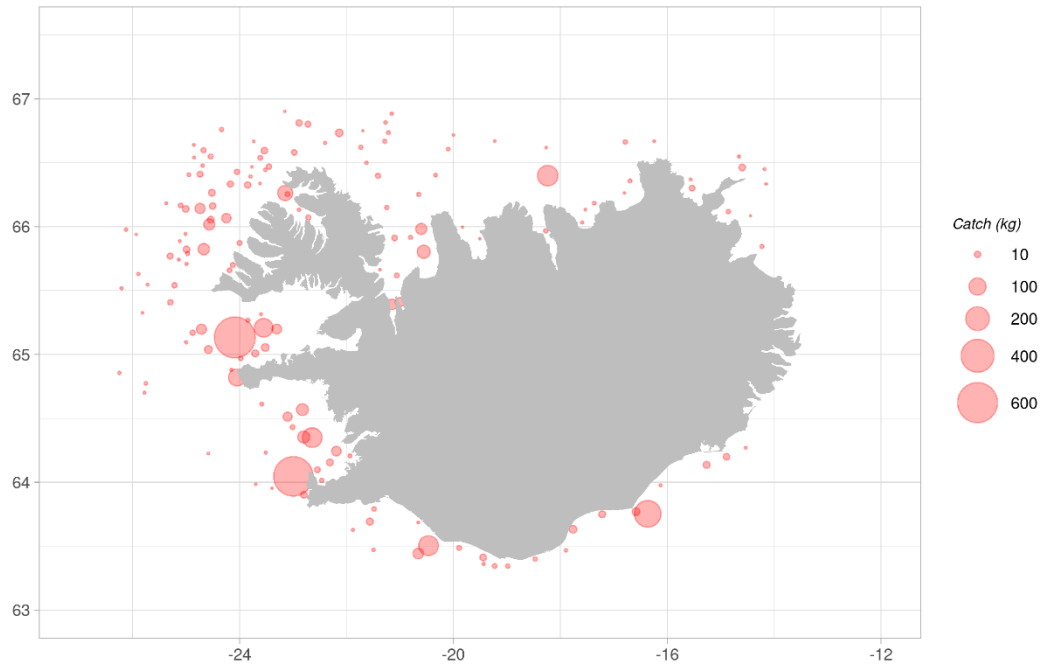


Figure 14. Plaice. Spatial distribution in the spring survey in 2020.

Mynd 14. Skarkoli. Útbreiðsla í stofnmælingu botnfiska að vori 2020.

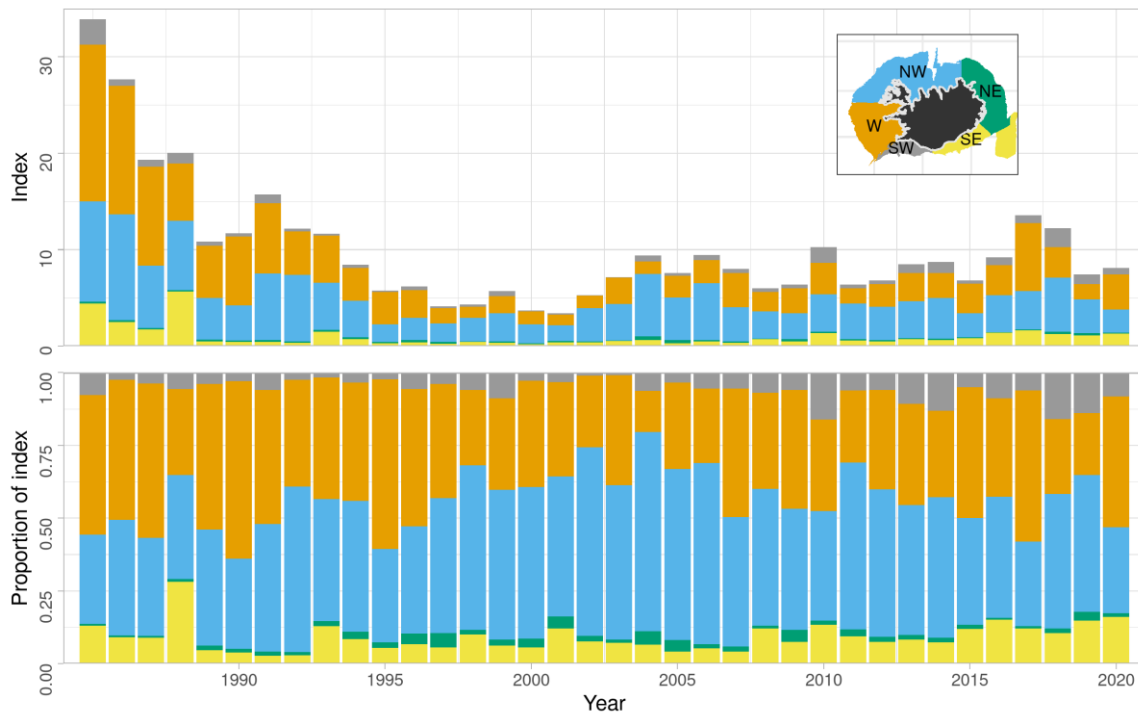


Figure 15. Plaice. Spatial distribution of biomass index from the spring survey.

