

ATLANTIC WOLFFISH – STEINBÍTUR

Anarhichas lupus

GENERAL INFORMATION

Atlantic wolffish is an oblong grey fish with large teeth and 10-12 stripes on each side. In the catch, common length range is 50-80 cm, but the largest one caught around Iceland was 125 cm. Atlantic wolffish is mainly found in the northwest part of the continental shelf of Iceland. At Atlantic wolffish feeding grounds, the substrate is commonly sand or clay at depth less than 100 m, but in its spawning grounds the substrate is usually coarser, with holes and crevices at depth below 100 meters.

THE FISHERY

The main fishing grounds for Atlantic wolffish are in the west and northwest part of the Icelandic shelf. From 2010, the proportion of the catch has been increasing northwest of Iceland compared to west of Iceland. Catches at the main spawning ground (Látragrunn) west of Iceland have been decreasing since 2008 (Figures 1-2).

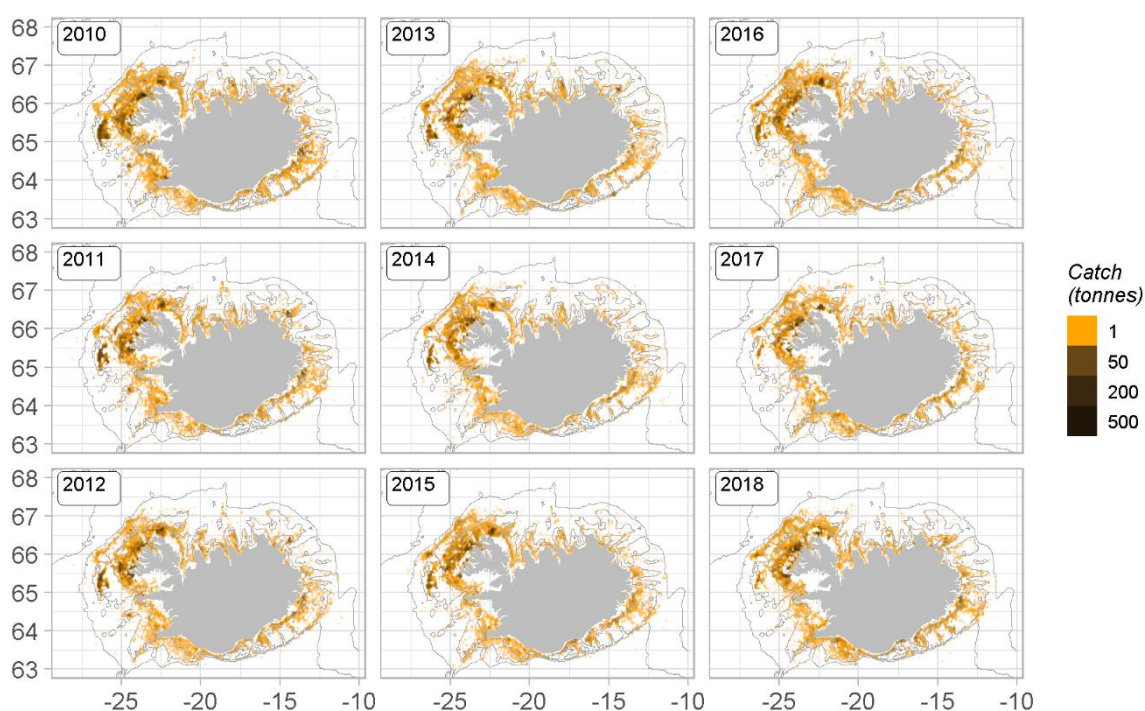


Figure 1. Atlantic wolffish. Geographical distribution of the Icelandic fishery since 2010. Reported catch from logbooks.

Mynd 1. Steinbítur. Útbreiðsla veiða á Íslandsmiðum frá 2010 samkvæmt afladagbókum.

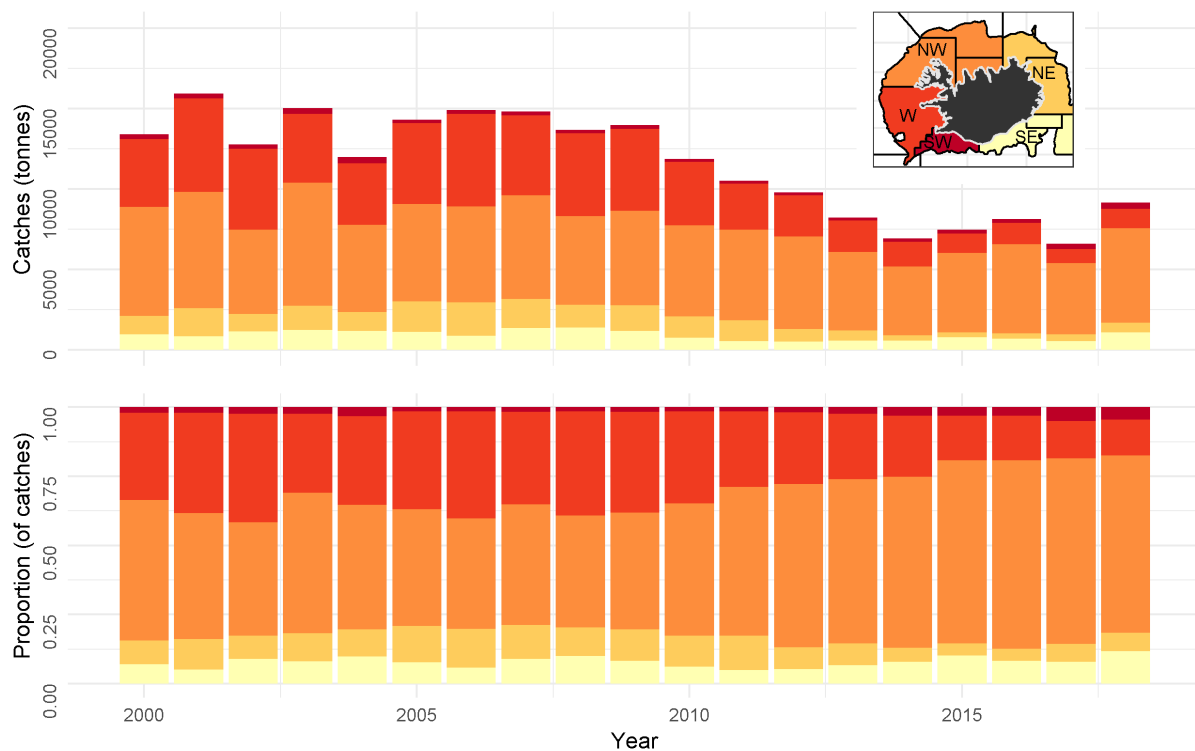


Figure 2. Atlantic wolffish. Spatial distribution of the Icelandic fishery by fishing area since 2000 according to logbooks. All gears combined.

Mynd 2. Steinbítur. Útbreiðsla veiða við Ísland frá 2000 samkvæmt aflaskýrslum. Öll veiðarfæri samanlagt.

About 80% of the catch of Atlantic wolffish is caught at depth less than 120 m. Proportion of the catch taken at depth range 0-60 m decreased from 2003 to 2007, but since then it has been increasing. At the range 61-120 the proportion of the catch has been rather stable since 2000. At depths of 121-180 m, which includes the main spawning ground (Látragrunn), it increased in 2003-2008 but since then it has generally been decreasing (Figure 3).

More than 97% of the Atlantic wolffish catch is taken by longline (50-65%), demersal trawl (20-30%) and demersal seine (about 10%) (Figure 4). This proportion has been relatively stable through the years. However, in 2004-2008 longline and demersal trawl catches were similar (40-50%) and in the last two years catch in demersal seine has been increasing and is now greater than in demersal trawl (Figure 4).

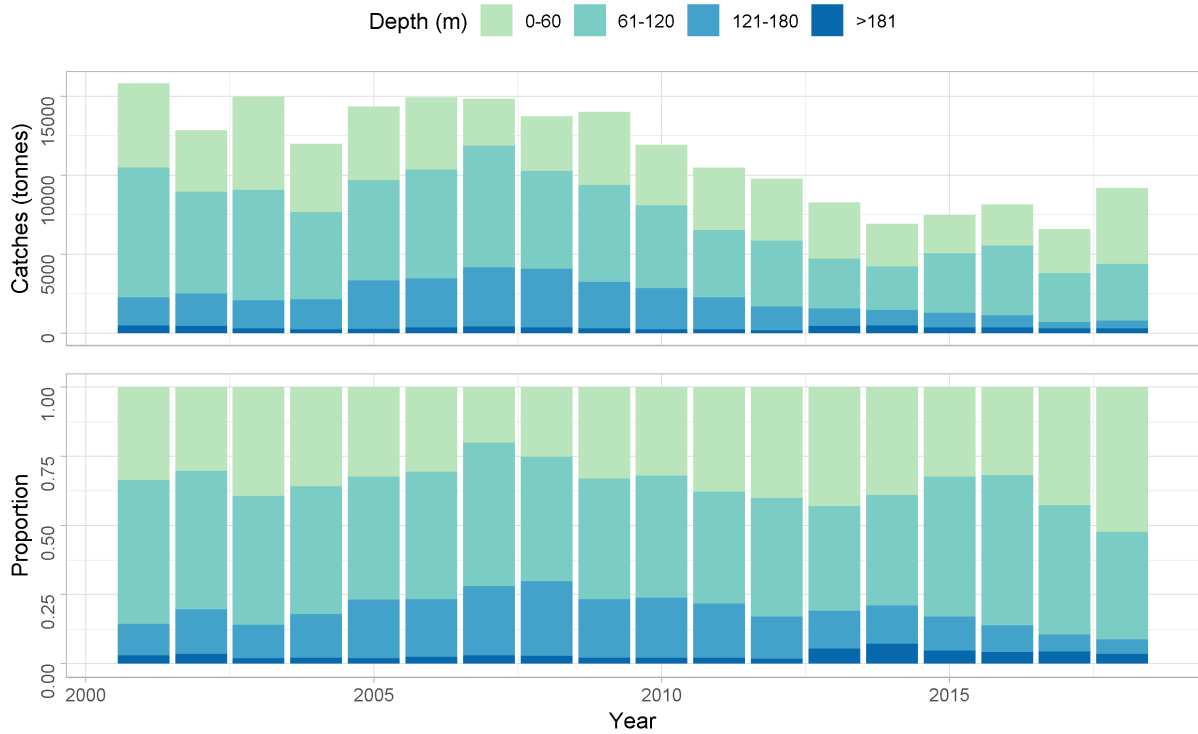


Figure 3. Atlantic wolffish. Depth distribution of demersal trawl, longline and demersal seine catches according to logbooks.

Mynd 3. Steinbítur. Afli í botnvörpu, á línu og dragnot, skipt eftir dýpi, samkvæmt afladagbókum.

