

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 2009, 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).

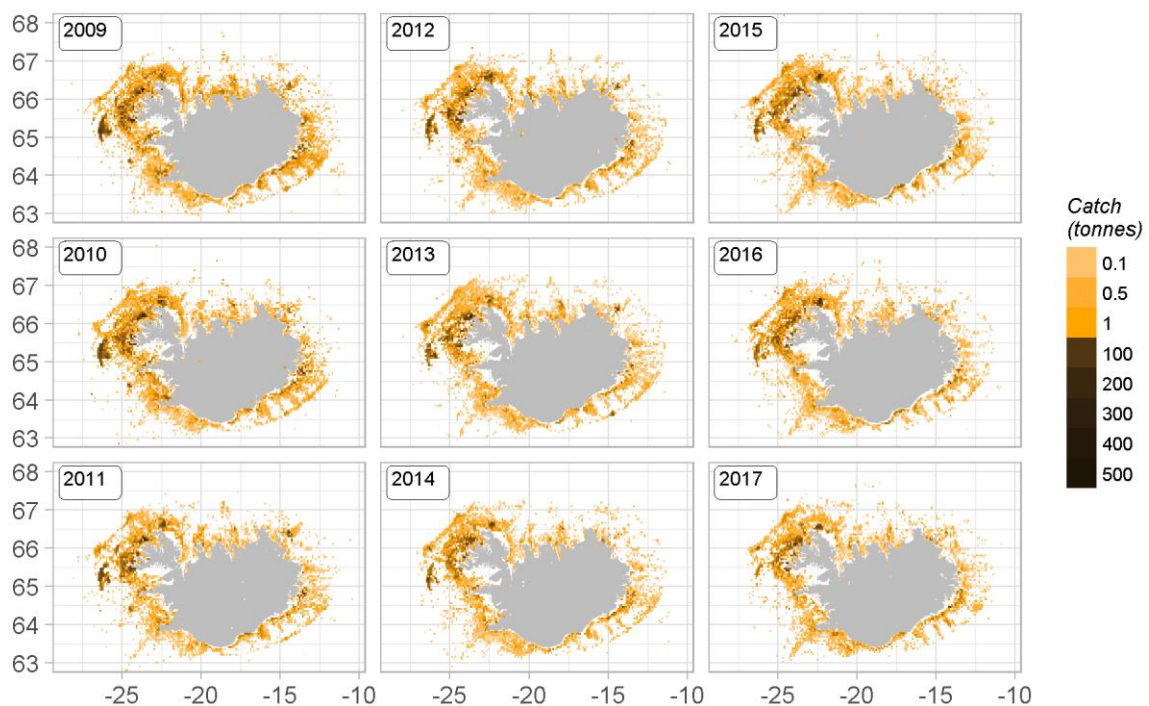


Figure 1. Atlantic wolffish. Geographical distribution of the Icelandic fishery since 2009. Reported catch from logbooks.

Mynd 1. Steinbítur. Útbreiðsla veiða á Íslandsmiðum frá 2009 samkvæmt afladagbókum.

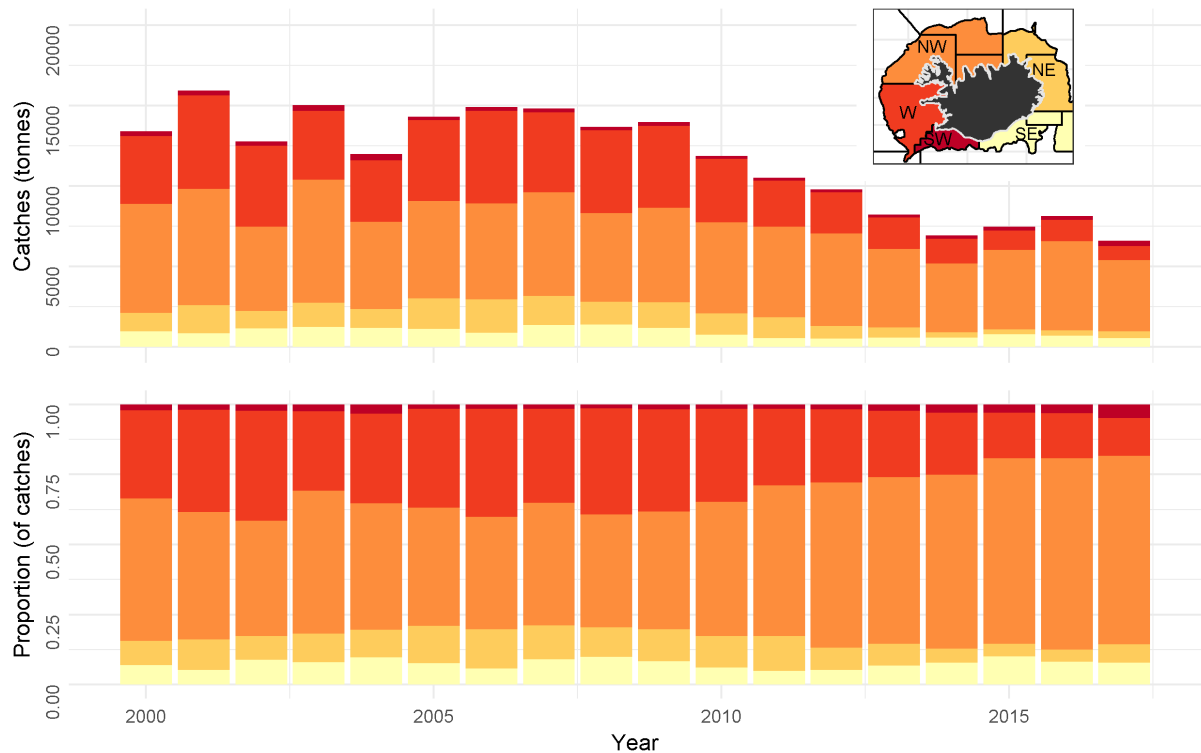


Figure 2. Atlantic wolffish. Spatial distribution of the Icelandic fishery by fishing area from 2000-2017. All gears combined.
Mynd 2. Steinbítur. Útbreiðsla veiða við Ísland árin 2000-2017. Öll veiðarfæri samanlagt.

About 80% of the catch of Atlantic wolffish is caught at depth less than 120 m. Portion of the catch at depth range 0-60 m decreased from 2003 to 2007 but since then it has been increasing. At the range 61-120 m the portion of the catch has been rather stable since 2000. At depths of 121-180 m, which includes the main spawning ground (Látragrunn), it increased from the year 2003 to 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, catches in longline and demersal trawl were similar (40-50%), and in the last four years catch in demersal seine has been increasing and is now similar to that taken in demersal trawl (Figure 4).

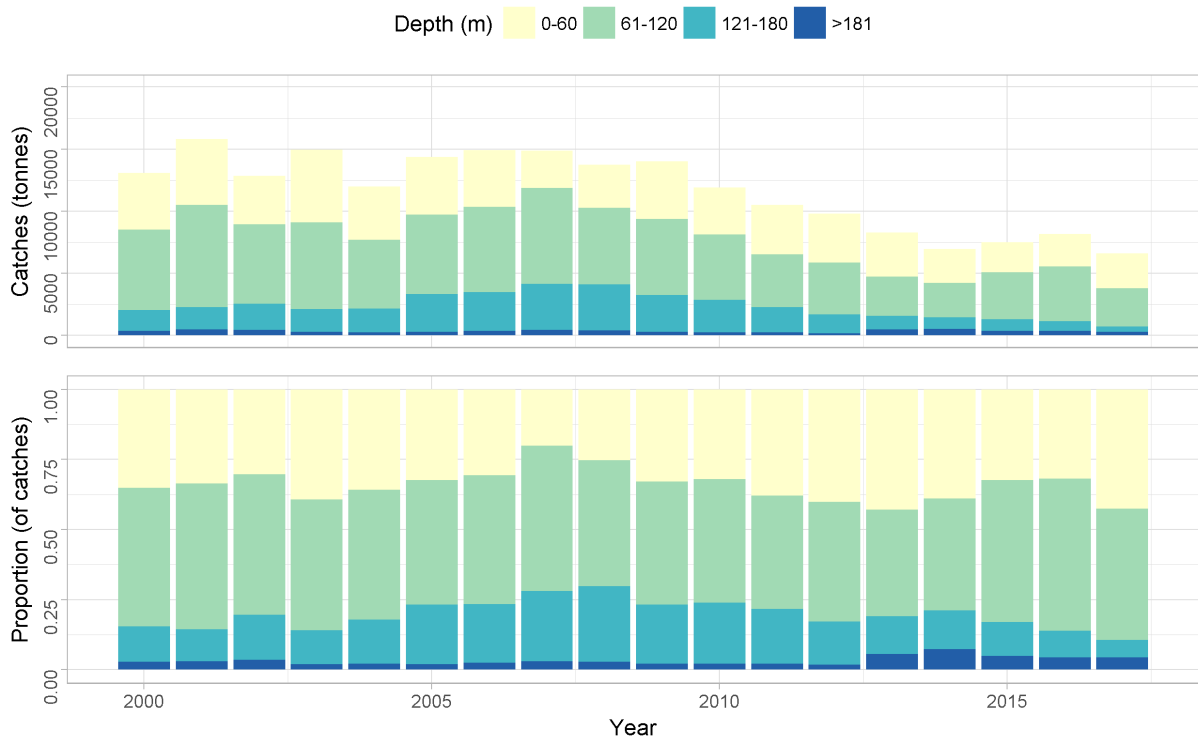


Figure 3. Atlantic wolffish. Depth distribution of demersal trawl, longline and demersal seine catches according to logbooks.