Mynd 15. Skarkoli. Dreifing lífmassavísitölu í stofnmælingu botnfiska að vori.

Plaice were mainly caught in the main feeding grounds for plaice in the northwest of the country in the autumn survey 2019 (Figure 16). Most plaice in the autumn survey has been caught on the traditional feeding grounds in the northwest. However, there has been a slight 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 2019, however, vast majority of the plaice was caught in the NW area.

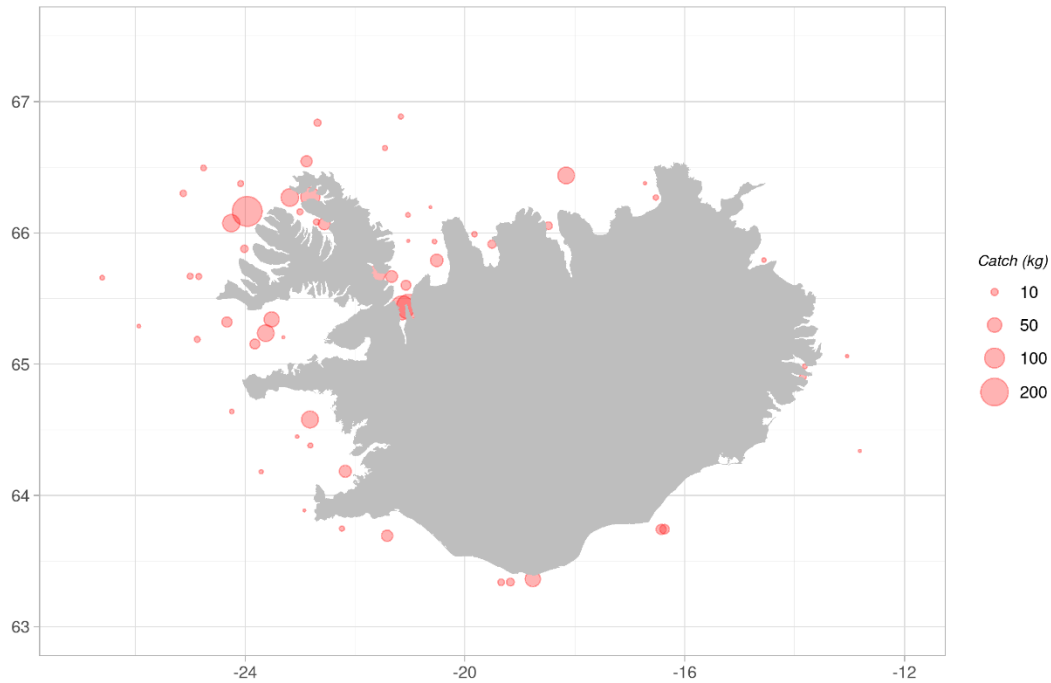


Figure 16. Plaice. Spatial distribution in the autumn survey in 2019.

Mynd 16. Skarkoli. Útbreiðsla í stofnmælingu botnfiska að hausti árið 2019.