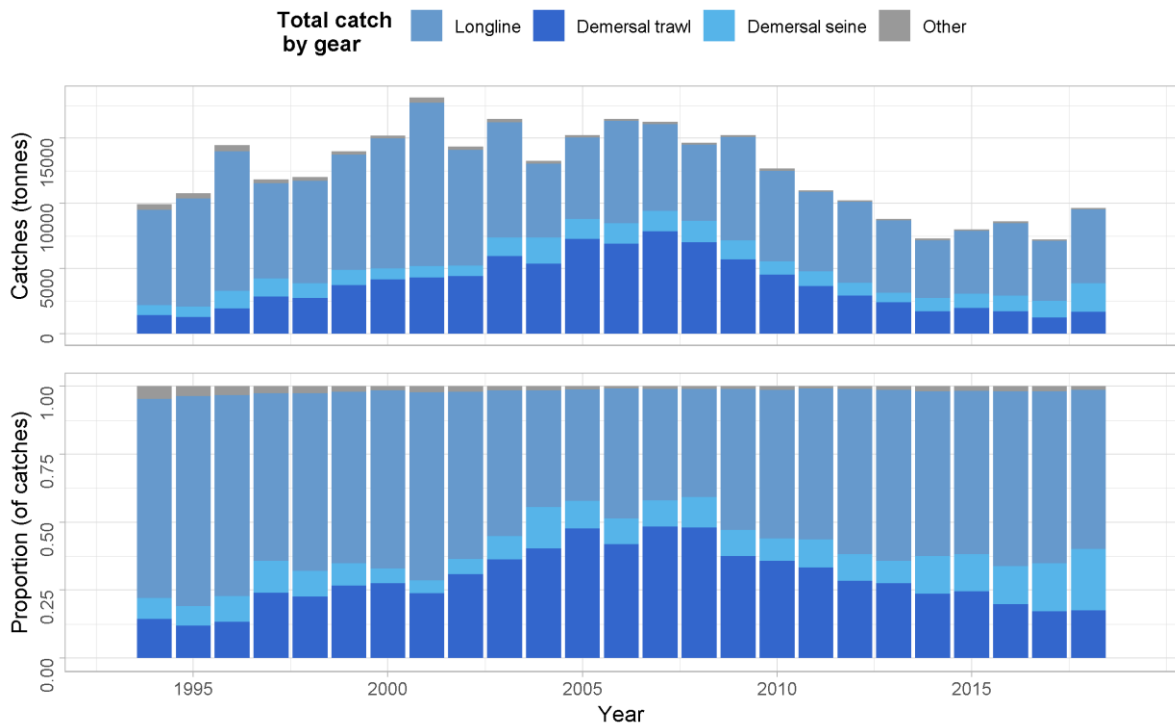


Figure 4. Atlantic wolffish. Total catch (landings) by fishing gear since 1993, according to statistics from the Directorate of Fisheries.

Mynd 4. Steinbítur. Landaður afli eftir veiðarfærum frá 2000, samkvæmt aflaskráningarkerfi Fiskistofu.

Since 2001, the number of longliners and trawlers reporting catches of 10 tonnes/year or more of Atlantic wolffish has decreased. In the longliners fleet the number has dropped from 198 vessels in 2001, down to 67 in 2018. The number of trawlers has also decreased significantly; from 76 in 2000 to 40 last year (Table 1).

Table 1. Atlantic wolffish. Number of Icelandic vessels reporting catch of 10 tonnes/year or more of Atlantic wolffish, and all landed catch divided by gear type.

Tafla 1. Steinbítur. Fjöldi íslenskra skipa sem veitt hafa 10 tonn eða meira af steinbít yfir árið og allur landaður afli eftir veiðarfærum.

YEAR	NUMBER OF VESSELS				CATCHES (TONNES)				
	<i>Longliners</i>	<i>Trawlers</i>	<i>Seiners</i>	<i>Other</i>	<i>Longline trawl</i>	<i>Demersal trawl</i>	<i>Demersal seine</i>	<i>Other</i>	<i>Sum</i>
2000	172	76	20	1	9979	4173	834	241	15227
2001	198	76	19	4	12595	4319	862	394	18170
2002	151	65	14	3	8897	4423	800	304	14424
2003	142	63	25	1	8943	5960	1402	263	16568
2004	109	60	40	2	5746	5349	2010	216	13321
2005	96	64	34	0	6370	7247	1552	177	15346
2006	136	66	32	1	7962	6885	1569	144	16560
2007	124	65	27	1	6655	7857	1551	171	16234
2008	100	60	25	2	5810	7026	1642	152	14630
2009	124	58	34	1	7896	5709	1462	143	15210
2010	82	46	23	2	6923	4531	1033	175	12662
2011	68	36	18	0	6094	4062	1138	97	11391
2012	80	28	21	0	6209	2910	992	103	10214
2013	77	29	19	2	5537	2424	721	110	8792
2014	77	22	17	1	4463	1722	1006	138	7329
2015	68	34	18	2	4828	1926	1097	137	7988
2016	65	37	19	3	5563	1713	1201	148	8625
2017	65	26	19	1	4586	1243	1286	128	7243
2018	67	40	26	4	5657	1689	2185	125	9656

In 1994 and 1995, more than 500 vessels accounted for 95% of the annual catch of Atlantic wolffish in Icelandic waters, but this number had dropped to 200 vessels in 2008 despite higher catches. Since 2010 the number of vessels accounting for 95% of the annual catch has remained relatively constant (about 150-200 vessels), despite catch reductions (Figure 5).

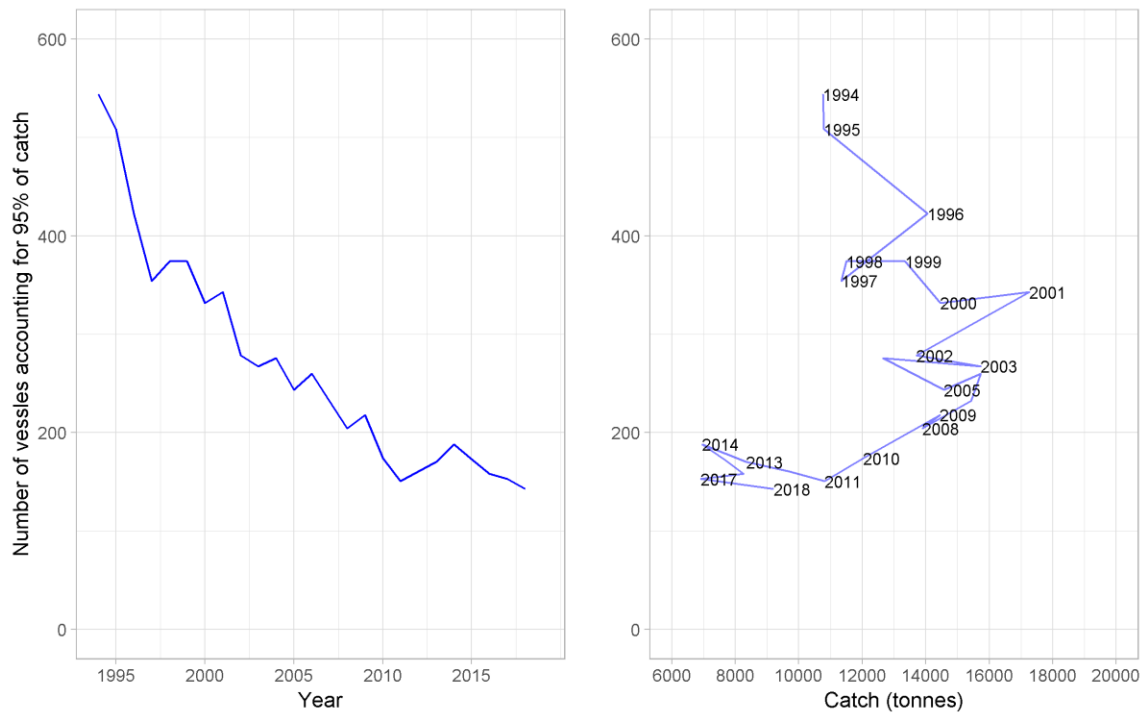


Figure 5. Atlantic wolffish. Number of vessels (all gear types) accounting for 95% of the total catch annually since 1994. Left: Plotted against year. Right: Plotted against total catch. Data from the Directorate of Fisheries.

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

CATCH PER UNIT EFFORT (CPUE) AND EFFORT.

CPUE estimates of Atlantic wolffish in Icelandic waters are not considered representative of stock abundance, as changes in fleet composition, technical improvements and differences in gear setup among other things have not been accounted for when estimating CPUE.

Non-standardised estimates of CPUE in longline (kg/1000 hooks), and demersal trawl (kg/hour), are calculated as the total weight in sets or tows in which Atlantic wolffish was more than 10% of the catch, according to logbooks. Effort of demersal trawl was defined as the number hours towed, and for longline number of hooks, in both cases where Atlantic wolffish was more than 10% of the catch.

CPUE in longline has been similar between years or around 100-150 kg/1000 hooks, except in 2018 (203 kg/1000 hooks). CPUE of demersal trawl increased from about 230 to 400 kg/h in 2000-2005, but since 2006 it has fluctuated at around 250-300 kg/h (Figure 6).

Fishing effort in longline increased from 66 million hooks in 2000 to 97 million hooks in 2001. Since then it has been generally decreasing and was around 22 million hooks in 2018. In demersal trawl, fishing effort increased from about 14 thousand tow-hours in 2004 to 23 thousand tow-hours in 2008, followed by a sharp decrease to 4.8 thousand tow-hours in 2014. Since then it has been at a similar level (Figure 6).

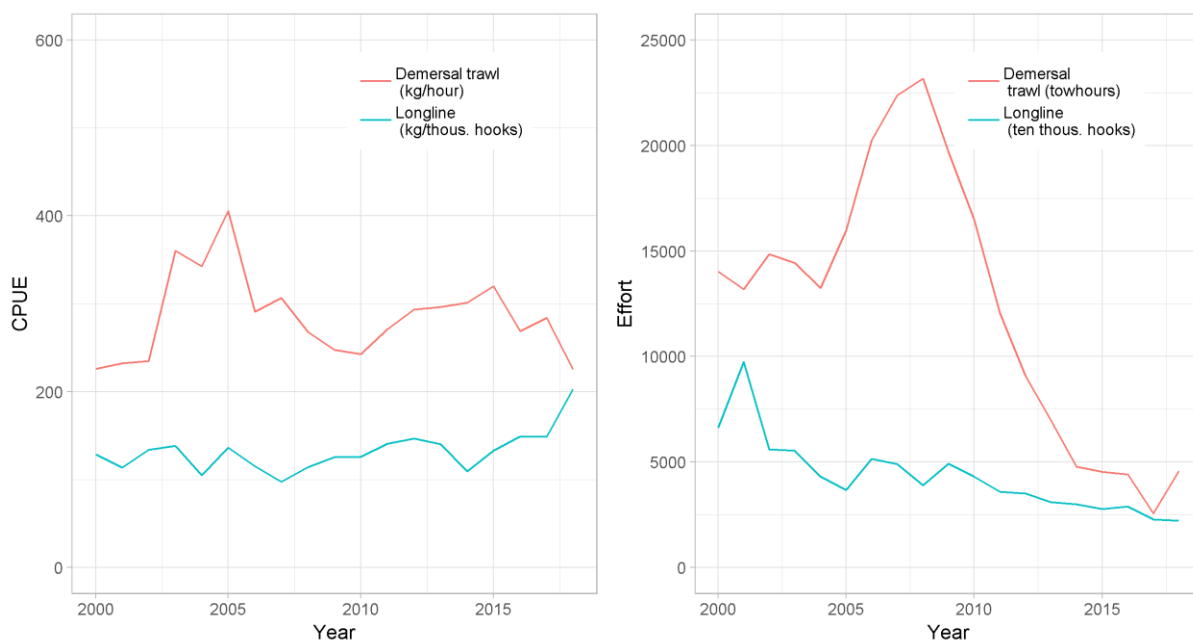


Figure 6. Atlantic wolffish. Non-standardised estimates of CPUE (left) from demersal trawl (kg/h) and longline (kg/1000 hooks). Fishing effort (right) for longline (10000 hooks) for demersal trawl (tow-hours).

Mynd 6. Steinbítur. Afli á sóknareiningu (vinstri) í botnvörpu (kg/togtími) og línu (kg/1000 krókar). Sókn (hægri) í botnvörpu (togtímar) á línu (10000 krókar).