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

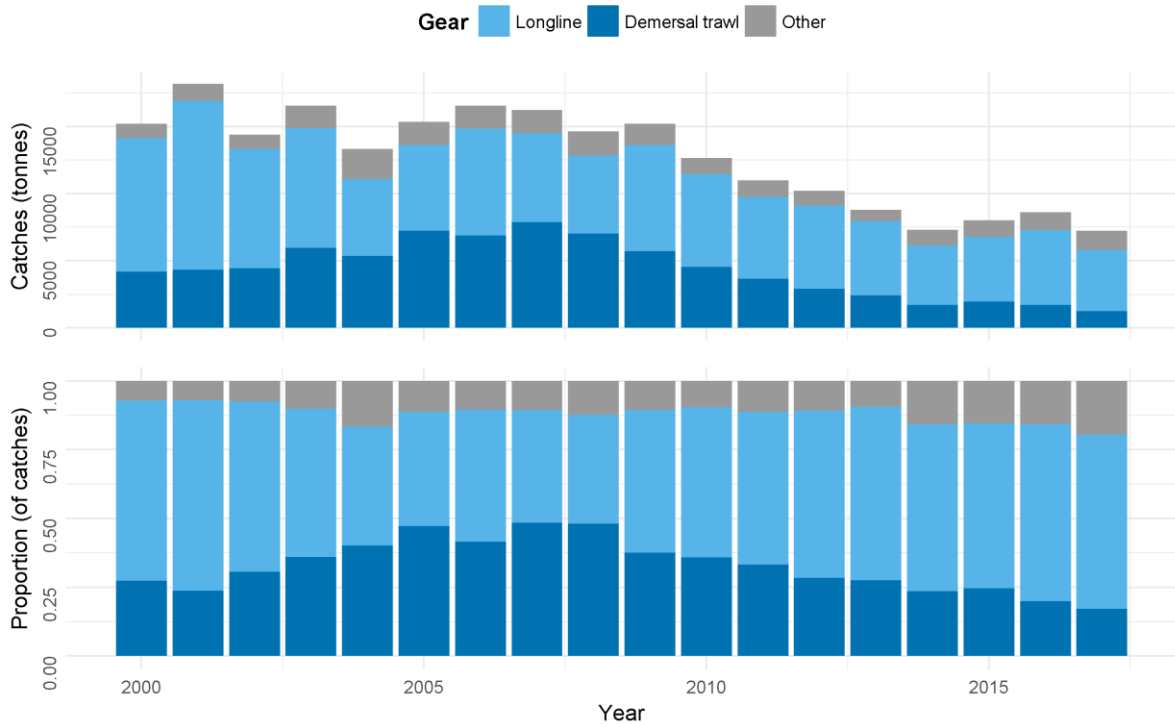


Figure 4. Atlantic wolffish. Total catch (landings) by fishing gear since 2000, according to statistics from the Directorate of Fisheries.

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 65 in 2017. The number of trawlers has also decreased significantly; from 76 in 2000 to 26 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>Other</i>	<i>Longline</i>	<i>Demersal trawl</i>	<i>Other</i>	<i>Sum</i>
2000	172	76	21	9979	4173	1075	15227
2001	198	76	23	12595	4319	1256	18170
2002	151	65	17	8897	4423	1104	14424
2003	142	63	26	8943	5960	1665	16568
2004	109	60	42	5746	5349	2226	13321
2005	96	64	34	6370	7247	1729	15346
2006	136	66	33	7962	6885	1713	16560
2007	124	65	28	6655	7857	1722	16234
2008	100	60	27	5810	7026	1794	14630
2009	124	58	35	7896	5709	1605	15210
2010	82	46	25	6923	4531	1208	12662
2011	68	36	18	6094	4062	1235	11391
2012	80	28	21	6209	2910	1095	10214
2013	77	29	21	5537	2424	831	8792
2014	77	22	18	4463	1722	1144	7329
2015	68	34	20	4828	1926	1234	7988
2016	65	37	21	5563	1713	1075	8625
2017	65	26	20	4586	1243	1414	7243

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).

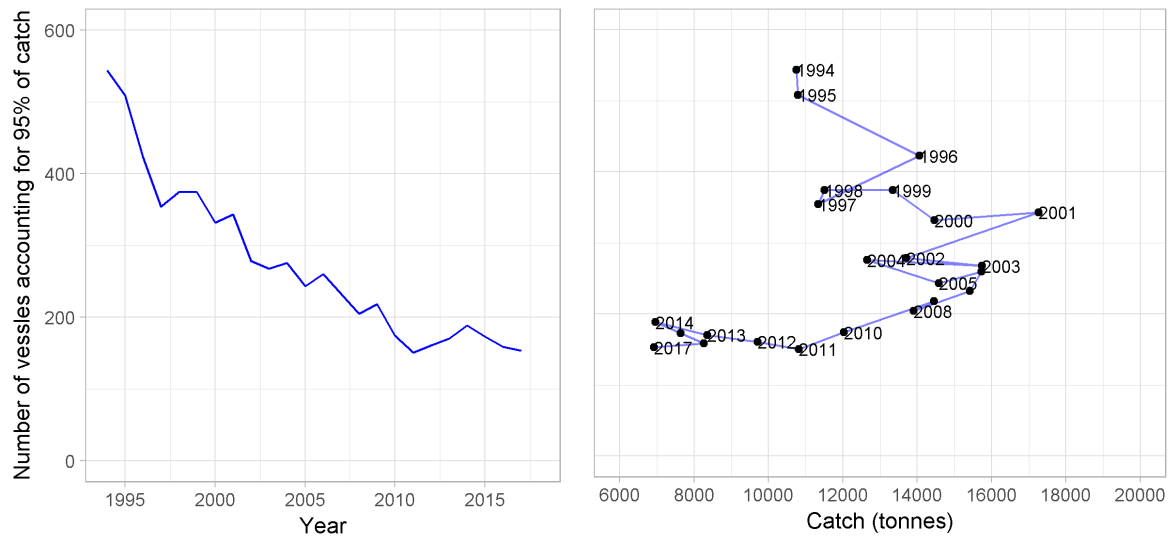


Figure 5. Atlantic wolffish. Number of vessels (all gear types) accounting for 95% of the total catch annually since 1994. Left: Plotted against year. Right: Plotted against total catch. Data from the Directorate of Fisheries.

Mynd 5. Steinbítur. Fjöldi skipa og báta (öll veiðarfæri) sem veiddu 95% heildaraflans hvert ár frá 1994. Vinstri: Sýnt eftir árum. Hægr: 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. CPUE of demersal trawl increased from 2000 (226 kg/h) to 2005 where it reached about 400 kg/h. Therefrom it decreased to the year 2010 (240 kg/h) and since then it has been slightly increasing (Figure 6).

Fishing effort in longline increased from 66 million hooks in 2000 to 97 million in 2001, since then it has been generally decreasing and was in 2017 around 23 million hooks. In demersal trawl fishing effort increased from about 14 thousand tow-hours in 2000 to 23 thousand in 2008, therefrom it decreased considerably and was 2.6 thousand tow-hours in 2016 (Figure 6).

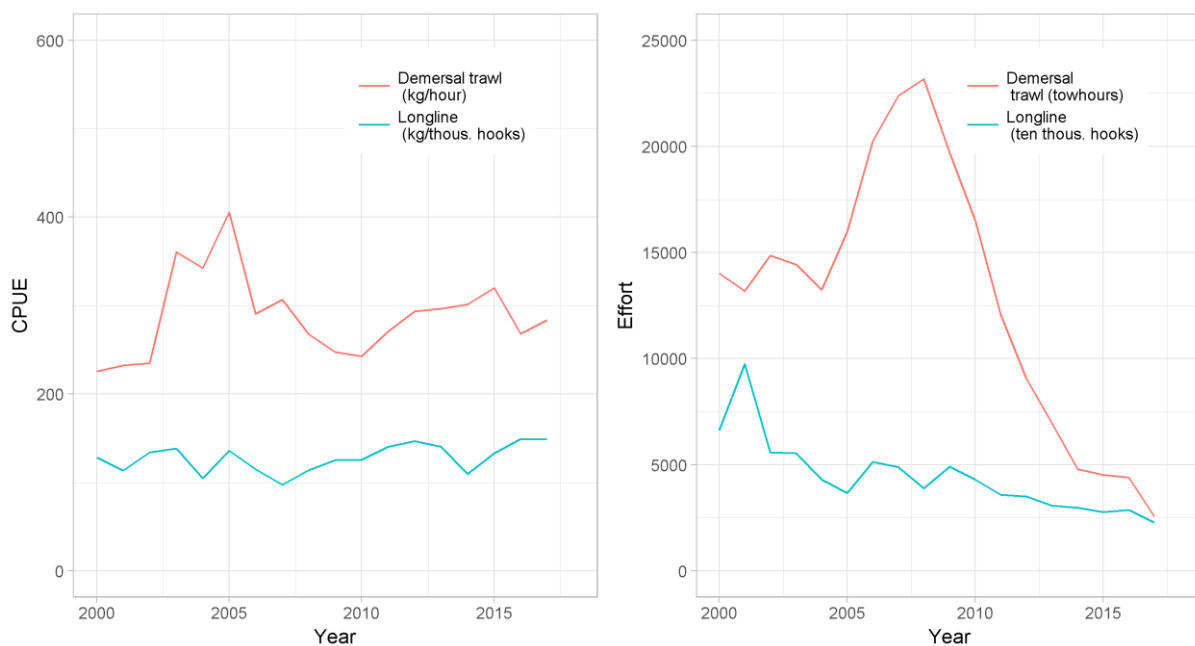


Figure 6. Atlantic wolffish. Non-standardised estimates of CPUE (left) from demersal trawl (kg/h) and longline (kg/1000 hooks). Fishing effort (right) for longline (10000 hooks) for demersal trawl (tow-hours).

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 amount of samples taken have been greatly reduced to save time and resources. Before this change, around 2000-2400 otoliths were being sampled yearly, but for last year 945 otoliths were sampled in 23, 9 and 6 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 wolffish catch.