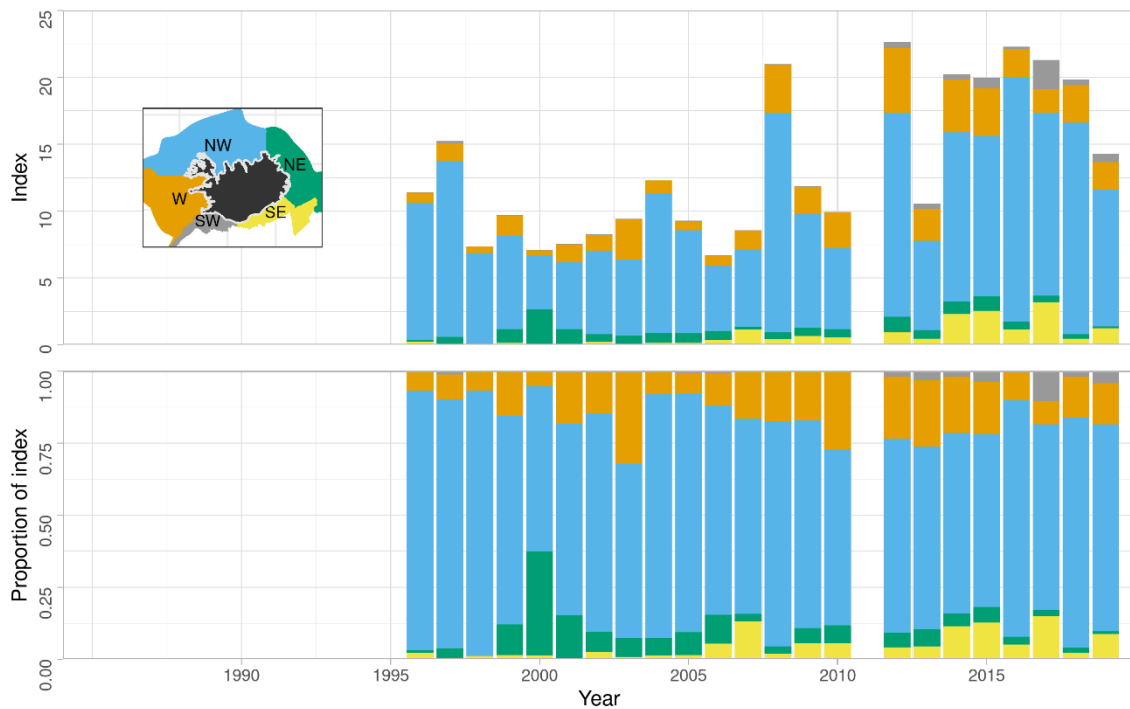


Figure 17. Plaice. Spatial distribution of biomass index from the autumn survey.

Mynd 17. Skarkoli. Dreifing lífmassavísitölu í stofnmælingu botnfiska að hausti.

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).

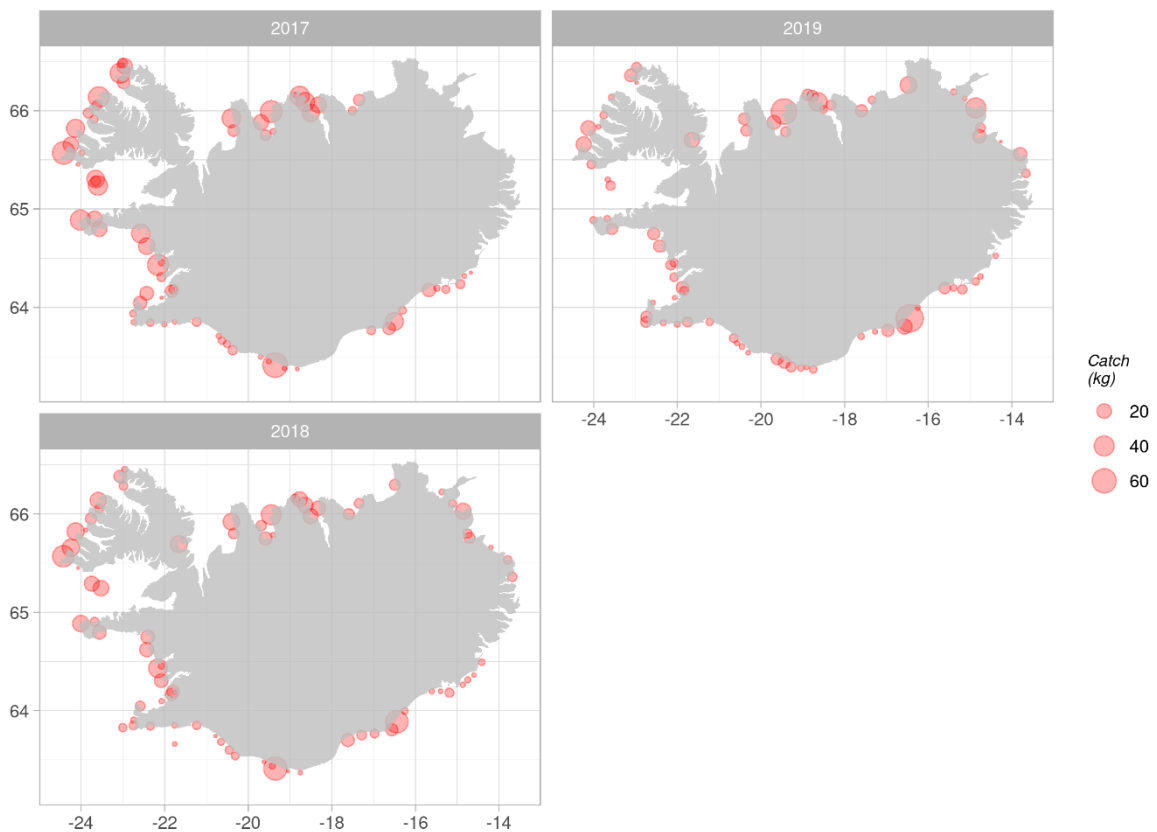


Figure 18. Plaice. Spatial distribution in the beam trawl survey since 2017. The NE area was not sampled in 2017.

Mynd 18. Skarkoli. Útbreiðsla í grunnslóðaralli frá árinu 2017. Ekki var farið á NA svæðið árið 2017.