AGE DISTRIBUTION OF LANDED ATLANTIC WOLFFISH

Analysis done in 2013 by the MFRI suggested that excessive amounts of otoliths were being taken from commercial catches of Atlantic wolffish, and as a result the number of samples taken has been greatly reduced. Before this change, around 2000-2400 otoliths were sampled yearly, but in 2018 a total of 1200 otoliths were sampled in 22, 9 and 17 samples from longline, demersal trawl and demersal seine, respectively. Samples were not taken from other gear, as they represent a very small proportion (~2%) of the total catch (Table 2, Figure 7).

Table 2. Atlantic wolffish. Number of samples and aged otoliths from landed catch of Atlantic wolffish.

Tafla 2. Steinbítur. Fjöldi sýna og aldursgreindra fiska úr lönduðum steinbítsafla.

Year	Longline		Demersal trawl		Demersal seine	
	Samples	Otoliths	Samples	Otoliths	Samples	Otoliths
2010	29	1669	18	1040	5	285
2011	14	750	15	778	9	550
2012	26	1300	14	700	7	350
2013	25	1249	14	692	5	249
2014	30	800	26	675	28	700
2015	25	625	19	479	19	474
2016	25	625	13	325	9	225
2017	23	575	9	220	6	150
2018	22	550	9	225	17	425

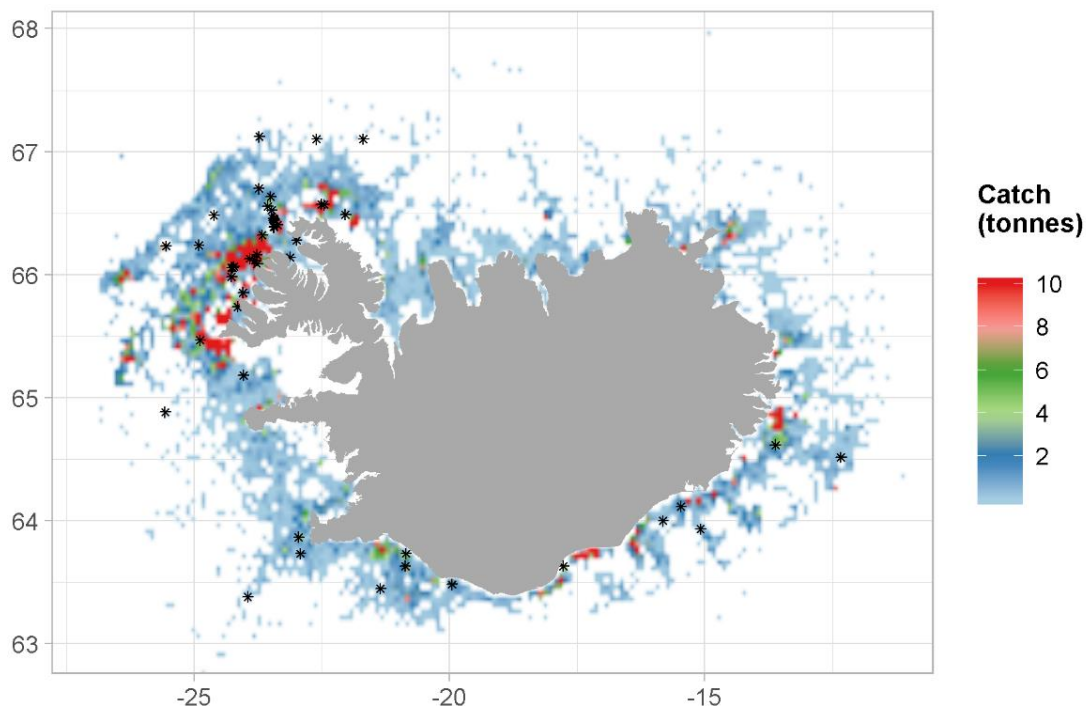


Figure 7. Atlantic wolffish. Fishing grounds in 2018 as reported in logbooks and positions of samples taken from landings (asterisks).

Mynd 7. Steinbítur. Veiðisvæði við Ísland árið 2018 samkvæmt afladagbókum og staðsetningar sýna úr lönduðum afla (stjörnur).

In samples from commercial landings, the mean age of Atlantic wolffish was around 10.7 years in 1999, when sampling from commercial catches was increased after a period of sporadic sampling. Since then, mean age in samples from commercial catches has generally been increasing and was 12.0 years in 2018. There are many year classes in commercial landings; most of them seem to be of similar size (Figure 8).

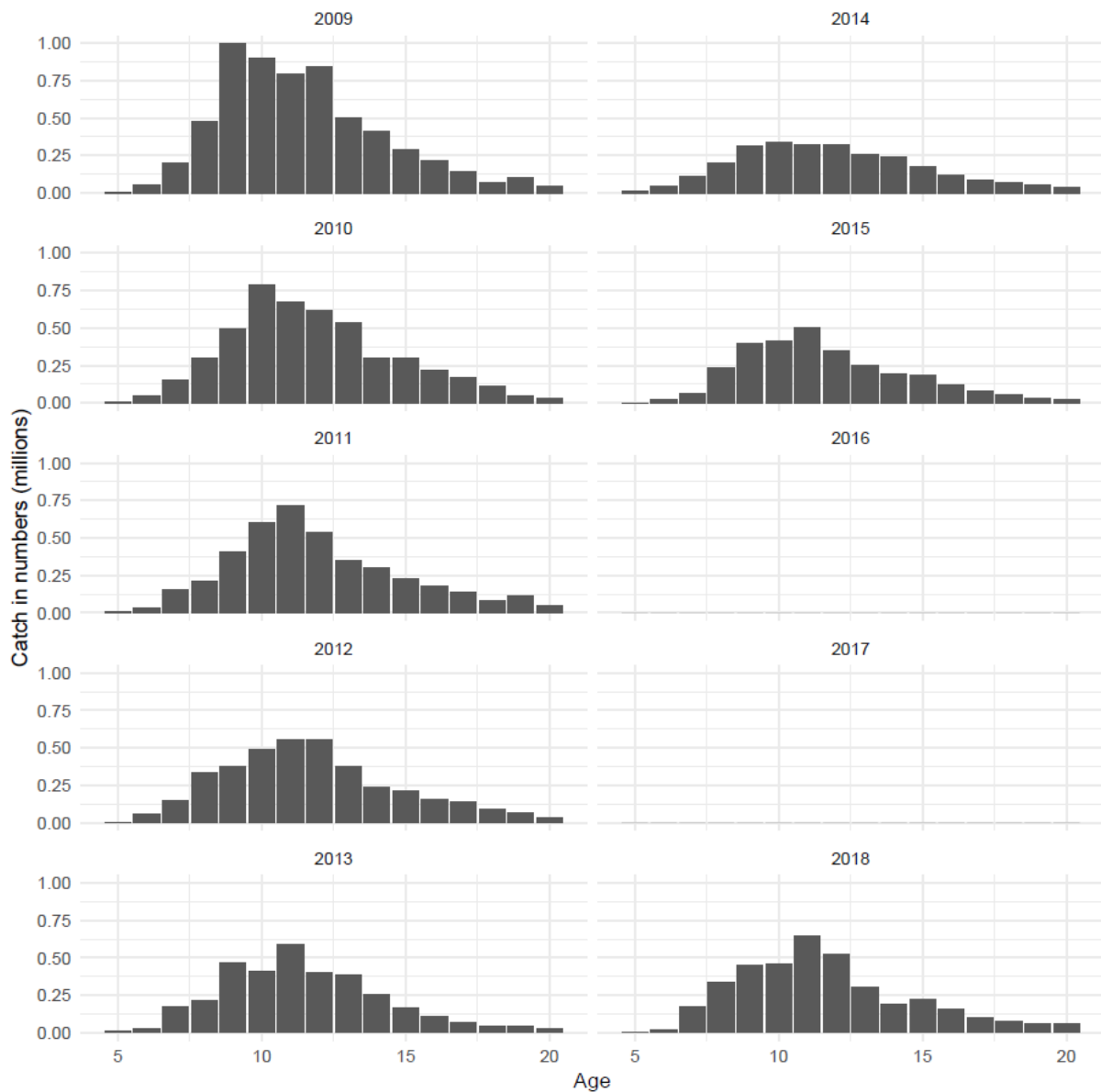


Figure 8. Atlantic wolffish. Estimated age distribution of landed catch based on landings and otoliths collected from landed catch. The years 2016 and 2017 are not included because of pending review of the age determination of these years.

Mynd 8. Steinbítur. Áætluð aldursdreifing landaðs afla byggð á aldursgreiningum á fiskum úr afla. Árin 2016 og 2017 er sleppt vegna yfirstandandi endurskoðunar á aldursgreiningum þessara ára.

LENGTH DISTRIBUTION OF LANDED ATLANTIC WOLFFISH

The length distribution of landed Atlantic wolffish catch has been relatively stable since 2003 (Figure 9). The average length in the commercial catch increased from about 65 cm in 2003 to about 70 cm in 2011 wherefrom it has been similar.

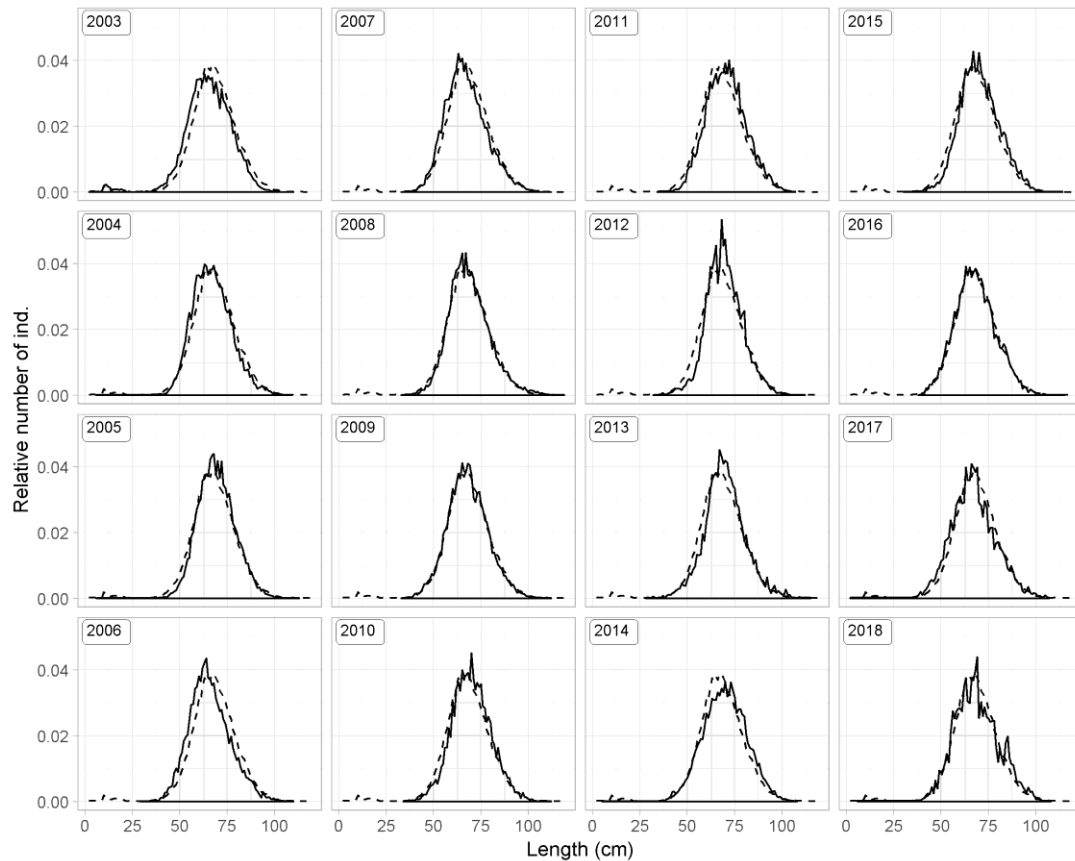


Figure 9. Atlantic wolffish. Relative length distribution of fish sampled from landed catch. The dotted line represents the mean length distribution for all years.