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

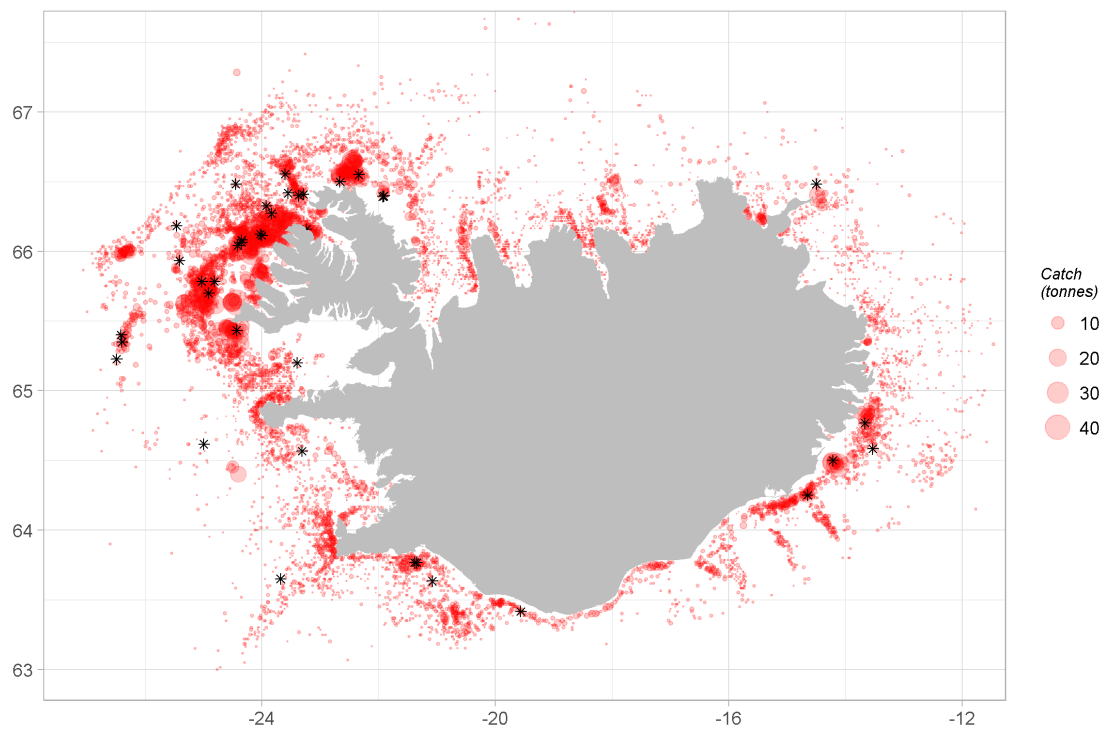


Figure 7. Atlantic wolffish. Geographical distribution of samples in 2017.

Mynd 7. Steinbítur. Svæðin (stjörnur) þar sem sýnin voru tekin úr afla árið 2017.

In samples from commercial landings, the mean age of Atlantic wolffish was around 11 years in 1999-2009 but has increased since then. There are many years classes in commercial landings, most of them seem to be of similar size (Figure 8). However, year classes 1989, 1990, 1997 and 2000 seem to be stronger than average and 1991 weaker.

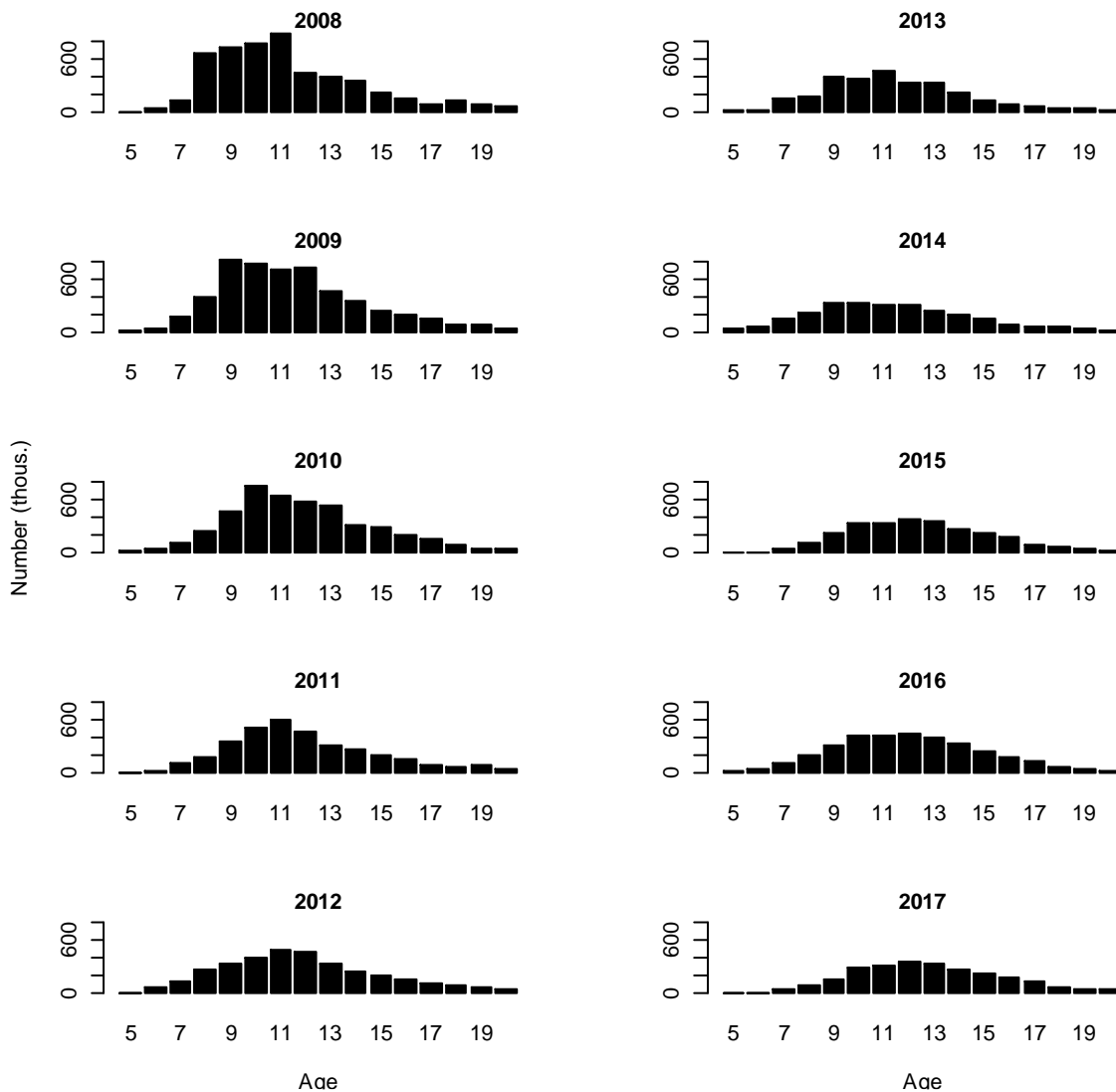


Figure 8. Atlantic wolffish. Estimated age distribution of landed catch based on landings and otoliths collected from landed catch.

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

LENGTH DISTRIBUTION OF LANDED ATLANTIC WOLFFISH

The length distribution of landed Atlantic wolffish catch has been relatively stable since 2002 (Figure 9). The average length in the commercial catch was around 70 cm for last 16 years.

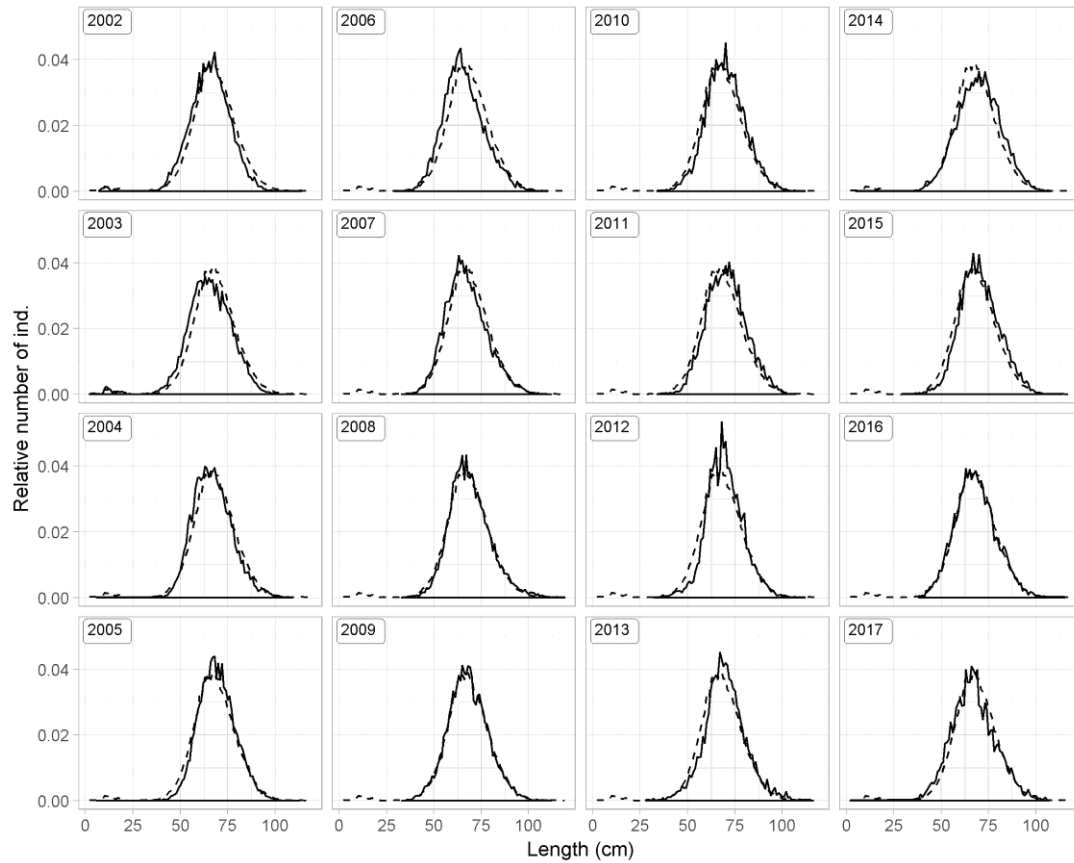


Figure 9. Atlantic wolffish. Length distribution of fish sampled from landed catch. The dotted line represents the mean length distribution for all years.

Mynd 9. Steinbítur. Lengdardreifing aflasýna frá árinu 2002 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 and therefore the results for 2011 are not presented. 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 decrease from 1985 to 1995. In 1996 the biomass index increased to 1998 but from that time it decreased to a historical low level in 2010-2012 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 (Látragrunn) 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 Látragrunn was enlarged from 500 km² (from 2002) to 1000 km² in October 2010.