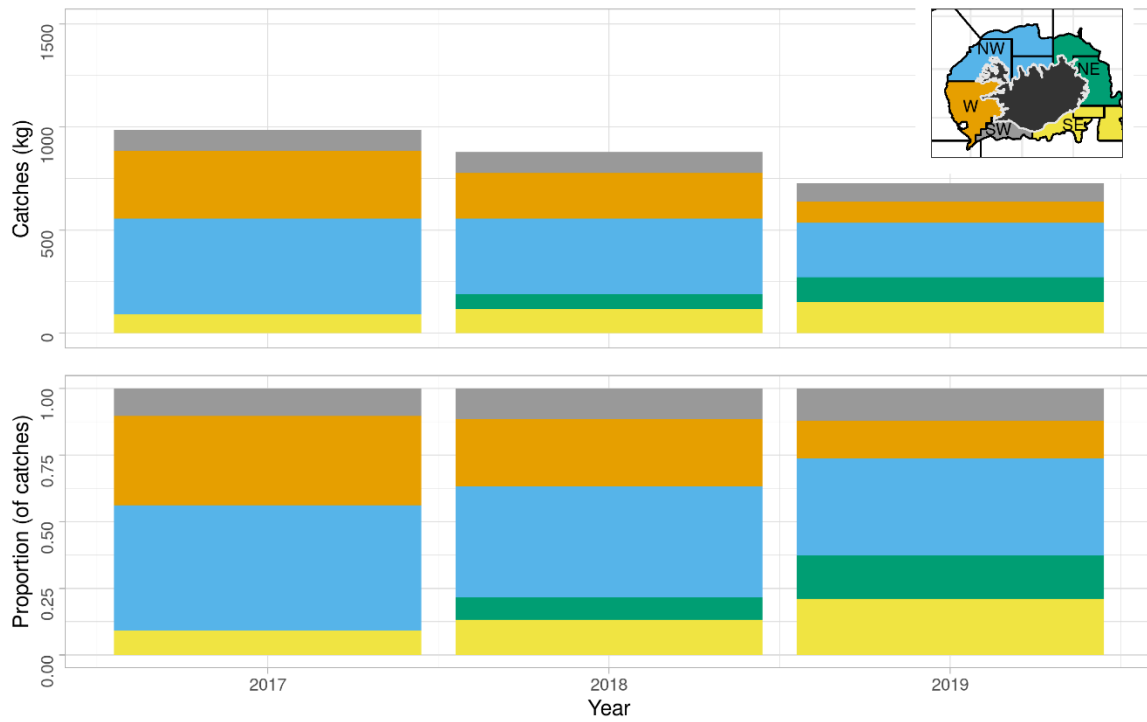


Figure 19. Plaice. Spatial distribution in the beam trawl survey since 2017. The NE area was not sampled in 2017.
Mynd 19. Skarkoli. Útbreiðsla eftir svæðum í grunnslóðaralli frá árinu 2017. Ekki var farið á NA svæðið árið 2017.