Mynd 9. Steinbítur. Hlutfallsleg lengdardreifing steinbíts úr aflasýnum frá árinu 2003 með meðal lengdardreifingu fyrir öll árin (punktalína).

SURVEY DATA

The Icelandic spring groundfish survey (hereafter spring survey, IS-SMB), which has been conducted annually in March since 1985, covers the most important distribution area of Atlantic wolffish in Icelandic waters. In addition, the Icelandic autumn groundfish survey (hereafter autumn survey, IS-SMH) was commenced in 1996 and expanded in 2000. However, a full autumn survey was not conducted in 2011 due to a labour dispute. The spring survey is considered to measure changes in abundance/biomass of Atlantic wolffish better than the autumn survey.

Total biomass and harvestable biomass indices decreased from 1985-1995. In 1996, the biomass index increased to 1998, then decreased to a historical low level in 2010-2012, but since then it has been increasing (Figure 10). The harvestable biomass has generally been increasing from 1995 with considerable oscillators. The recruitment index was high in the years 1992-2003, since 1999 it has been decreasing, which coincide with increasing effort and catch of trawlers at its main spawning ground west of Iceland (Látragrúnn) during its spawning and incubation time. The recruitment index reached a historical low level in 2011, but since then it has been rather stable or increased slightly. This coincides with that the closed spawning/incubation area on Látragrúnn was enlarged from 500 km² (from 2002) to 1000 km² in October 2010.

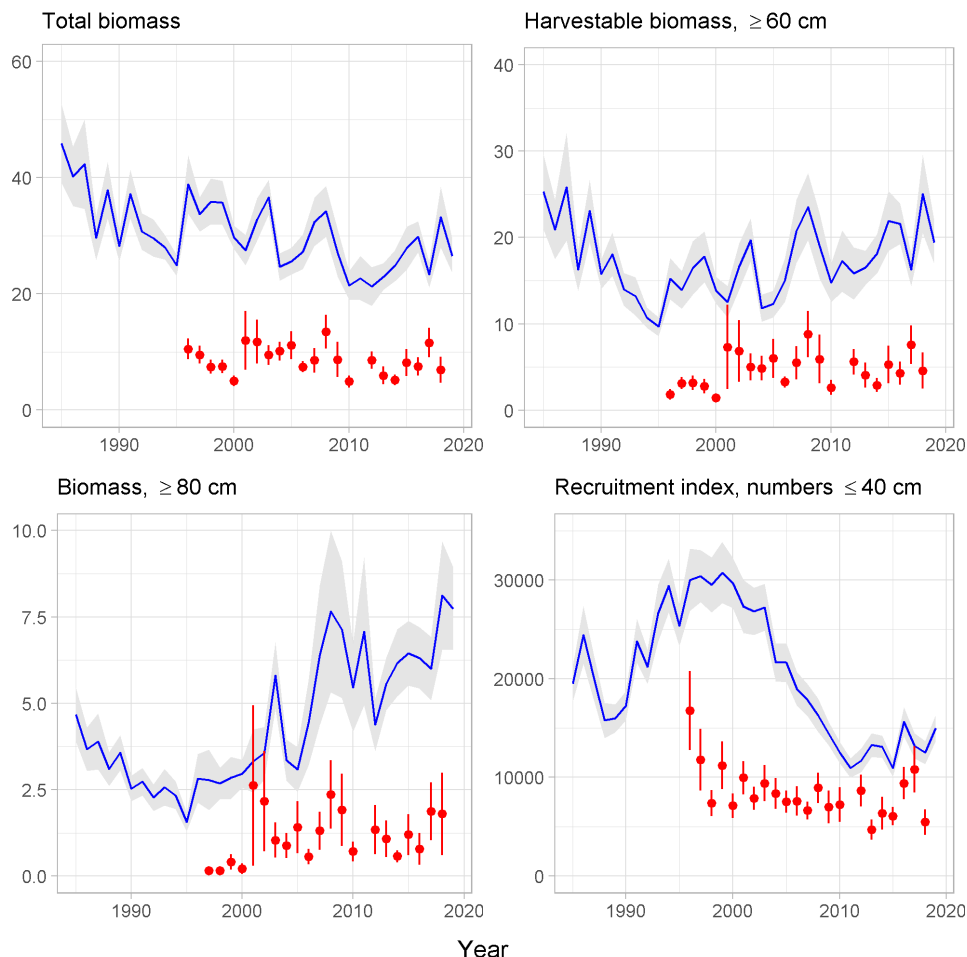


Figure 10. Atlantic wolffish. Total biomass indices (upper left) and harvestable biomass indices (≥ 60 cm, upper right), large fish biomass indices (≥ 80 cm, lower left) and juvenile abundance indices (≤ 40 cm, lower right), from the spring survey (blue) and the autumn survey (red), along with the standard deviation.

Mynd 10. Steinbítur. Stofnvísitala (efri til vinstri), vísitala veiðistofns (≥ 60 cm, efri til hægri), vísitala stærri fiska (≥ 80 cm, neðri til vinstri) og nýliðunarvísitala (≤ 40 cm, neðri til hægri) úr stofnmælingu botnfiska að vori (blátt) og hausti (rautt) frá, ásamt staðalfrávikum.

Since 2004, the length distribution in the spring survey has been bimodal because of a relatively greater decrease in number of fish at 40–60 cm. The mean length of Atlantic wolffish has been similar between years or on the average about 39 cm. It was, however, lowest in 1994–2004, about 37 cm, but in these years the recruitment index was high. During decreasing recruitment from 2004 (Figure 10) the mean length increased and was on the average about 41 cm in 2007–2019 (Figure 11). The number of fish caught in the spring survey was highest in 1996 or 24 thousand, from then the number was rather stable to 2003, wherefrom it decreased to 2011. Since then, the number has increased and was 11.5 thousand in 2019.

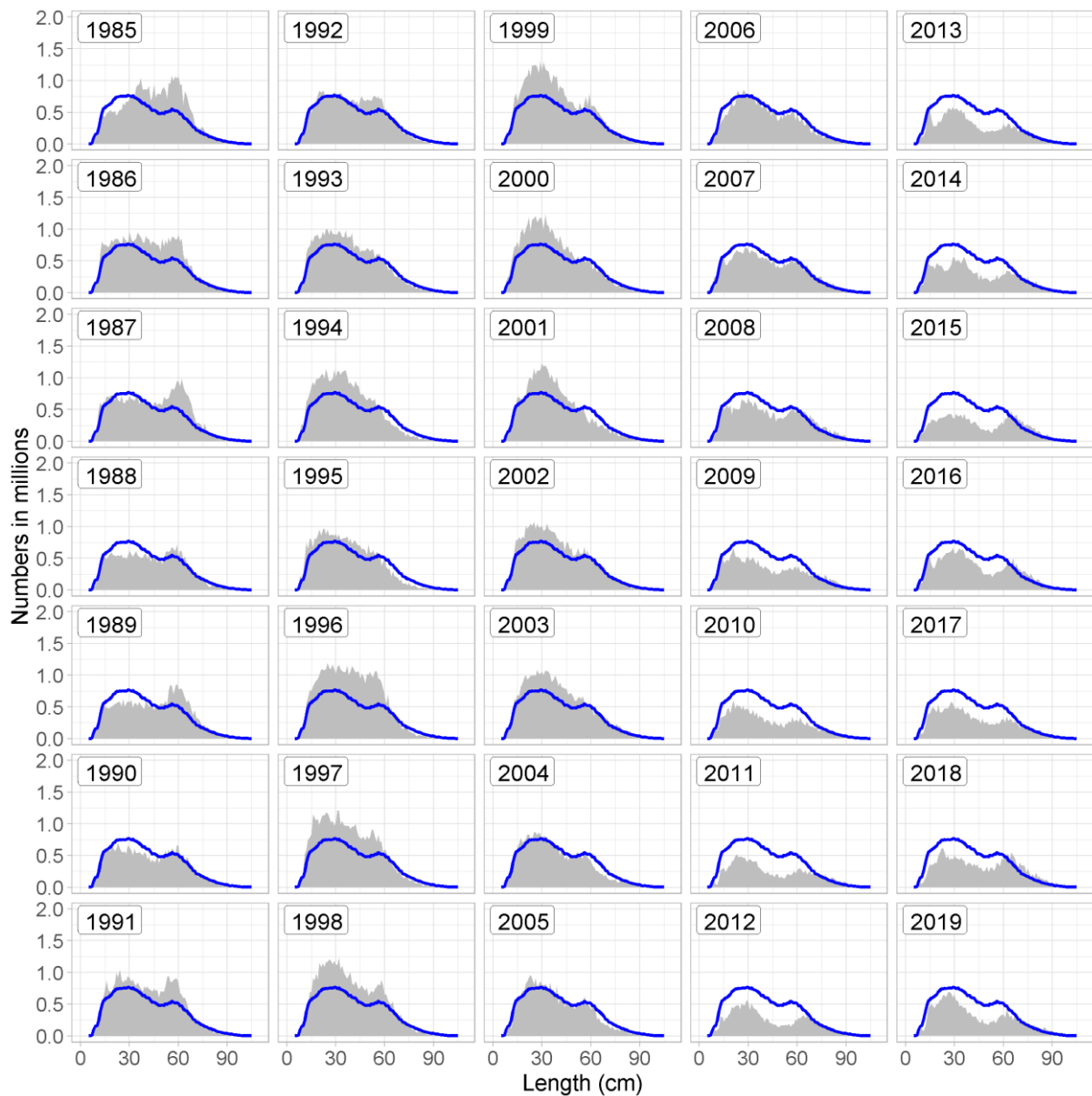


Figure 11. Atlantic wolffish. Length disaggregated abundance indices from the spring survey. The blue line shows the mean for all years.

Mynd 11. Steinbítur. Lengdarskiptar vísitölur úr stofnmælingu botnfiska að vori frá 1985 ásamt meðaltali allra ára (blá lína).

When the spring survey is conducted, Atlantic wolffish are on their feeding grounds which are commonly in relatively shallow waters (Figure 12). In the spring survey, highest abundance has always been measured in the NW area (Figure 13).