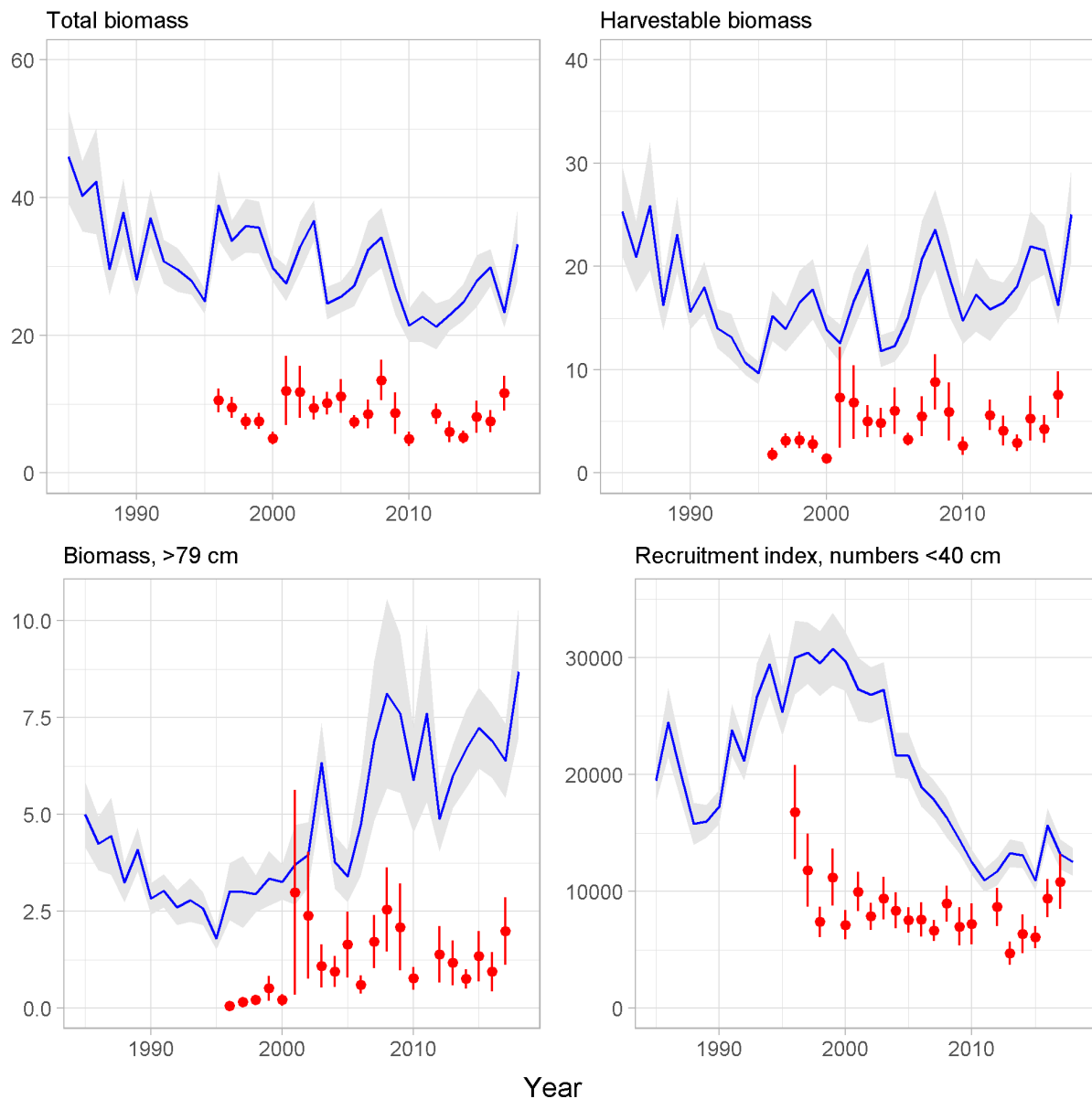


Figure 10. Atlantic wolffish. Total biomass indices (upper left) and harvestable biomass indices (>60 cm, upper left), large fish biomass indices (> 79 cm, lower left) and juvenile abundance indices (<40 cm, lower right), from the spring survey (blue) from 1985 and autumn survey (red) from 1996, along with the standard deviation.

Mynd 10. Steinbítur. Stofnvísitala (efri til vinstri), vísitala veiðistofns (60 cm og stærri, efri til hægri), vísitala fiska stærri en 79 cm (neðri til vinstri) og nýliðunarvísitala (40 cm og minni, neðri til hægri) úr stofnmælingu botnfiska að vori (blátt) frá árinu 1985 og hausti (rautt) frá árinu 1996, ásamt staðalfrávik.

The length distribution in the spring survey was unimodal and skewed to the right from 1985 to 2007. Since then the shape of the distribution has been bimodal because of more decrease in number in catch of fish at 40-60 cm than other lengths. The mean length of Atlantic wolffish has been similar between years or on the average about 39 cm. It was however lowest in the years 1994-2004 or on the average about 37 cm, but in these years the recruitment index was high. During decreasing recruitment index from 2004 the mean length increased and was in the years 2007 to 2018 on the average about 41 cm (Figures 10-11). The number of fish caught in spring survey increased from 14 thousand in 1988 to 24 thousand in 1996, from then the number was rather stable to 2003, wherefrom it decreased steadily between years to 2011-2012 were 9 thousand fish were caught. Since then the number has increased a little and in 2018, 11 thousand fish were caught.

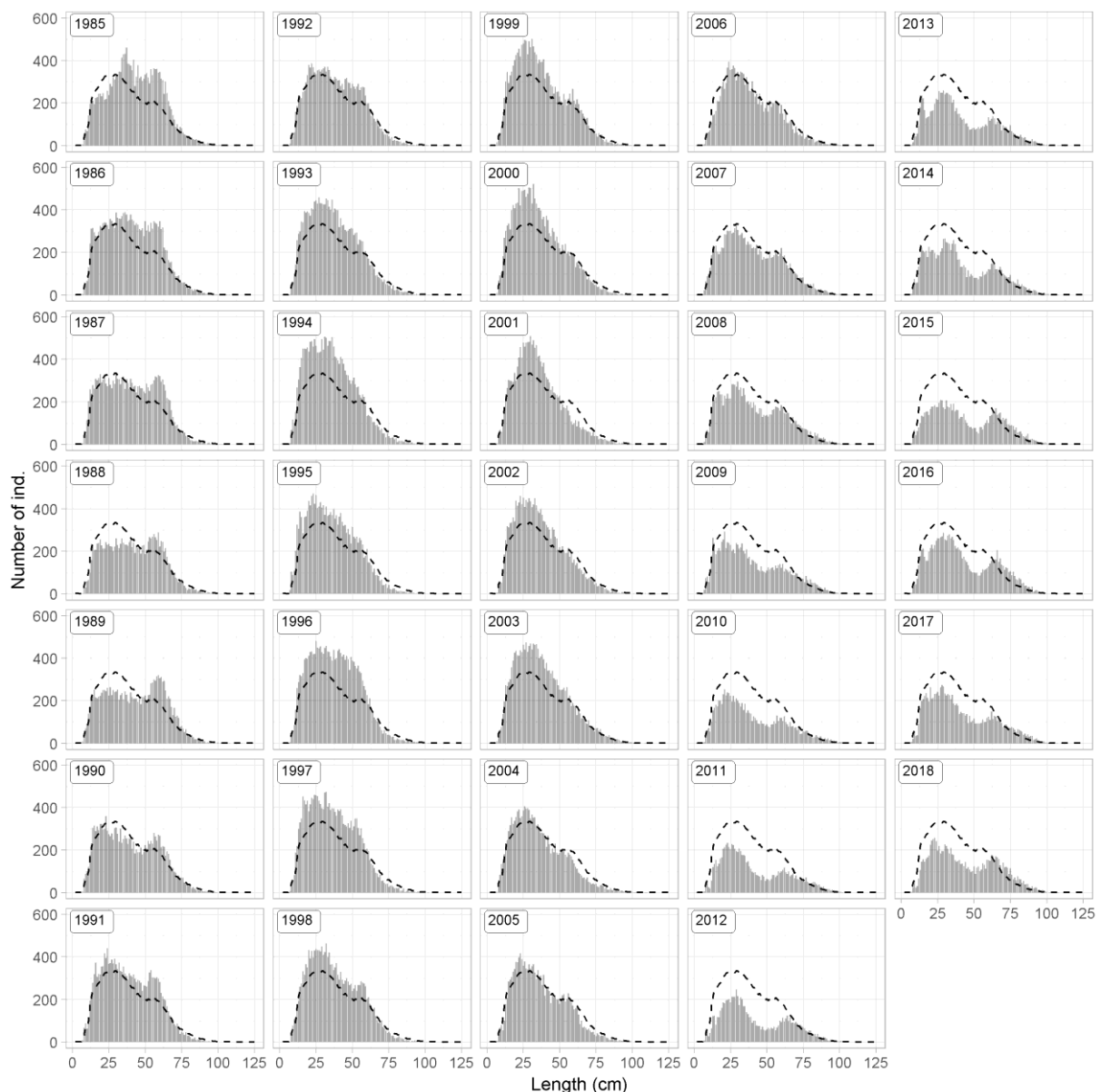


Figure 11. Atlantic wolffish. Length distribution from the spring survey. The dotted line shows mean length distribution for all years combined.

Mynd 11. Steinbítur. Lengdardreifing úr stofnmælingu botnfiska að vori frá 1985 ásamt meðal lengdardreifingu allra ára (punktalína).

In the spring survey, Atlantic wolffish are mainly caught in shallow waters in northwest of Iceland (Figure 12). When the spring survey is conducted the Atlantic wolffish are on its feeding grounds which are commonly in shallow waters. In the spring survey, most of the catch has always been in the north-west area. However, in the years 2010–2012 there was more caught in the west area than usually and in 1995 to 1998 more in north east area than usually (Figure 13).