STOCK ASSESSMENT

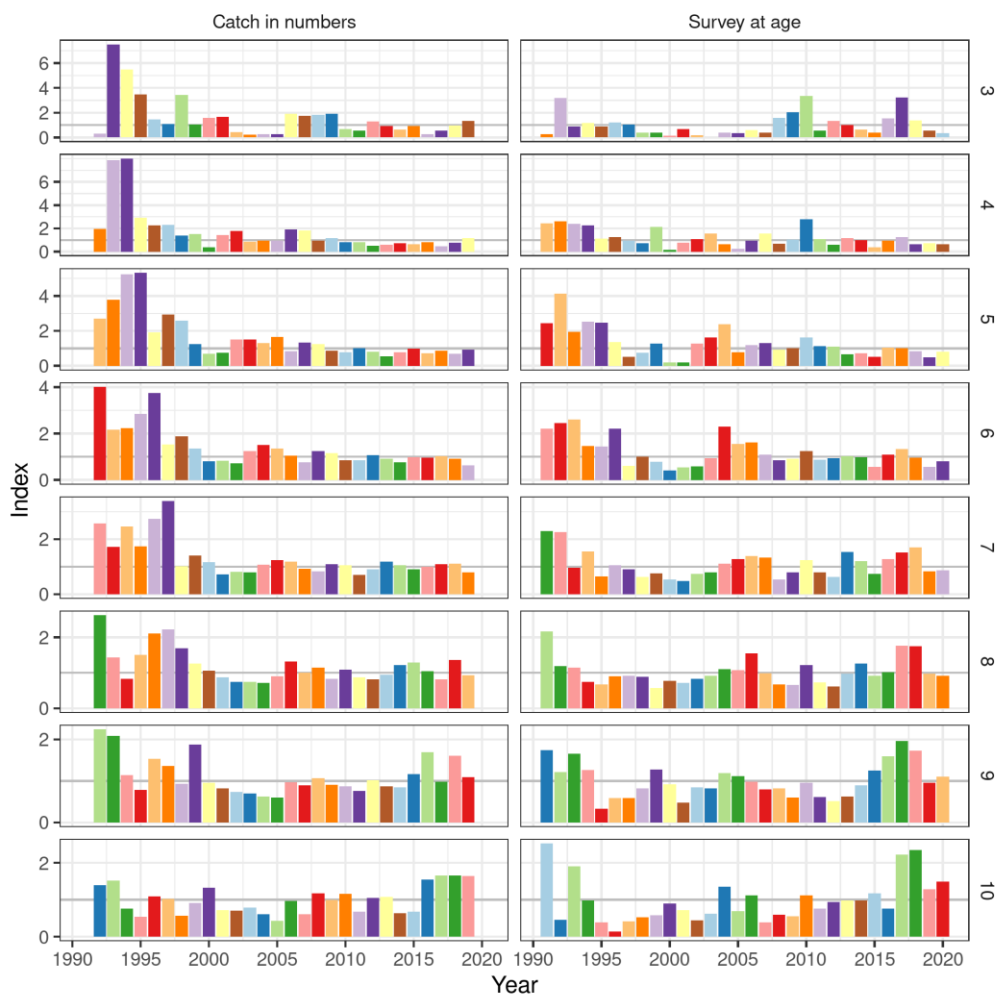


Figure 20. Plaice. Estimated numbers of 3-10 year old fish in the commercial catch (1992-2019) and age-disaggregated survey indices from the spring survey (1991-2020). Input data for the stock assessment.

Mynd 20. Skarkoli. Metinn fjöldi 3-10 ára fiska í afla (1992-2019) og aldurskiptar vísitölur í stofnmælingu að vori (1991-2020). Inntaksgögn fyrir stofnmatíð.

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 20. 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 21). The result of the assessment indicate that the stock is stable (Figure 22 & 23). Maximum sustainable yield is the basis for the advice, and the reference point is set as $F = 0.22$.