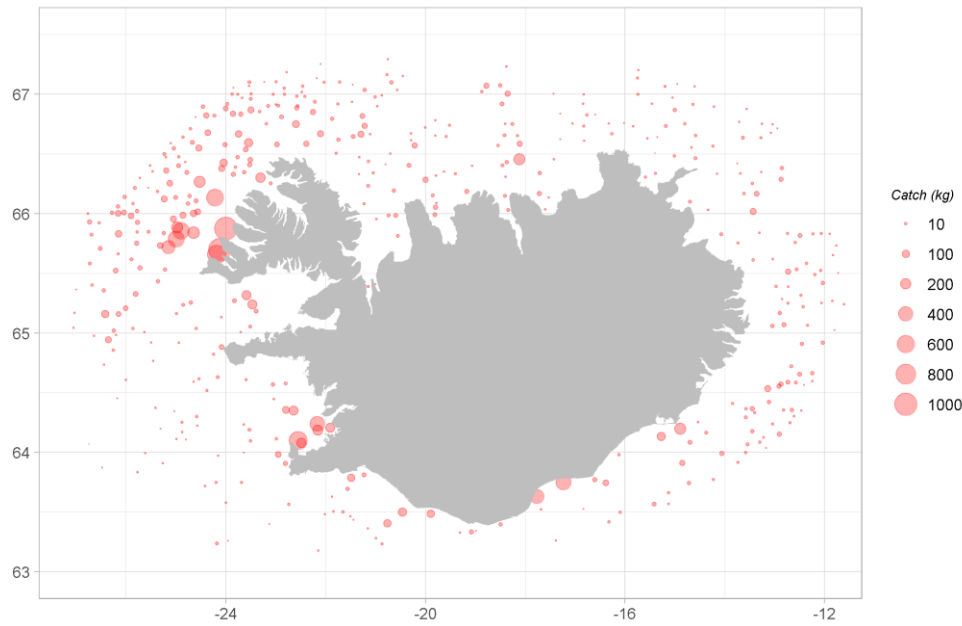


Figure 12. Atlantic wolffish. Spatial distribution in the spring survey in 2019.

Mynd 12. Steinbítur. Útbreiðsla í stofnmælinqu botnfiska að vori 2019.

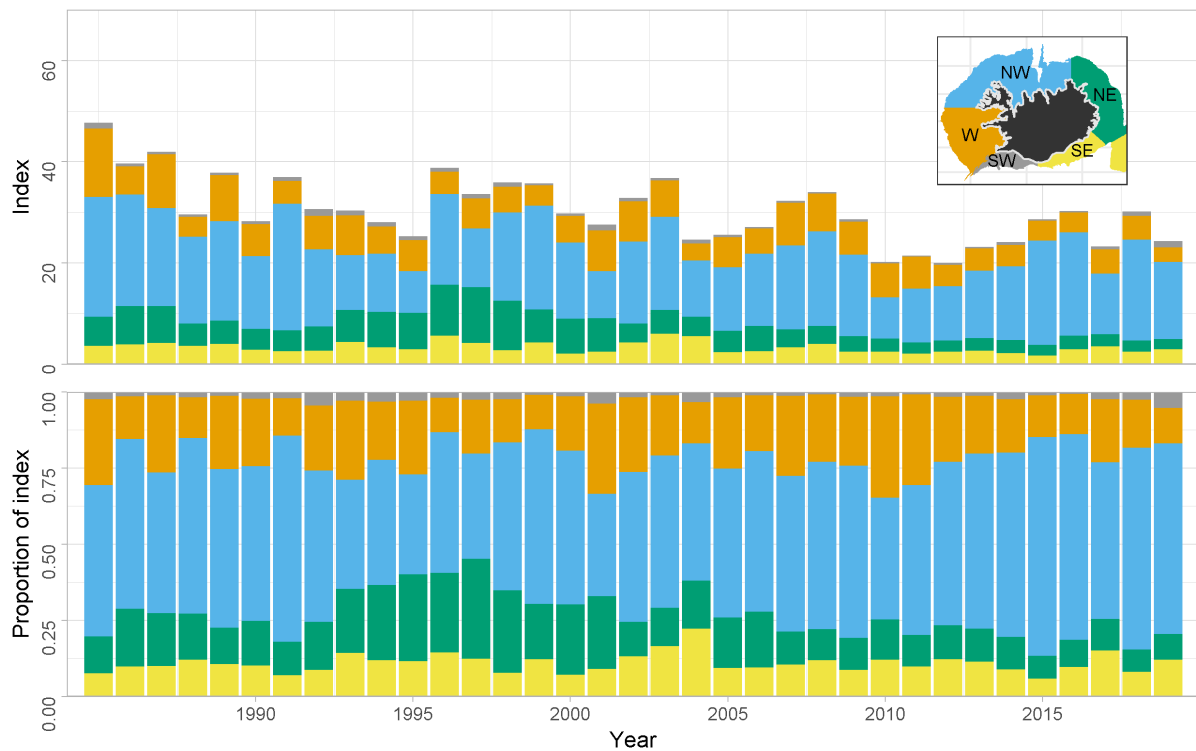


Figure 13. Atlantic wolffish. Spatial distribution of biomass index from the spring survey.

Mynd 13. Steinbítur. Dreifing lífmassavísitölu í stofnmælingu botnfiska að vori.

Mean length in the autumn survey oscillated from 34-40 cm in 1996-2018, with no clear trend. The number caught, however, has a similar trend as in spring survey; decreasing from 1578 fish in 2002 to 777 fish in 2013. In 2014-2017 the number of Atlantic wolffish increased, but only 785 fish were caught in the autumn survey in 2018 (Figure 14).

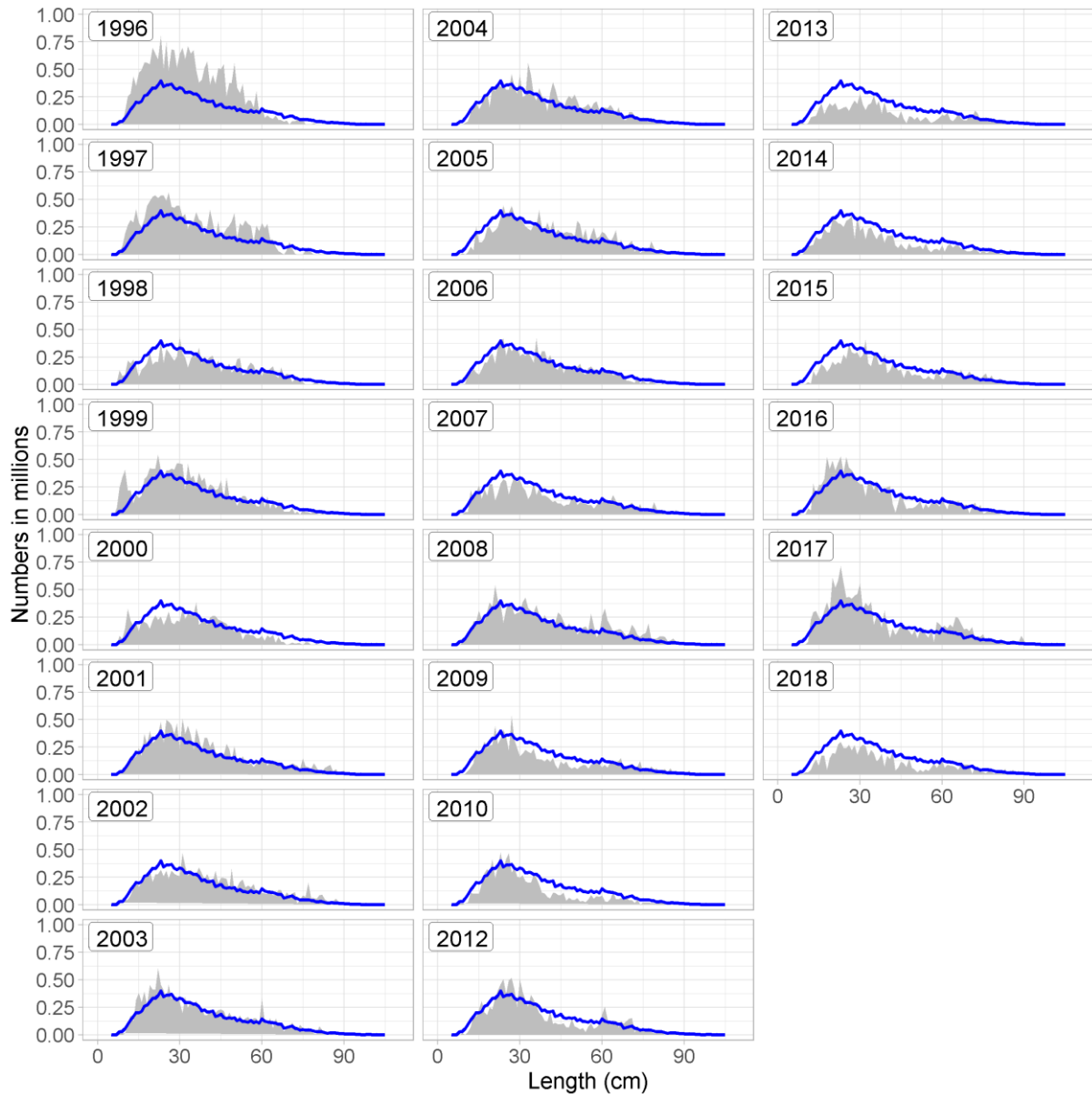


Figure 14. Atlantic wolffish. Length disaggregated abundance indices from the autumn survey. The blue line shows the mean for all years.

Mynd 14. Steinbítur. Lengdarskiptar vísitölur úr stofnmælingu botnfiska að hausti frá 1996 ásamt meðaltali allra ára (blá lína).

In the autumn survey, Atlantic wolffish are more often caught in deeper waters than in the spring survey. The autumn survey is conducted when Atlantic wolffish is spawning, and the spawning grounds are usually deeper than the feeding grounds. Since 2000, the highest biomass has been measured in the northwest and west areas (Figures 15-16). The main spawning area of Atlantic wolffish is located at the northern part of the west area.

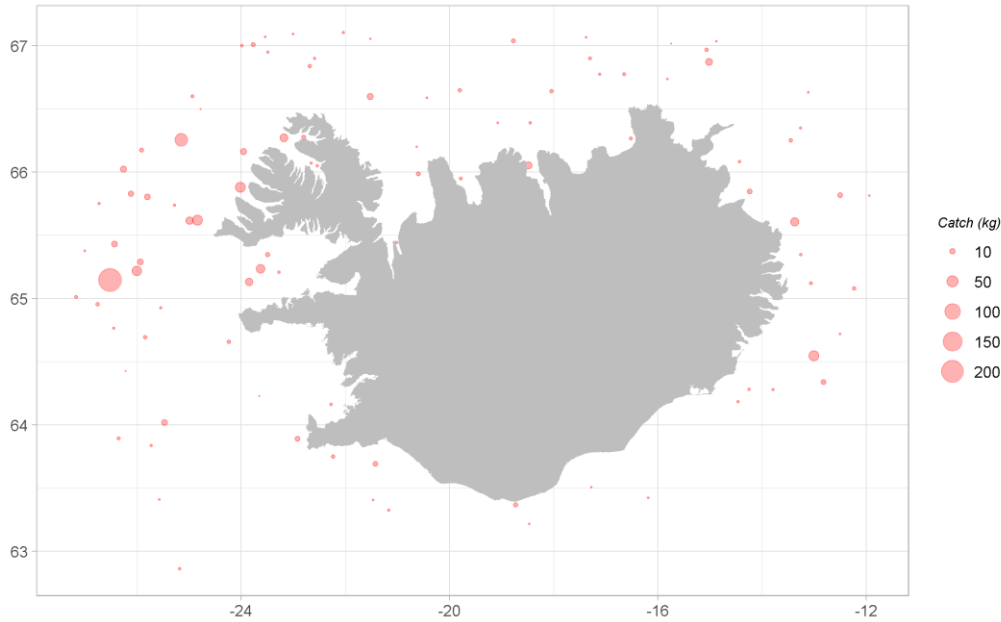


Figure 15. Atlantic wolffish. Spatial distribution in the autumn survey in 2018.

Mynd 15. Steinbítur. Útbreiðsla í stofnmælingu botnfiska að hausti árið 2018.