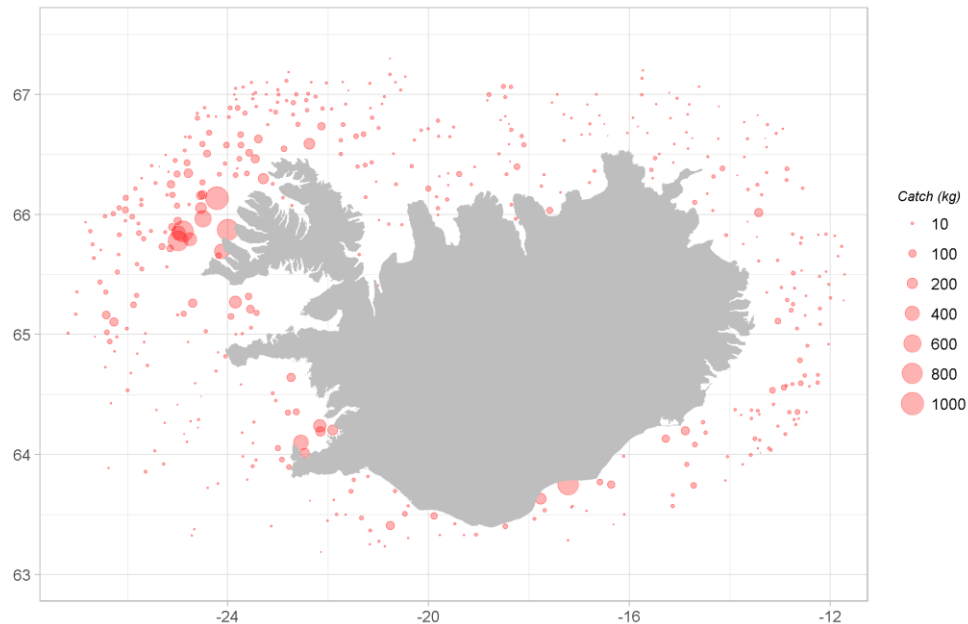


Figure 12. Atlantic wolffish. Spatial distribution in the spring survey in 2018.

Mynd 12. Steinbítur. Útbreiðsla í stofnmælinqu botnfiska að vori 2018.

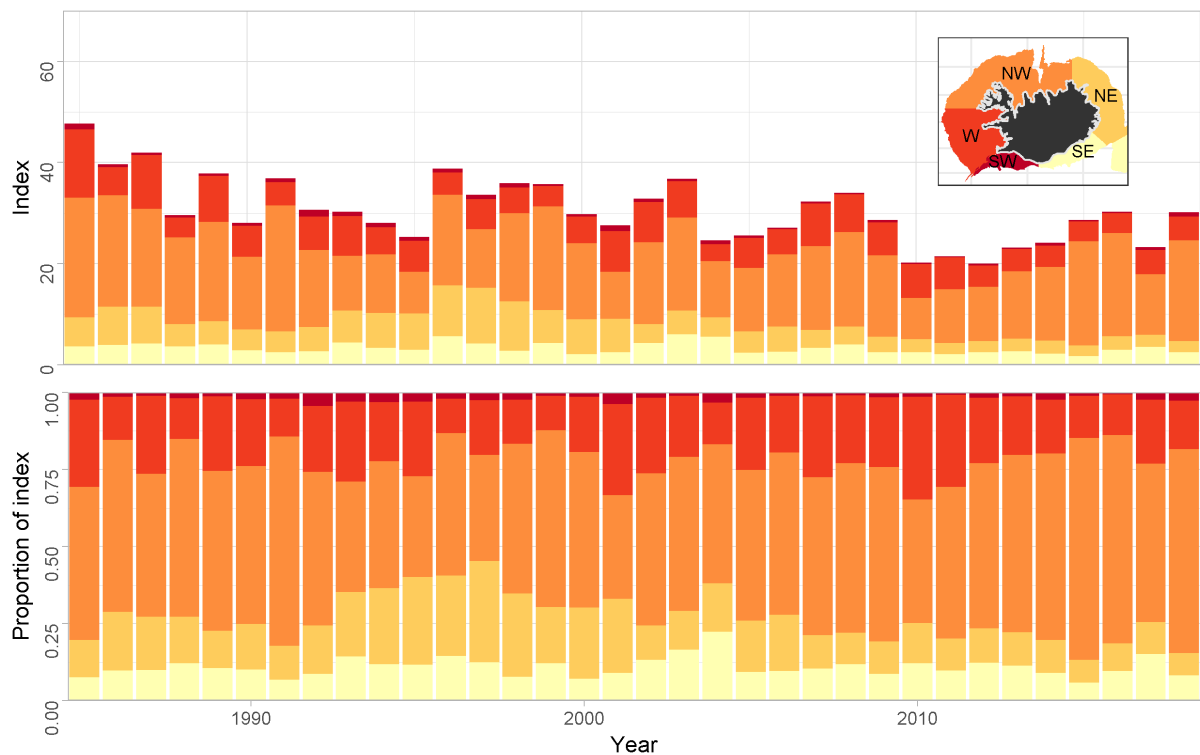


Figure 13. Atlantic wolffish. Spatial distribution of biomass index from the spring survey in 1985–2018.

Mynd 13. Steinbítur. Dreifing lífmassavísitölu í stofnmælingu botnfiska að vori árin 1985–2018.

The mean length in the autumn survey has been oscillating from 34 cm to 40 cm in the years 1996-2017 with no trend. The number caught however has similar trend as in spring survey, in 2002 the number was 1578 fish, wherefrom it decreased almost constantly between years to 2013 when 777 fish were caught. Since then the number has increased and was 1349 fish in 2017 (Figure 14).

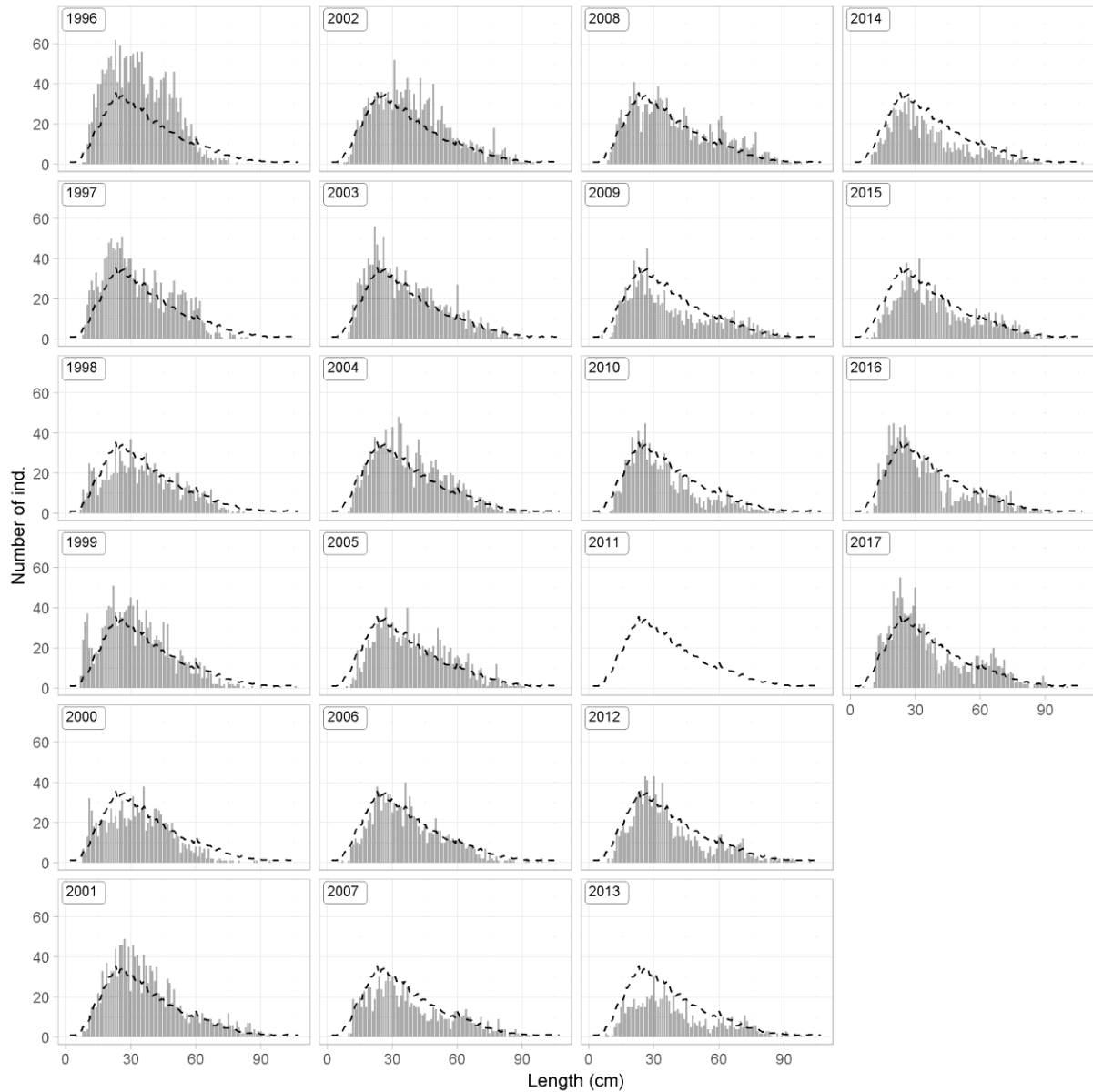


Figure 14. Atlantic wolffish. Length distribution from the autumn survey. The dotted line shows mean length distribution for all years combined.

Mynd 14. Steinbítur. Lengdardreifing úr stofnmælingu botnfiska að hausti frá 1996 ásamt meðal lengdardreifingu allra ára (punktalína).

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.

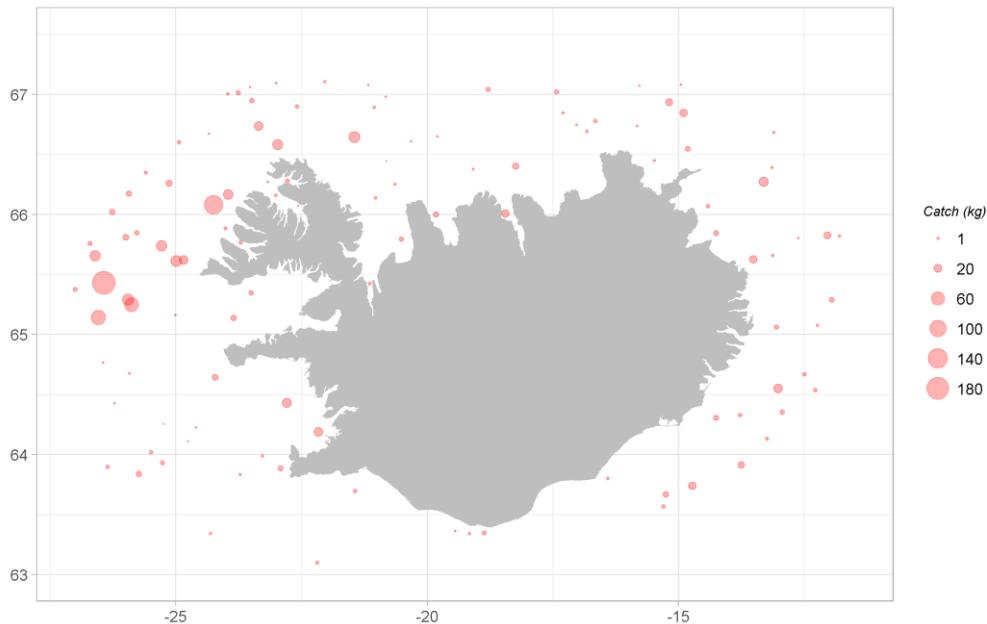


Figure 15. Atlantic wolffish. Spatial distribution in the autumn survey in 2017.