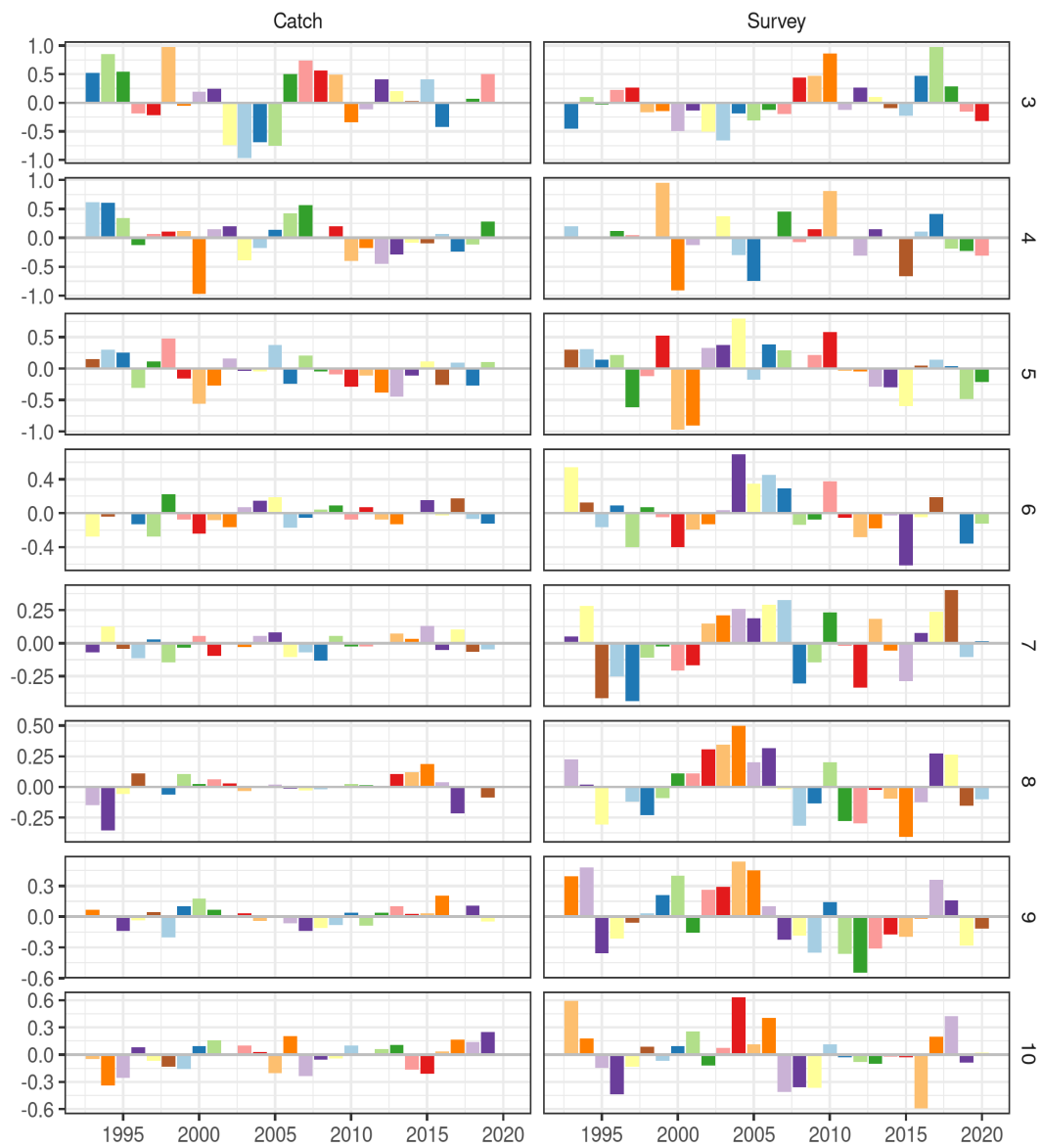


Figure 21. Plaice. Residuals of the model fit to IS-SMB survey indices and catch data by age.

Mynd 21. Skarkoli. Frávik stofnmatslíkans, bæði fyrir aldursskiptan afla og stofnvísitölur úr SMB.

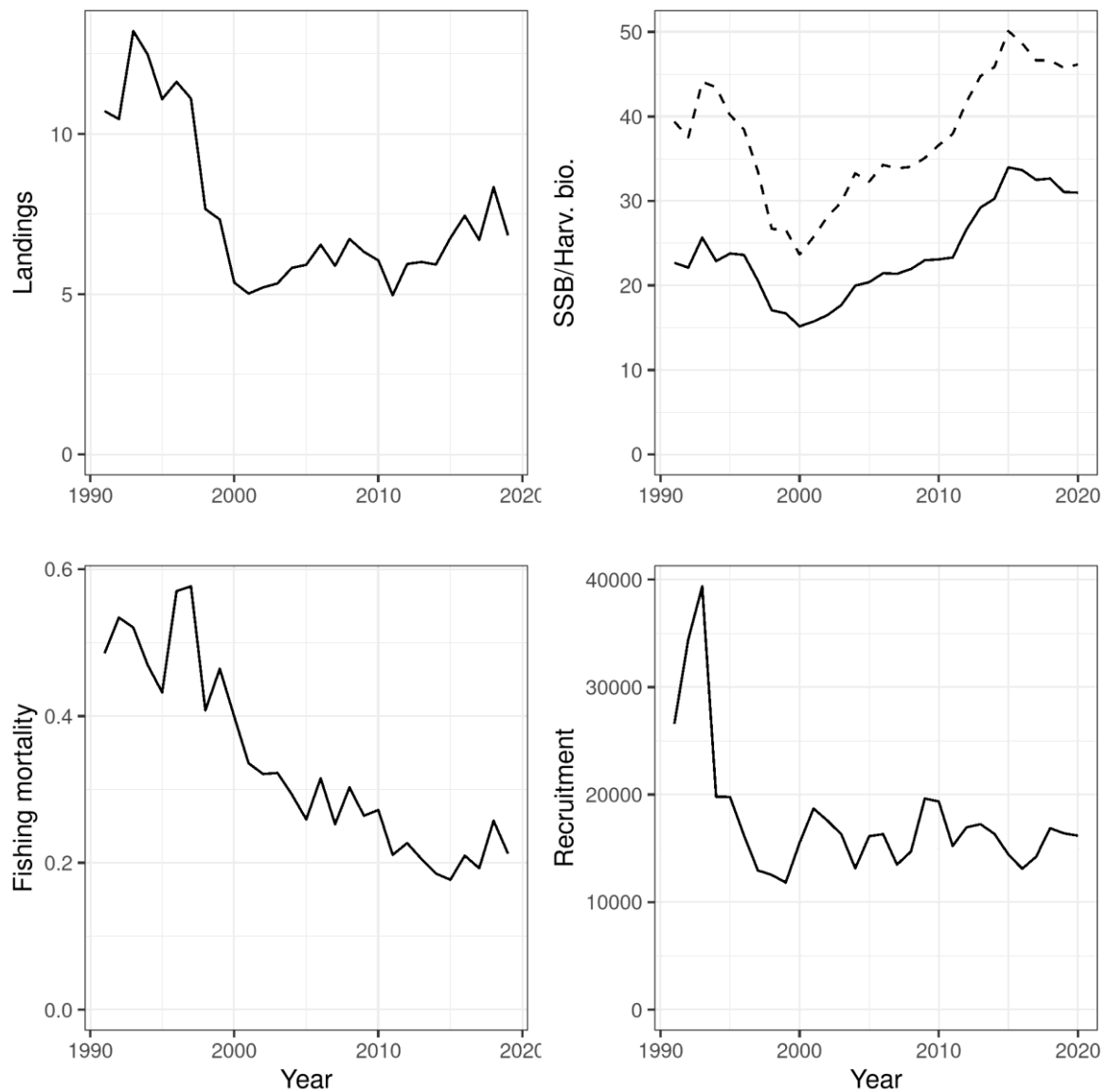


Figure 22. Plaiice. Summary from the assessment 2020. Results of spawning stock (SSB) and harvestable stock biomass, fishing mortality, and recruitment (age 3) are shown.