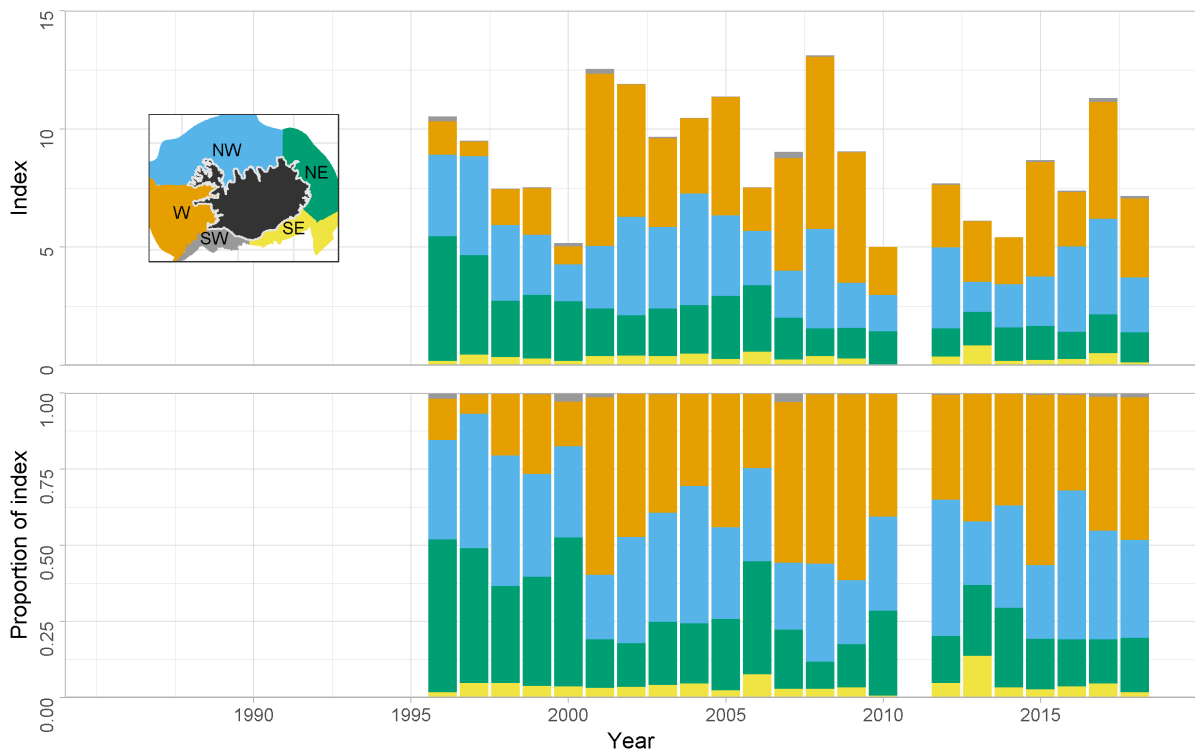


Figure 16. Atlantic wolffish. Spatial distribution of the biomass index from the autumn survey.

Mynd 16. Steinbítur. Dreifing lífmassavísitölu í stofnmælingu að hausti.

STOCK ASSESSMENT

SETTINGS

The advice for Atlantic wolffish has since 2001 been based on a Gadget model. In 2001-2010 natural mortality (M) was set at 0.15 and the advice based on $F_{0.1}$ but since 2011 natural mortality has been set as $M=0.10$ and advice based on F_{msy} (F_{max}). Weights of different likelihood components were estimated in the 2011 assessment and again in the 2013 and 2015 assessments. The weights in the final run have been kept unchanged since 2013.

The parameters estimated in the model are:

- Initial numbers at age
- Recruitment at age 1 every year
- Size of recruits
- Selection pattern of the commercial fleet and survey.

Data used in the estimation are:

- Length distributions from survey and catches.
- Length disaggregated abundance indices from survey in 6 groups. 5-13 cm, 14-19 cm, 29-29 cm, 30-55 cm, 56-74 cm and 75-109 cm.
- Age data from survey and catches used as age-length keys.

Selection pattern of the fisheries and the survey are size based.

RESULTS

According to the selection pattern, estimated by the model, the L50 of the commercial fleet is 62 cm that corresponds to approximately 13 years old fish (Figure 18). The estimated biomass in each length group is multiplied by this selection pattern to calculate fishable biomass.

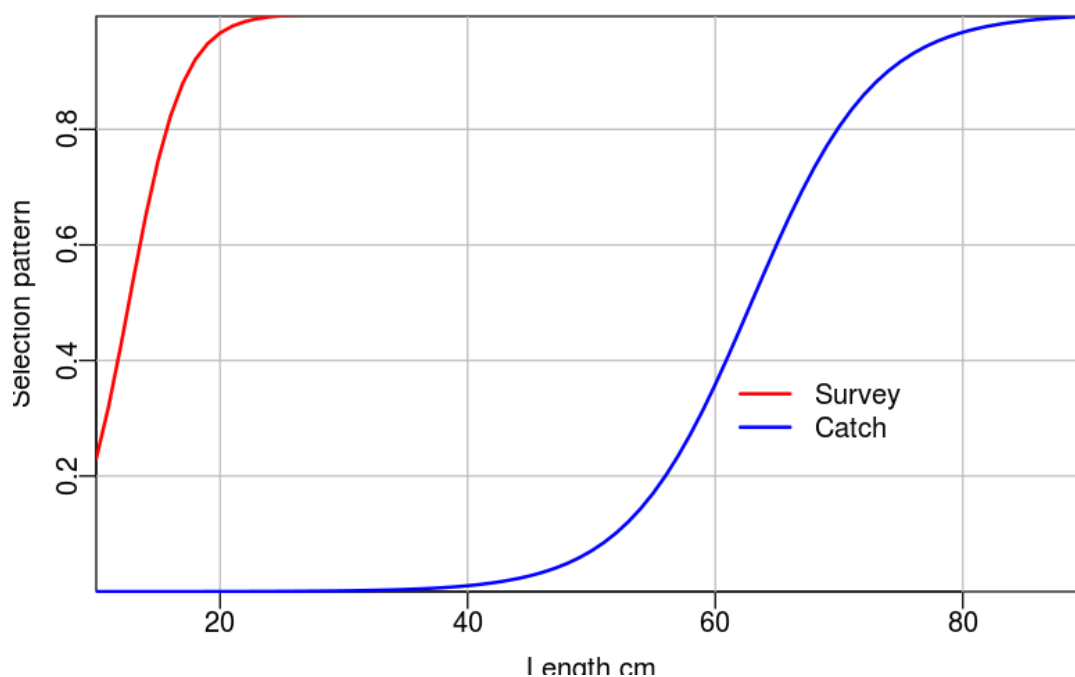


Figure 18. Atlantic wolffish. Estimated selection pattern from landed catch and the spring survey.

Mynd 18. Steinbítur. Metið veiðimynstur hjá flotanum og í stofnmælingu botnfiska að vori.

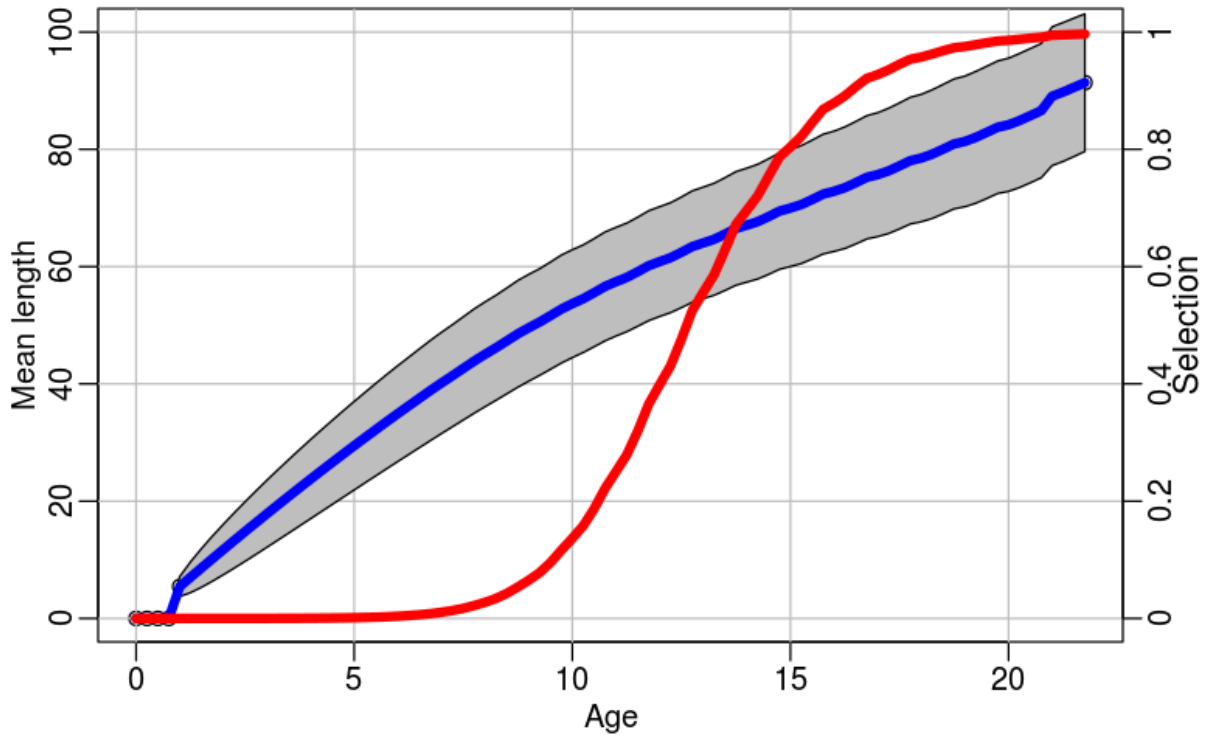


Figure 19. Atlantic wolffish. Estimated mean length and selection pattern as function of age.

Mynd 19. Steinbítur. Meðallengd og veiðimynstur sem fall af aldri.

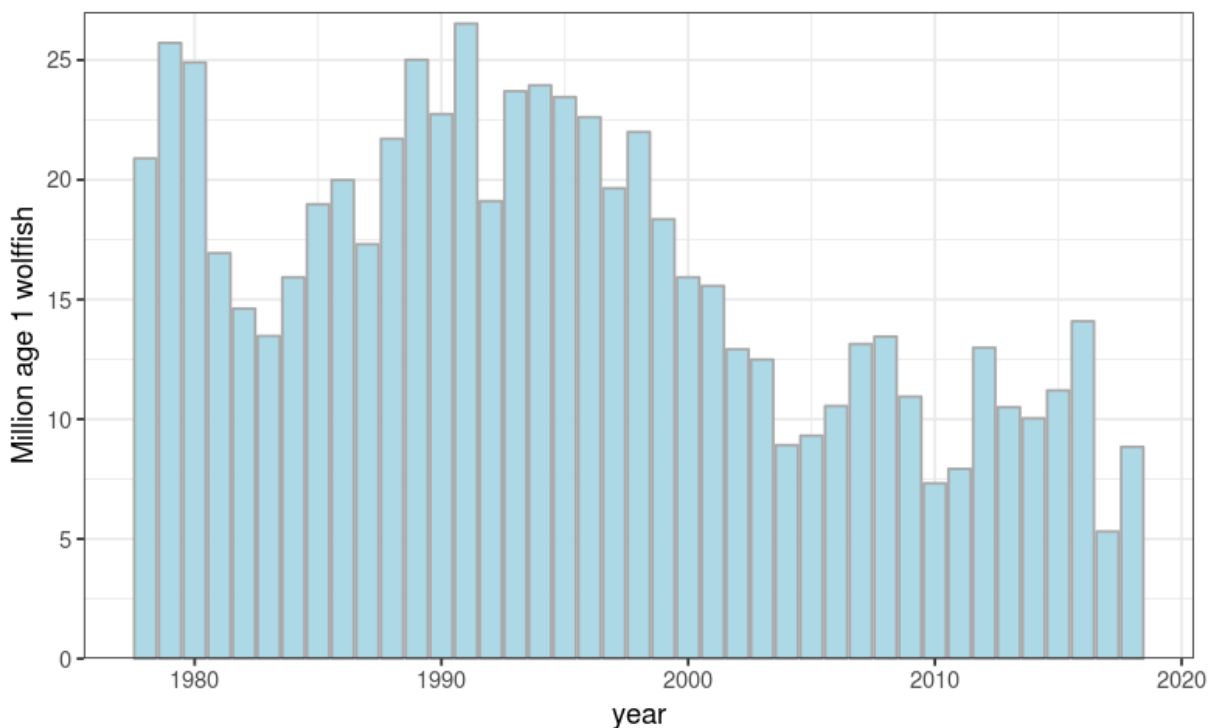


Figure 20. Atlantic wolffish. Estimated recruitment at age one according to the model in 2019.