Mynd 15. Steinbítur. Útbreiðsla í stofnmælingu botnfiska að hausti árið 2017.

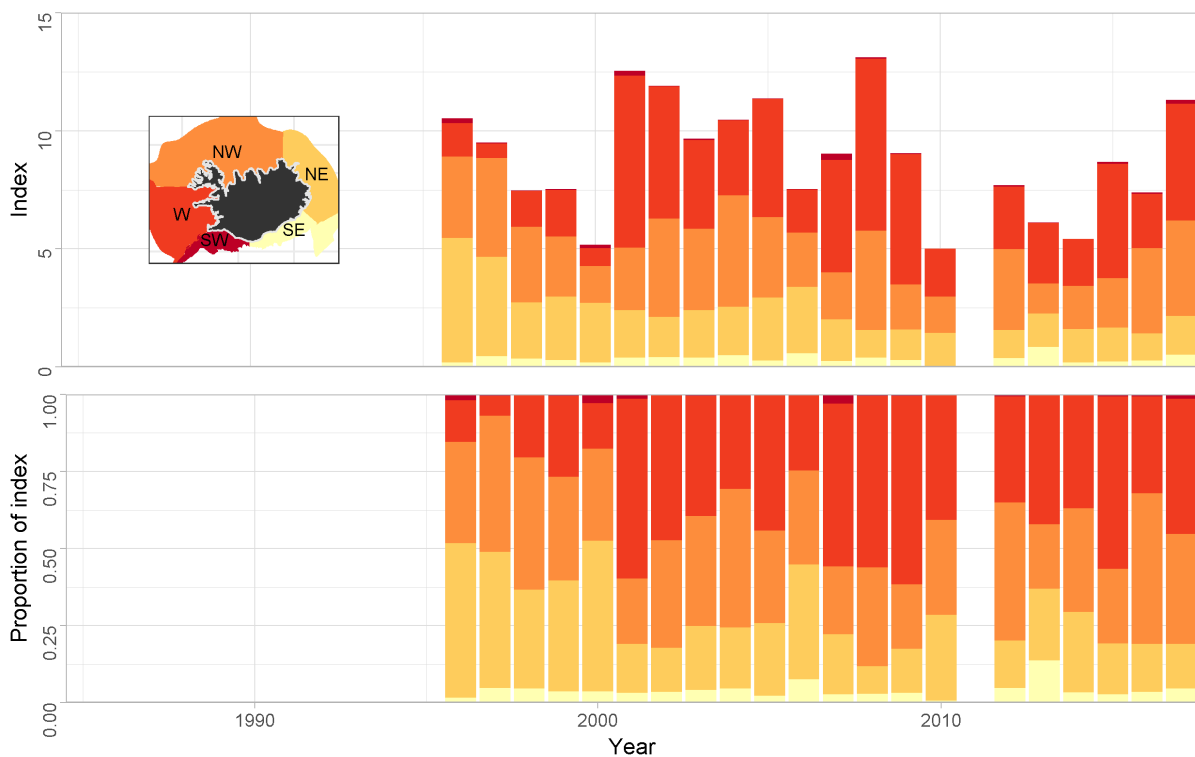


Figure 16. Atlantic wolffish. Spatial distribution of the biomass index from the autumn survey in 1996-2017.

Mynd 16. Steinbítur. Dreifing lífmassavísitölu í stofnmælingu að hausti árin 1996-2017.

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.

RESULT

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.

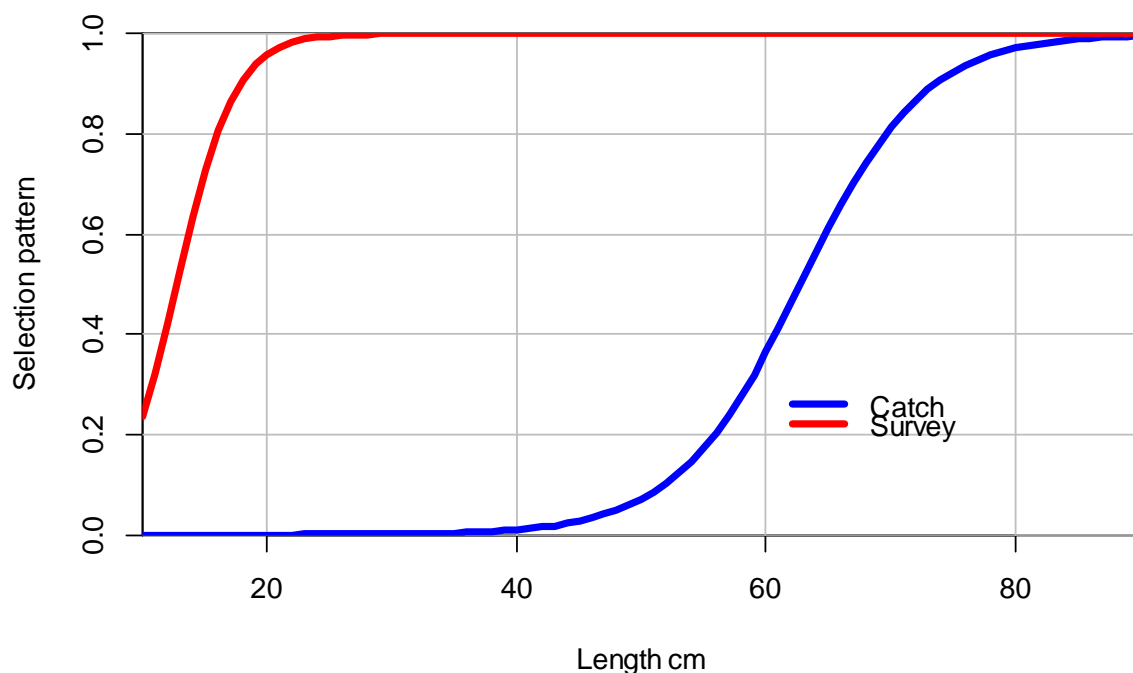


Figure 18. Atlantic wolffish. Estimated selection pattern from landed catch and the spring survey.

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

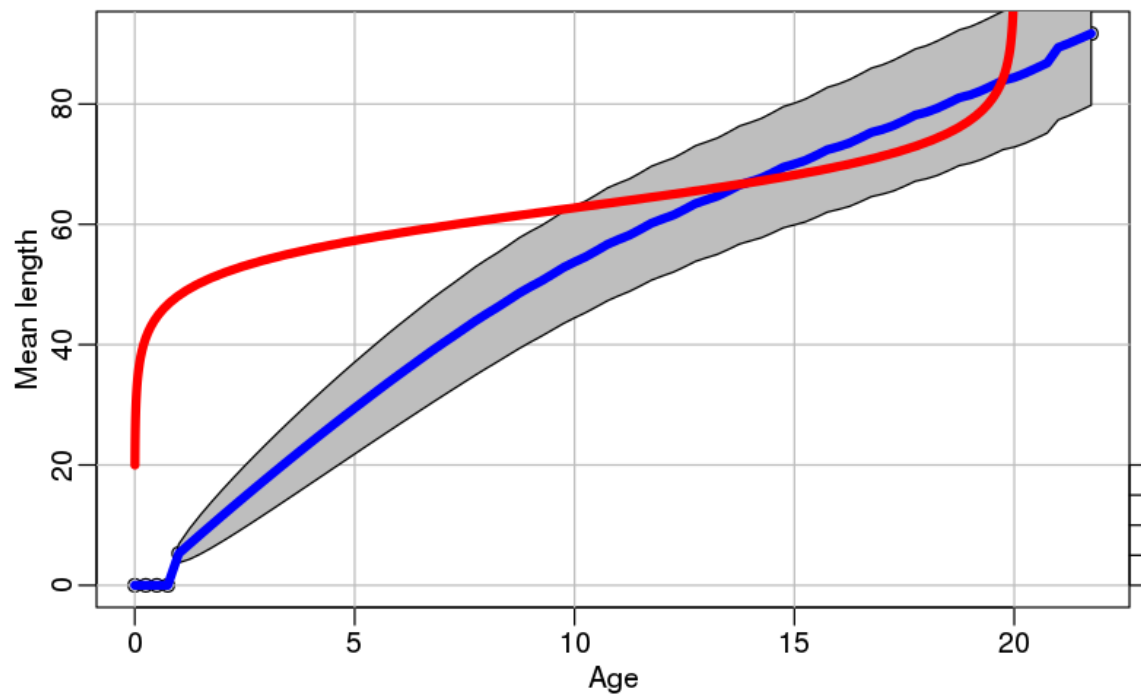


Figure 19. Atlantic wolffish. Estimated mean length and selection pattern as function of age.