Mynd 22. Skarkoli. Niðurstöður stofnmats árið 2020. Niðurstöður eru sýndar fyrir hrygningarstofn (SSB) og veiðistofn, fiskveiðidánartölu og nýliðun (3 ára).

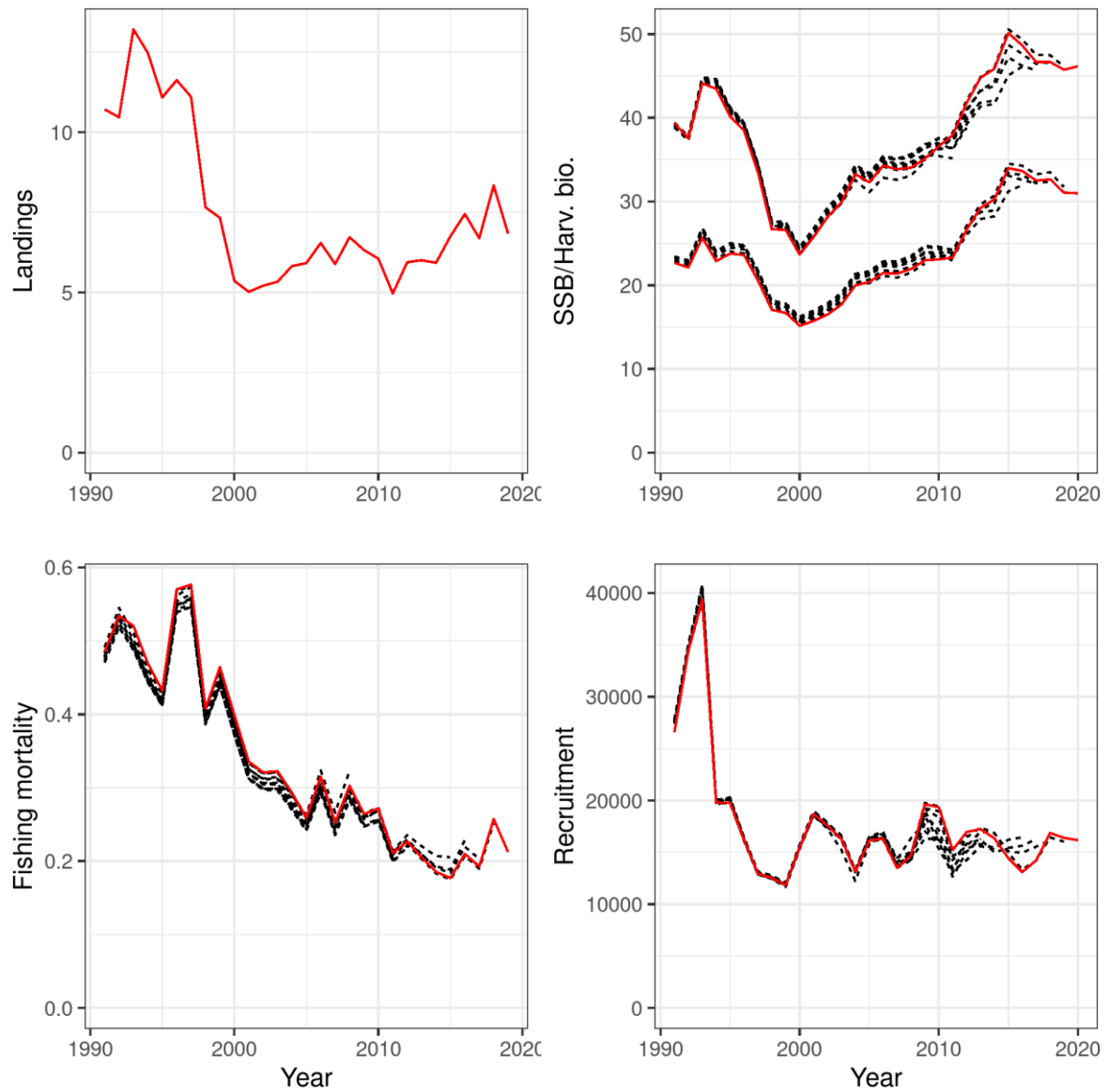


Figure 23. Plaice. Analytical retrospective plots illustrating stability in model estimates over a 9-year 'peel' in data. Results of spawning stock (SSB) and harvestable stock biomass, fishing mortality, and recruitment (age 3) are shown.