Mynd 20. Steinbítur. Metin nýliðun eins árs samkvæmt stofnmatinu 2019.

As fishing mortality has decreased since 2010 the fishable biomass (called harvestable biomass in the advice report) has not changed much despite relatively low recruitment and is not expected to change much in coming years if annual catches are between 7 and 9 thousand tonnes (Figures 20-21).

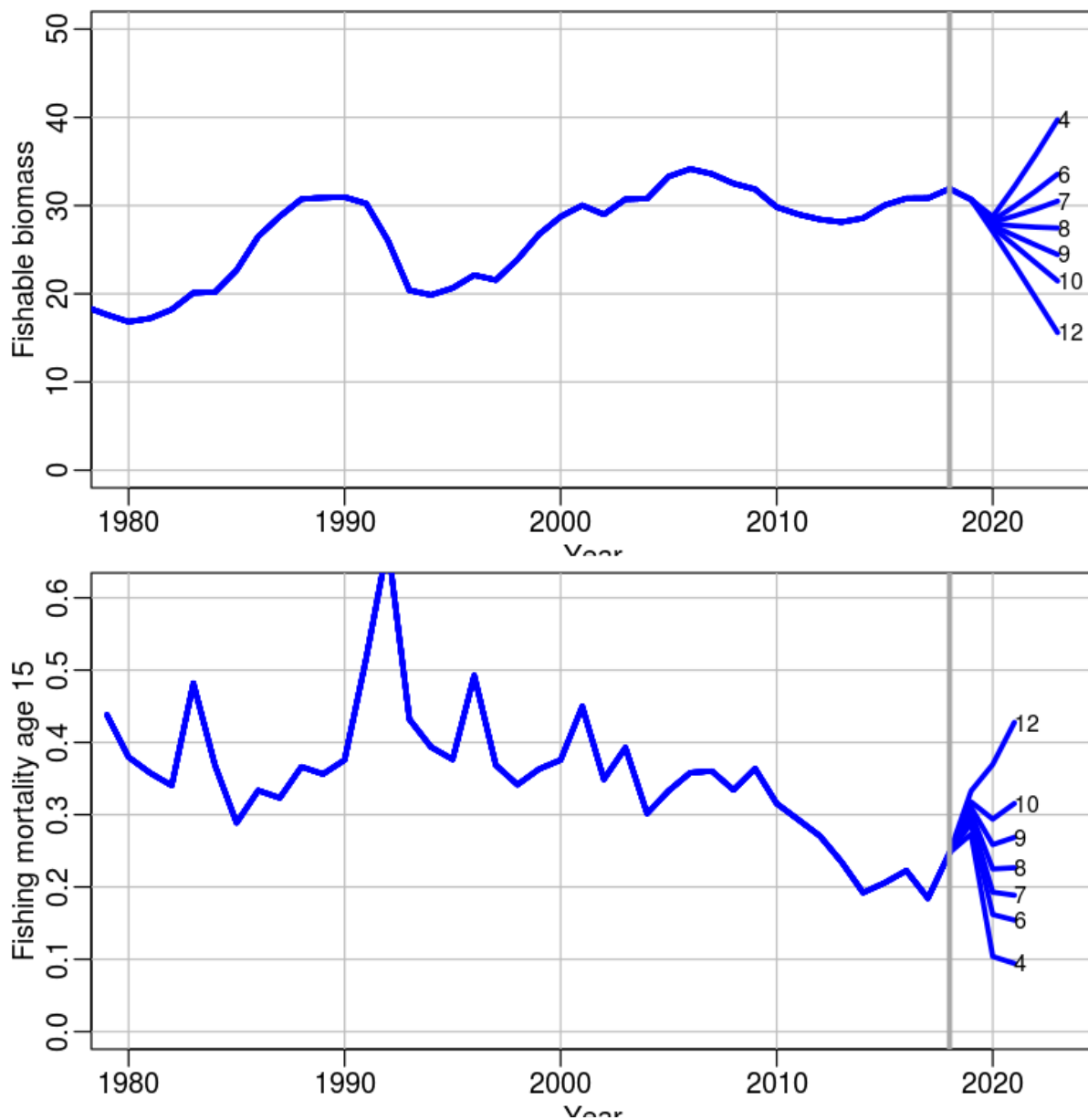


Figure 21. Atlantic wolffish. Historical values and prediction based on different annual catch next years, for fishable biomass and fishing mortality for 15 years old Atlantic wolffish.

Mynd 21. Steinbítur. Söguleg gildi og þróun fyrir mismunandi árlegan afla næstu ár, fyrir veiðistofn og fiskveiðidauða 15 ára steinbíts.

The assessment has been conducted using the same settings since 2013. There has been a tendency for an upward revision of fishable biomass in this period (Figure 22). The assessment does though seem to be reasonably consistent. Fishing mortality has been low in recent years so a longer time than 5 years is required to conclude much about the consistency.

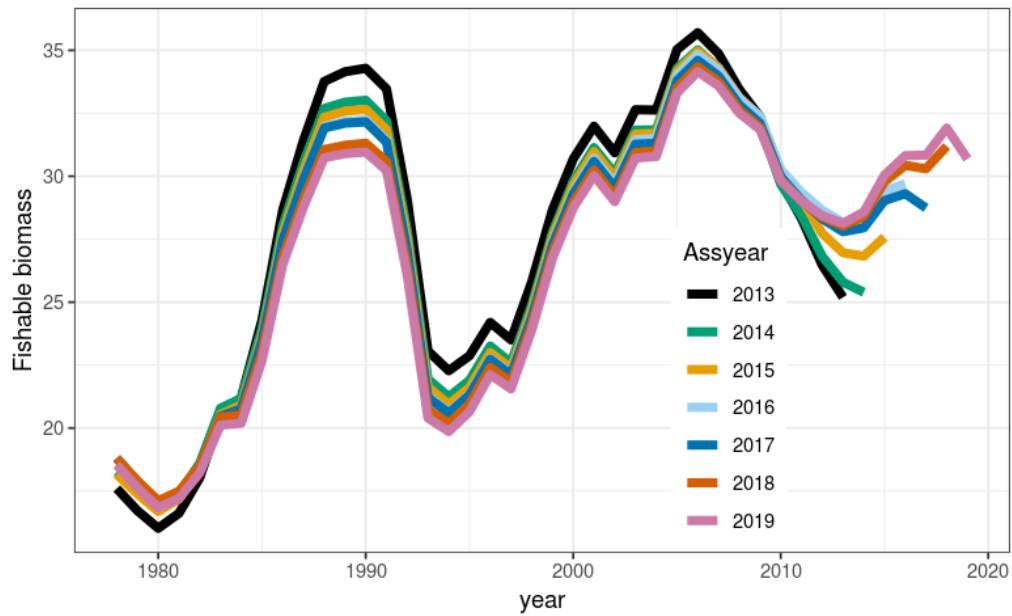


Figure 22. Atlantic wolffish. Estimated fishable biomass in the assessments 2013-2019.

Mynd 22. Steinbítur. Metinn veiðistofn í stofnmötunum 2013-2019.

Abundance indices from the spring survey and estimated number in stock by the model, show a reasonable correlation (Figure 23). However, for the size group 56-74 cm, which is the size accounting for largest part of the biomass the correlation is low. Part of the explanation is small dynamic range of the stock in this size group (12-18 million fish). The setup of having the same catchability all years for this size group could also be a problem, the catchability might vary depending on which part of the range 56-74 cm is most heavily populated. Current values (intersection of the green lines) shows that the current survey indices are according to predictions except for 56-74 cm and 75-109 cm length groups where they are above prediction.

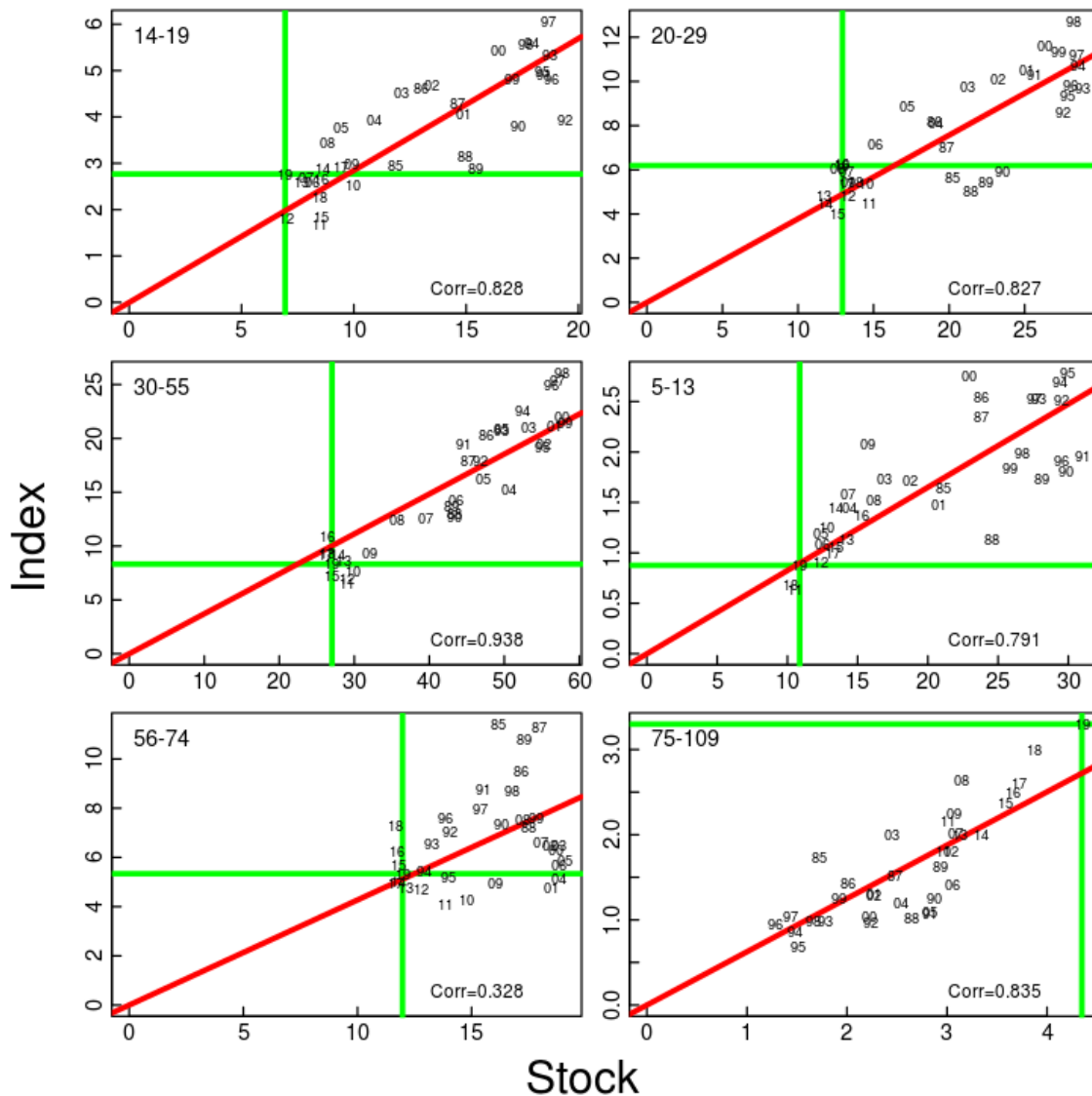


Figure 23. Atlantic wolffish. Correlation of the Abundance indices from spring survey and estimated stock number for the 6 length groups used in tuning. The labels indicate years and the most recent values are shown by the overlap of the green lines. The red line shows predicted values.