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

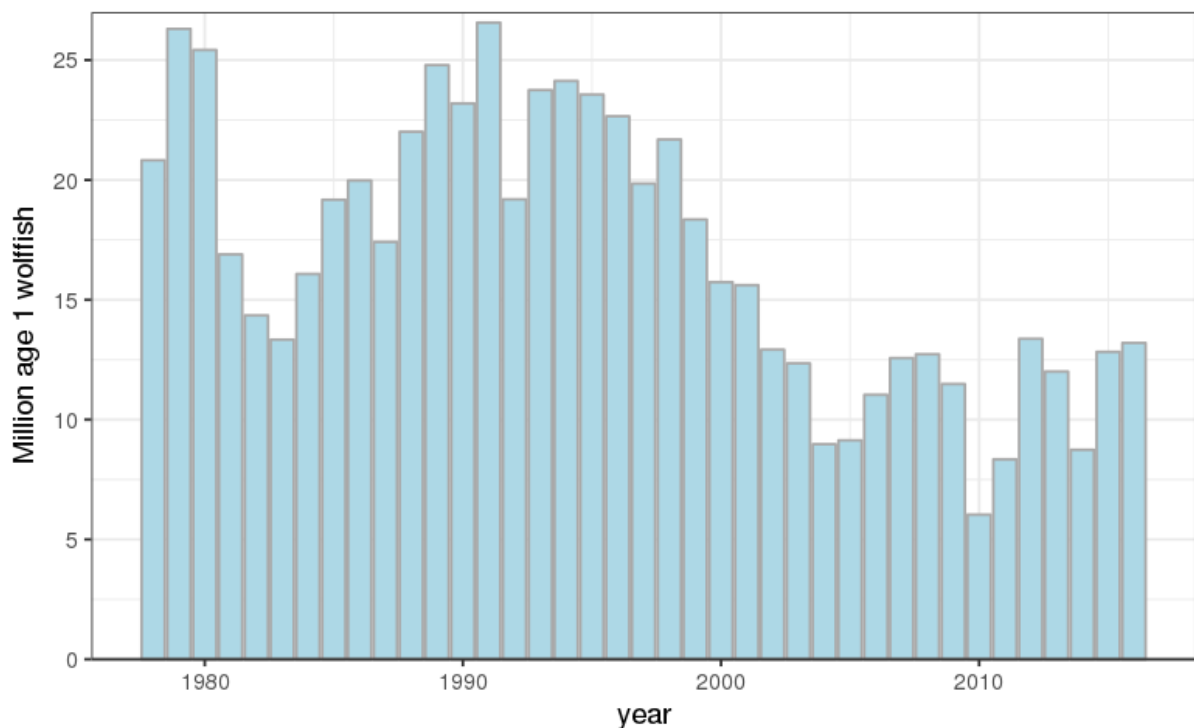


Figure 20. Atlantic wolffish. Estimated recruitment at age one according to the model in 2018.

Mynd 20. Steinbítur. Metin nýliðun eins árs samkvæmt stofnmatinu 2018.

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).

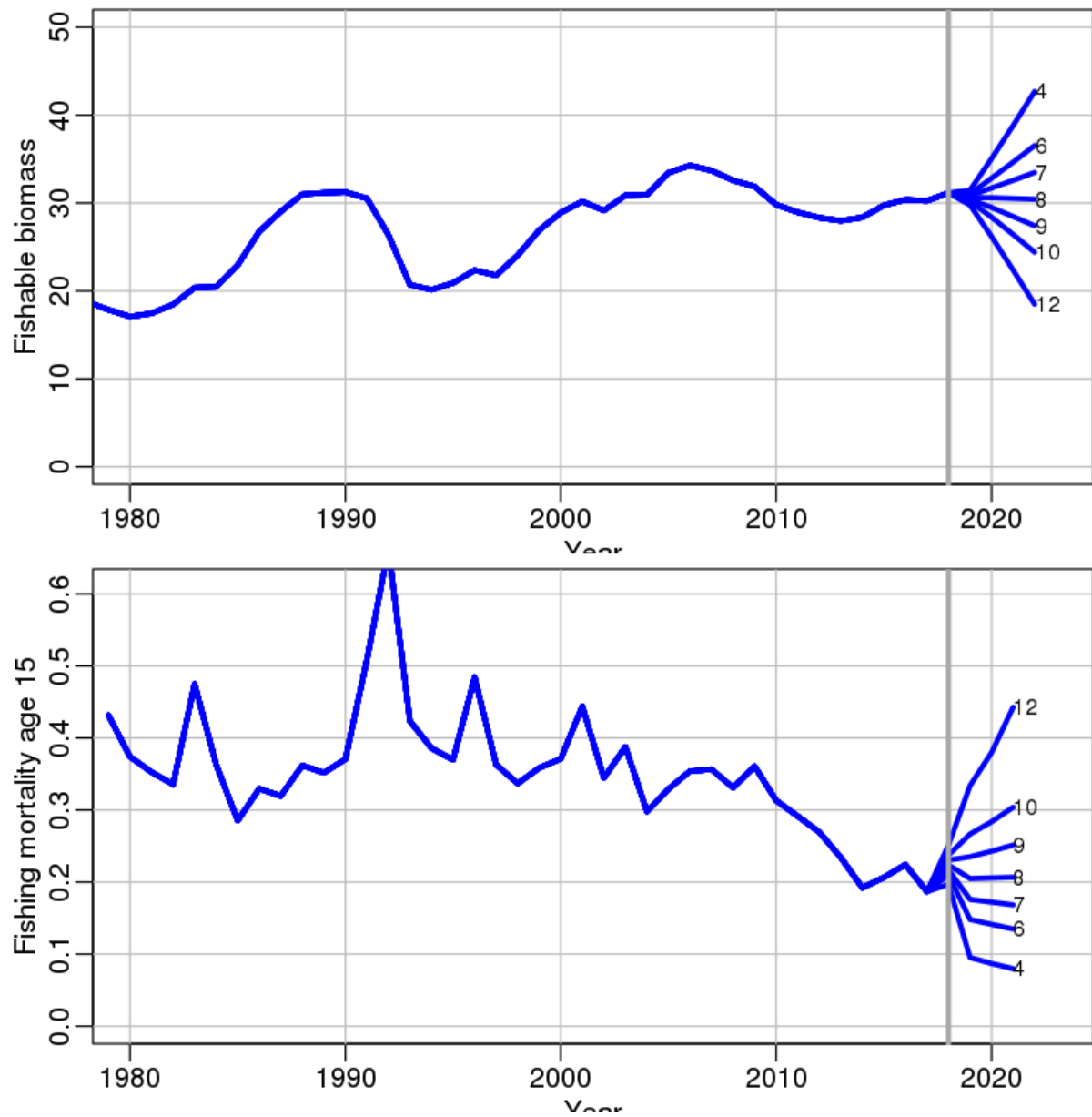


Figure 21. Atlantic wolffish. Historical values and prediction based on different annual catch next years, for fishable biomass and fishing mortality for 15 years old Atlantic wolffish.

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 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.

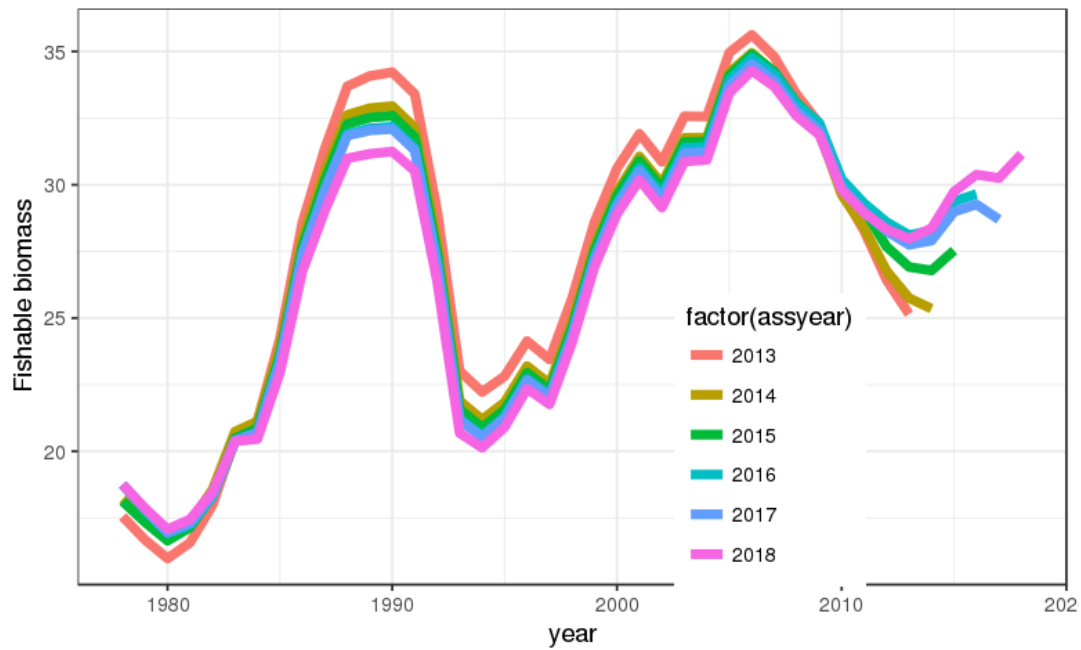


Figure 22. Atlantic wolffish. Estimated fishable biomass in the assessments 2013-2018.

Mynd 22. Steinbítur. Metinn veiðistofn í stofnmötunum 2013-2018.

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.