Mynd 23. Skarkoli. Endurlitsgreining sem sýnir stöðuleika í mati stofnmatslíkansins fimm ár aftur í tímann. Niðurstöður eru sýndar fyrir hrygningarstofn (SSB) og veiðistofn, fiskveiðidánartölu og nýliðun (3 ára).

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. One reason is that no formal harvest rule exists for this stock. In some recent quota years, landings have been lower than the advised TAC (Table 6).

Table 6. Plaice. Recommended TAC, National TAC set by the Ministry, and landings (tonnes).

Tafla 6. Skarkoli. Tillögur Hafrannsóknastofnunar um hámarksafla, ákvörðun stjórnvalda um aflamark og landaður afli (tonn).

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	
2020/21	7037		

Figure 24, shows the net transfers in the Icelandic ITQ-system. From 2002-2008 (positive values in Figure 19) there was a net transfer of other species being transferred to plaice quota. 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).

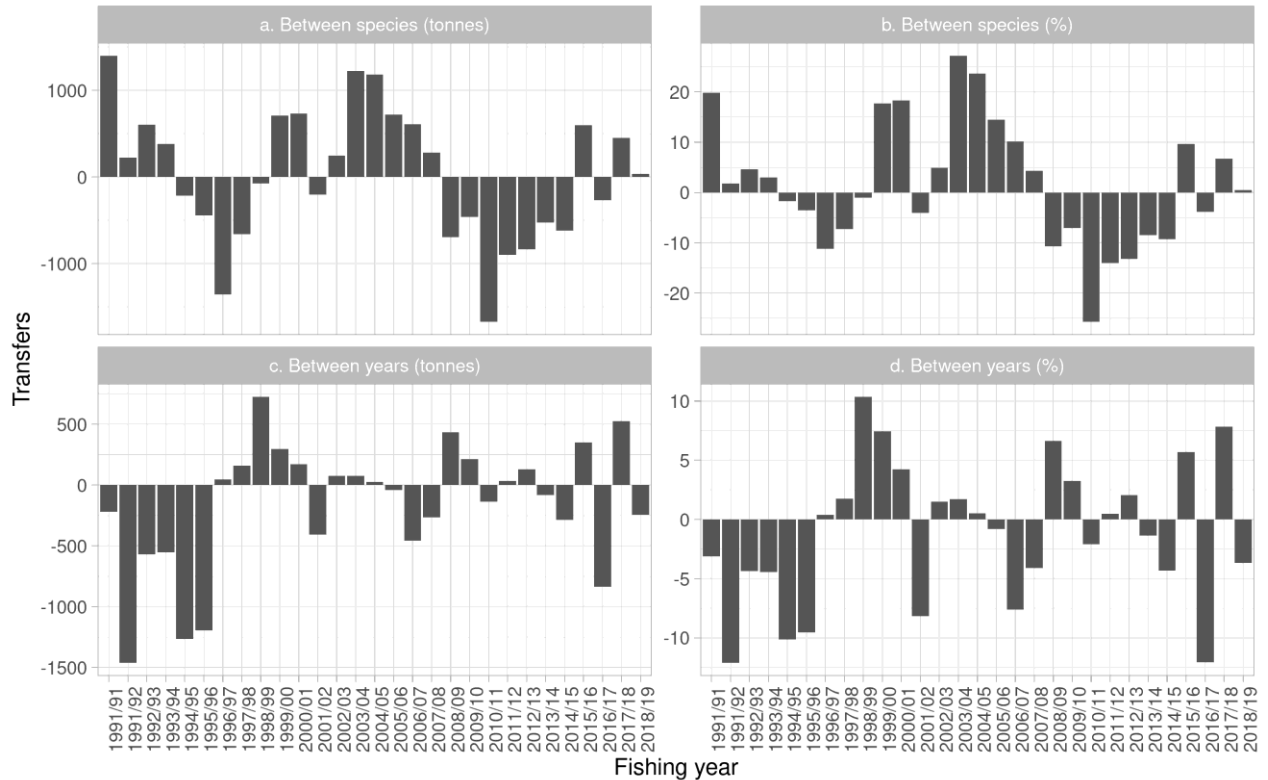


Figure 24. Plaice. Net transfers of quota to and from plaice in the Icelandic ITQ system by quota year. Between species (upper): Positive values indicate a transfer of other species to plaice, but negative values indicate a transfer of plaice quota to other species. Between years (lower): Net transfer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

Mynd 24. Skarkoli. Nettó tilfærsla á kvóta eftir fiskveiðiárum. Tilfærsla milli tegunda (efri myndir): Jákvæð gildi tákna tilfærslu á kvóta annarra tegunda yfir á skarkola en neikvæð gildi tilfærslu skarkolakvóta á aðrar tegundir. Tilfærsla milli ára (neðri myndir): Nettó tilfærsla kvóta á viðkomandi fiskveiðiári.