Mynd 23. Steinbítur. Fylgni milli fjöldavísitalna úr stofnmælingu botnfiska að vori og metnum fjölda í stofni fyrir þá 6 lengdar hópa sem eru notaðir í samstillingu. Textinn á myndinni sýnir ár og nýjustu gildin sjást sem skurðpunktur grænu línanna. Rauða línan sýnir spágildin.

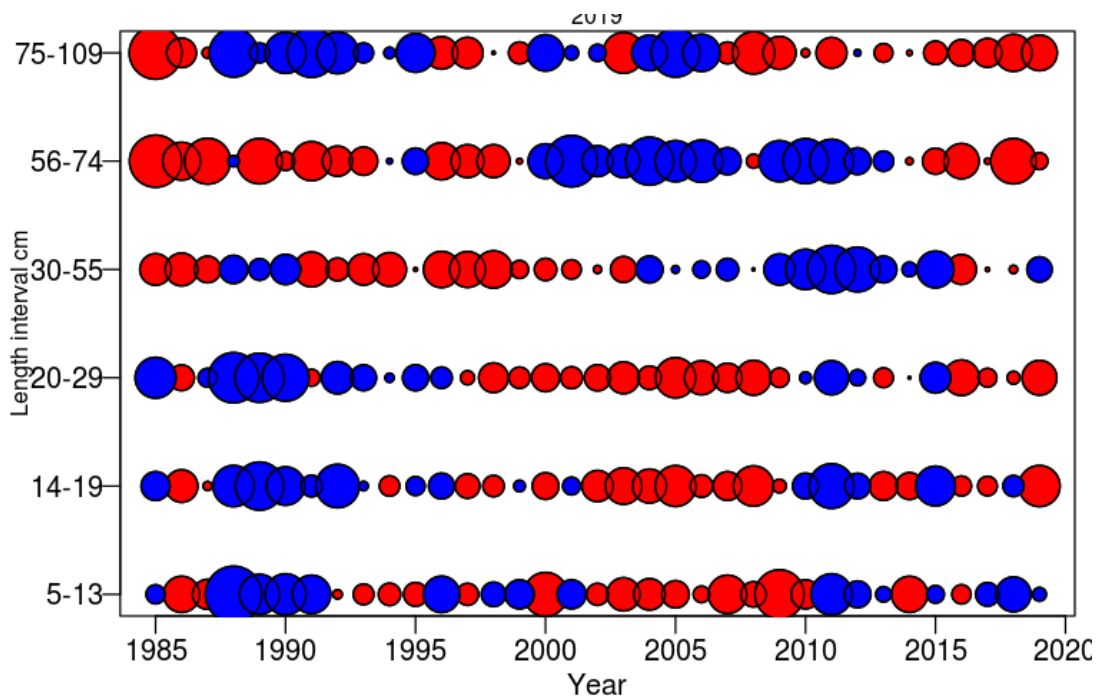


Figure 24. Atlantic wolffish. Log-residuals between observed abundance indices from spring survey and predicted. Red circles indicate positive residuals (observed > predicted).

Mynd 24. Steinbítur. Frávik á log skala á milli athugaðra gilda fjöldavísitalna í stofnmælingu botnfiska að vori og spáðra gilda. Rauðir hringir sína jákvæð frávik, þ.e. rallvísitala > spágildi rallvísitölu úr líkani.

In the model the growth and selection pattern are fixed for all the simulation period. Still the size at age can be changed as the fisheries are modelled to target the largest fish of each cohort leading to lower mean length at age of the survivors and some change in selection by age if fishing mortality varies much.

The F used for advice is F_{max} from yield per recruit analysis of the stock (Figure 25). The model is size-based, and M is relatively low so F_{max} is expected to be precautionary harvesting strategy. The advice for next fishing year is 8344 tons. Formal HCR evaluation is expected to take place in the winter 2019/20. The advice is based on F for fully recruited fish or 90 cm (Figure 18). In the advice $F_{90cm} = 0.3$ is used which corresponds to $F_{15} = 0.23$ but F_{15} is the value for F shown in Figure 21.

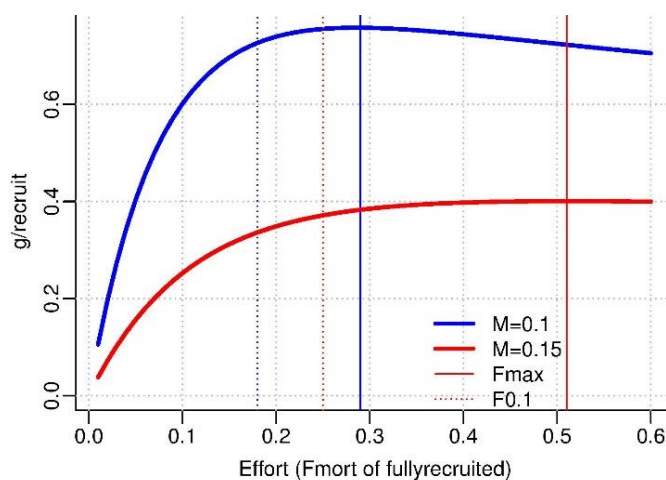


Figure 25. Atlantic wolffish. Yield per recruit as function of fishing mortality of fully recruited Atlantic wolffish.

Mynd 25. Steinbítur. Afrakstur á nýliða sem fall af fiskveiðidauða steinbíts sem er að fullu kominn inn í veiði.

MANAGEMENT

The Ministry of Industries and Innovation is responsible for management of the Icelandic fisheries and implementation of legislation. Atlantic wolffish was included in the ITQ system in the 1996/1997 quota year and as such subjected to TAC limitations. From that time to the fishing year 2004/2005, the catch was on average 5% more than recommended by the MRI, although in some years it was lower than advised TAC. In the fishing years 2005/2006 to 2011/2012, the catch was on average around 34% above the advised TAC. The main reasons were that national TAC was set higher than the advised TAC, and quota of other species were being transferred to Atlantic wolffish quota (Table 3, Figure 17). Net transfer of Atlantic wolffish quota for each fishing year is usually less than 10%.

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

Tafla 3. Steinbítur. Tillögur Hafrannsóknastofnunar um hámarksafli, ákvörðun stjórnvalda um aflamark og landaður afli (tonn).

FISHING YEAR	REC. TAC	NATIONAL TAC	CATCH
1996/97	13000	13000	11523
1997/98	13000	13000	11689
1998/99	13000	13000	13051
1999/00	13000	13000	14906
2000/01	13000	13000	18094
2001/02	13000	16100	13667
2002/03	15000	15000	16953
2003/04	15000	16000	13253
2004/05	13000	16000	14208
2005/06	13000	13000	16473
2006/07	12000	13000	15796
2007/08	11000	12500	15159
2008/09	12000	13000	15453
2009/10	10000	12000	13096
2010/11	8500	12000	12122
2011/12	7500	10500	10607
2012/13	7500	8500	8953
2013/14	7500	7500	7531
2014/15	7500	7500	7862
2015/16	8200	8200	8982
2016/17	8811	8811	7545
2017/18	8540	8540	9515
2018/19	9020	9020	
2019/20	8344		

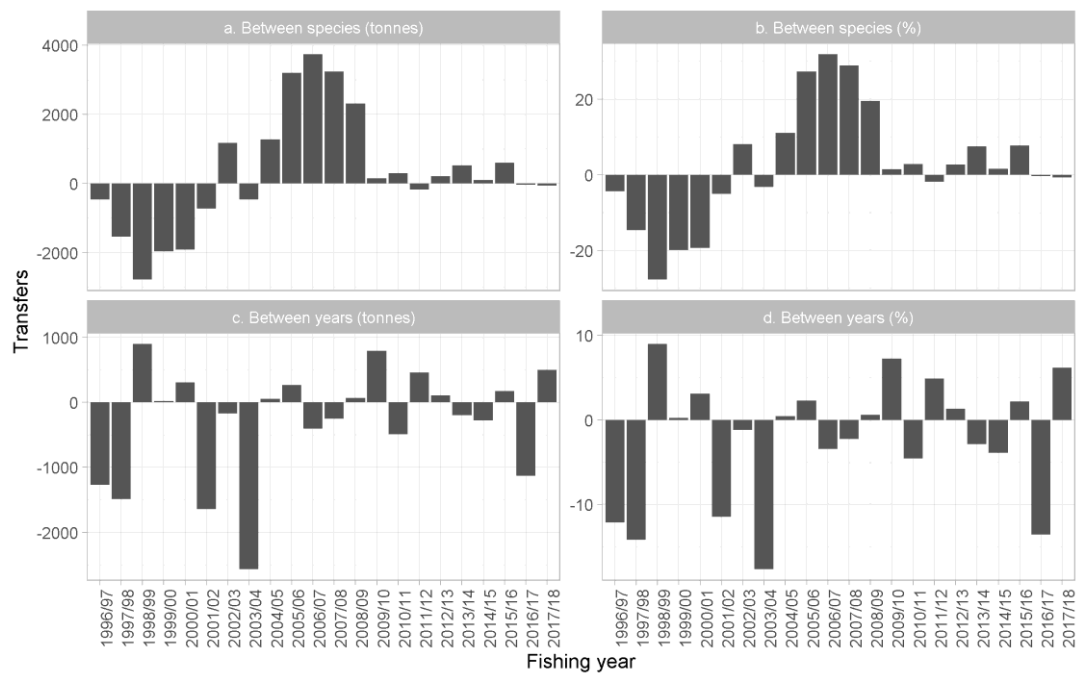


Figure 26. Atlantic wolffish. Net transfers of quota to and from Atlantic wolffish in the Icelandic ITQ system by quota year. Between species (upper): Positive values indicate a transfer of other species to Atlantic wolffish, but negative values indicate a transfer of Atlantic wolffish quota to other species. Between years (lower): Net transfer of quota for a given quota year.

Mynd 26. Steinbítur. Nettó tilfærsla á kvóta eftir fiskveiðiárum. Tílfærsla milli tegunda (efri myndir): Jákvæð gildi tákna tilfærslu á kvóta annarra tegunda yfir á steinbít en neikvæð gildi tilfærslu steinbít kvóta á aðrar tegundir. Tílfærsla milli ára (neðri myndir): Nettó tilfærsla kvóta frá viðkomandi fiskveiðiári.

ADVICE

MFRI advises that when the MSY approach is applied, catches in the fishing year 2019/2020 should be no more than 8344 tonnes. MFRI recommends a continued closure of the spawning area off West Iceland during the spawning and incubation season in autumn and winter.