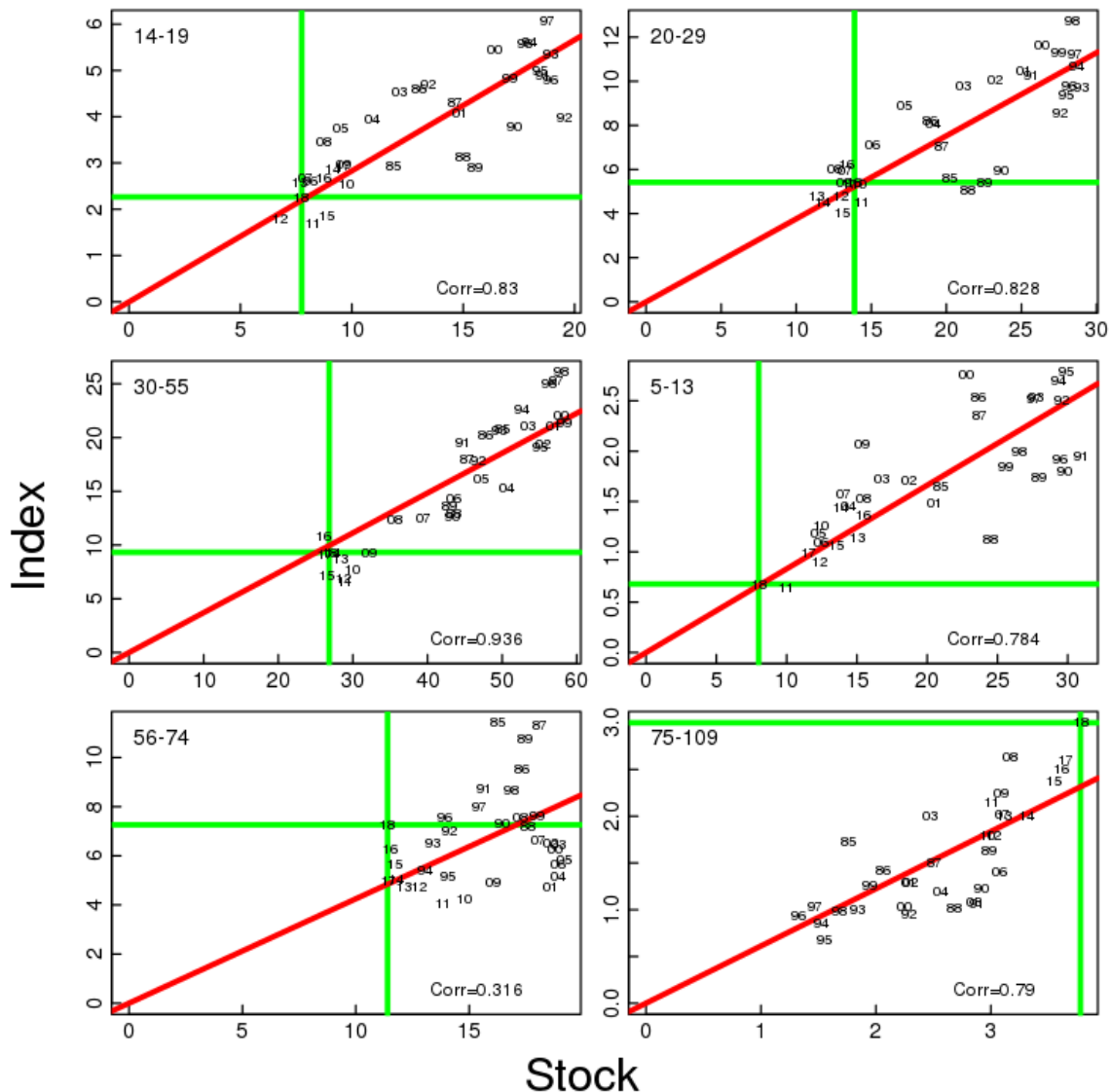


Figure 23. Atlantic wolffish. Correlation of the Abundance indices from spring survey and estimated stock number for the 6 length groups used in tuning. The labels indicate years and the most recent values are shown by the overlap of the green lines. The red line shows predicted values.

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 grænnu línanna. Rauða línan sýnir spágildin.

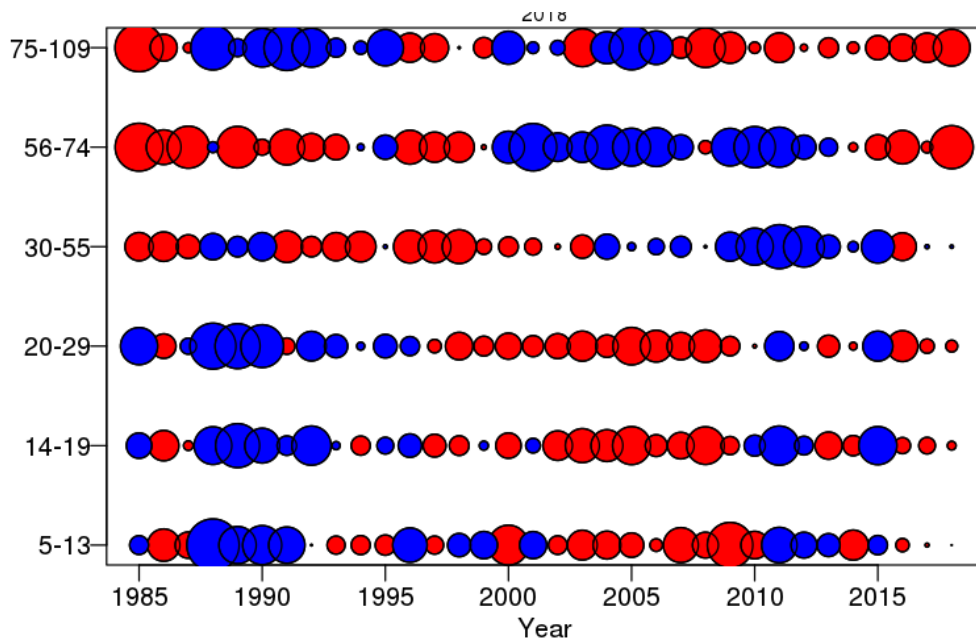


Figure 24. Atlantic wolffish. Log-residuals between observed abundance indices from spring survey and predicted. Red circles indicate positive residuals (observed > predicted).

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 a precautionary harvesting strategy. The advice for next fishing year is 9020 tons. Formal HCR evaluation is expected to take place in the winter 2018/19. The advice is based on F for fully recruited fish or 90 cm (Figure 18). In the advice $F_{90\text{cm}} = 0.3$ is used which corresponds to $F_{15} = 0.23$ but F_{15} is the value for F shown in Figure 21.

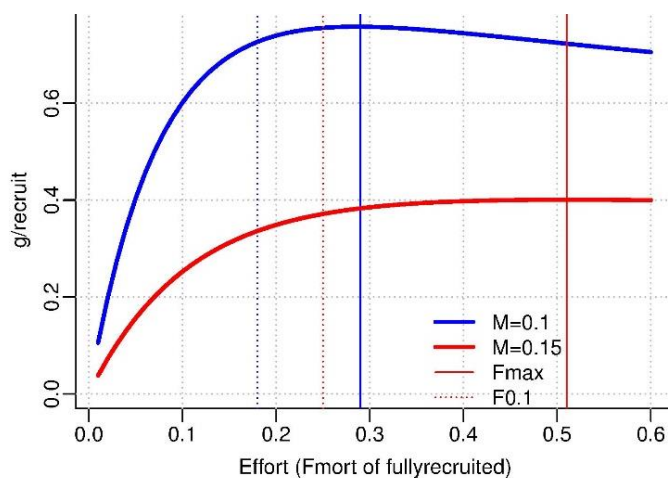


Figure 25. Atlantic wolffish. Yield per recruit as function of fishing mortality of fully recruited Atlantic wolffish.

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, in some years it was lower than advised TAC and higher in others. In the fishing years 2005/2006 to 2008/2009 the catch was around 31% more than the advised TAC. The main reasons were that national TAC was set higher than advice TAC, and on average about 3000 tonnes of quota of other species were being transferred to Atlantic wolffish quota (Table 3, Figure 17). Transfer of Atlantic wolffish quota from one quota year to the next is usually around 2-12%, but about 18% of the quota of 2016/2017 was transferred to the next year.

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

Tafla 3. Steinbítur. Tillögur Hafrannsóknastofnunar um hámarksafla, 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	
2018/19	9020		

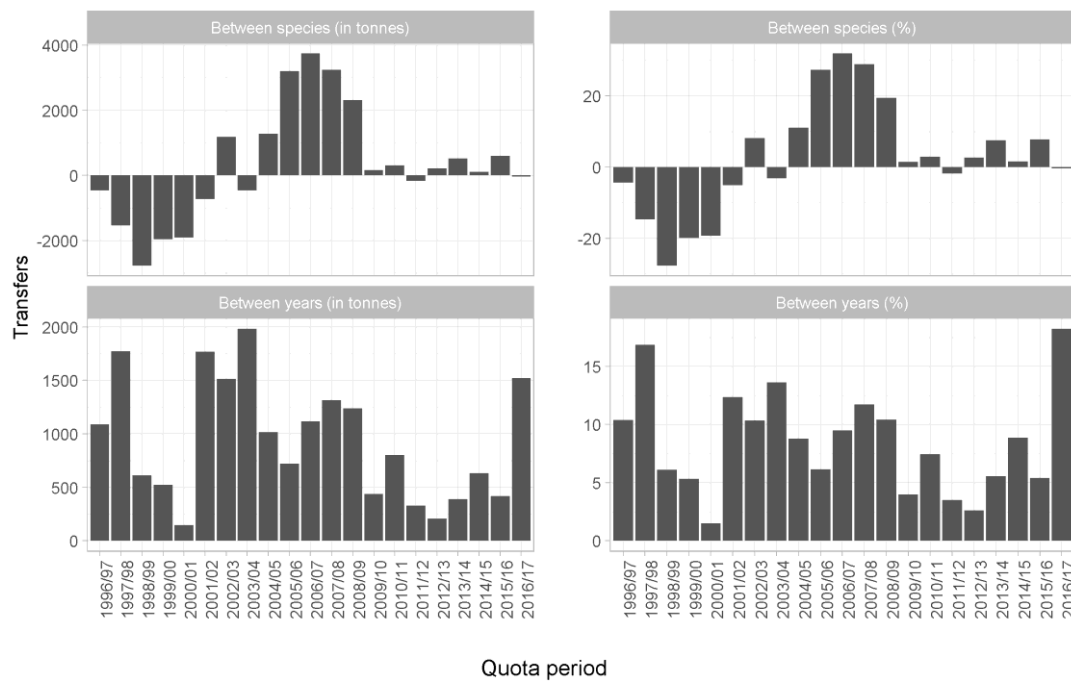


Figure 17. Atlantic wolffish. Net transfers of quota to and from Atlantic wolffish in the Icelandic ITQ system by quota year. Between species (upper): Positive values indicate a transfer of other species to Atlantic wolffish, but negative values indicate a transfer of Atlantic wolffish quota to other species. Between years (lower): Transfer of quota from given quota year to the next quota year.

Mynd 17. Steinbítur. Nettó tilfærsla á kvóta eftir fiskveiðiarum. Tilfærsla milli tegunda (efri myndir): Jákvæð gildi tákna tilfærslu á kvóta annarra tegunda yfir á steinbít en neikvæð gildi tilfærslu steinbít kvóta á aðrar tegundir. Tilfærsla milli ára (neðri myndir): Tilfærsla kvóta frá viðkomandi fiskveiðiarí yfir á næsta fiskveiðiarí.

ADVICE

MFRI advises that when the MSY approach is applied, catches in the fishing year 2018/2019 should be no more than 9020 tonnes. MFRI recommends a continued closure of the spawning area off West Iceland during the spawning and incubation season in autumn and winter.