

# COD – ÞORSKUR

## *Gadus morhua*

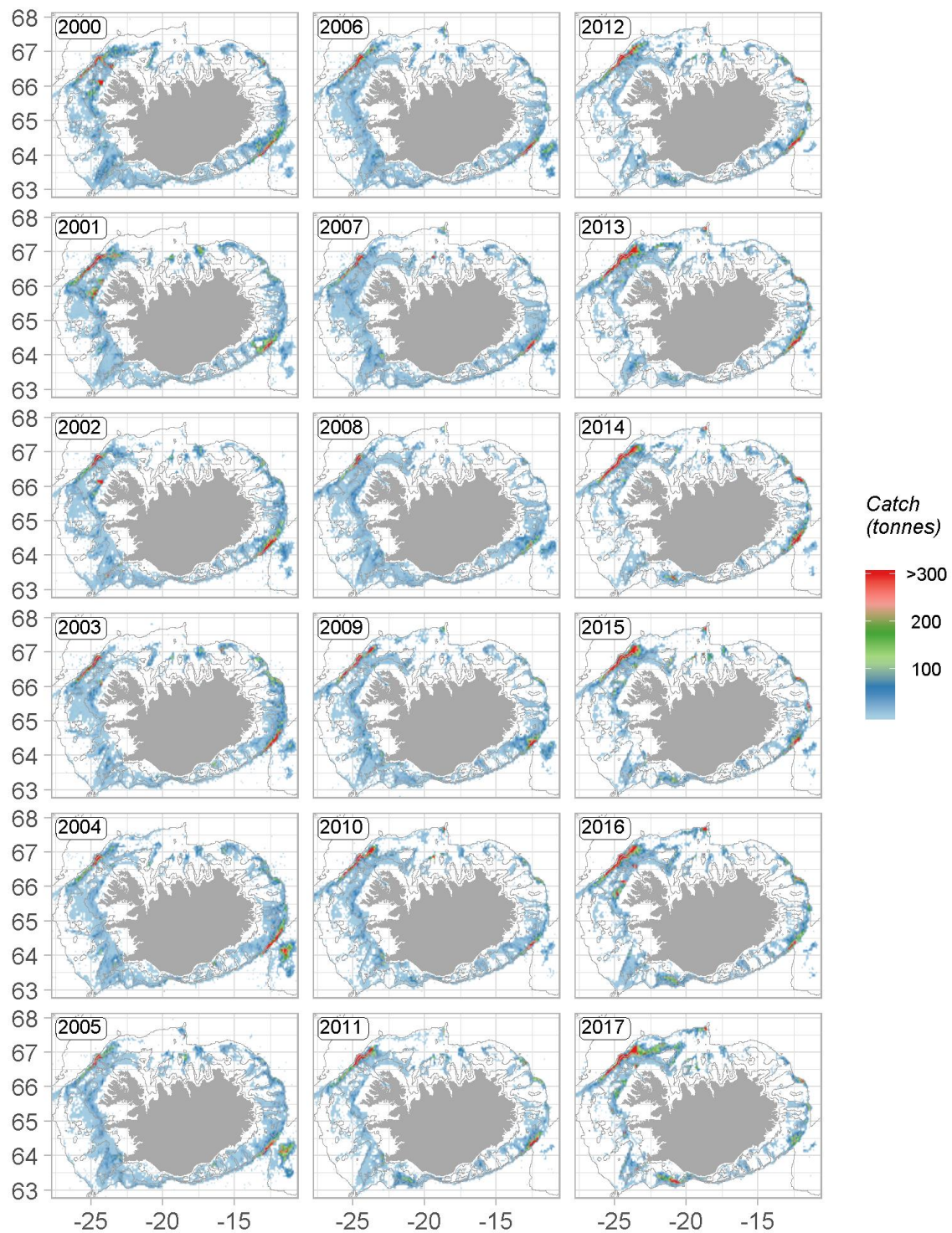
### GENERAL INFORMATION

Cod is widely dispersed in Icelandic waters, with higher abundance in north-western, northern and north-eastern part of the shelf. Cod is considered demersal with moderately wide depth distribution which can vary from depths of few meters down to 600 m, occasionally even deeper. Adult cod has not much of preference regarding bottom structure and can be found on various substrates, however large share of the cod juveniles prefer moderately sheltered, shallow kelp and seagrass environments. The ideal sea temperature for cod is around 4-7°C, nevertheless the temperature limits for this species are somewhat wider, and a significant proportion of the catch is taken where temperature is less than 2 degrees.

Cod spawns all around Iceland by smaller regional spawning components, however the main spawning areas are situated in the south, southwest and west of the island. Spawning starts early in the spring (March-April) on main spawning grounds in the warmer waters in the south. Spawning used to start later on in the colder waters in the north, but in recent years spawning time in the north has advanced significantly. North- and eastward pelagic egg- and larval drift mainly occurs clockwise to the nursery grounds situated in the north and northeastern area. The adult stock takes feeding migrations to the deeper waters in the north-west and south-east, but part stays in the shallow domains to feed. Cod is the most important exploited groundfish species in Iceland.

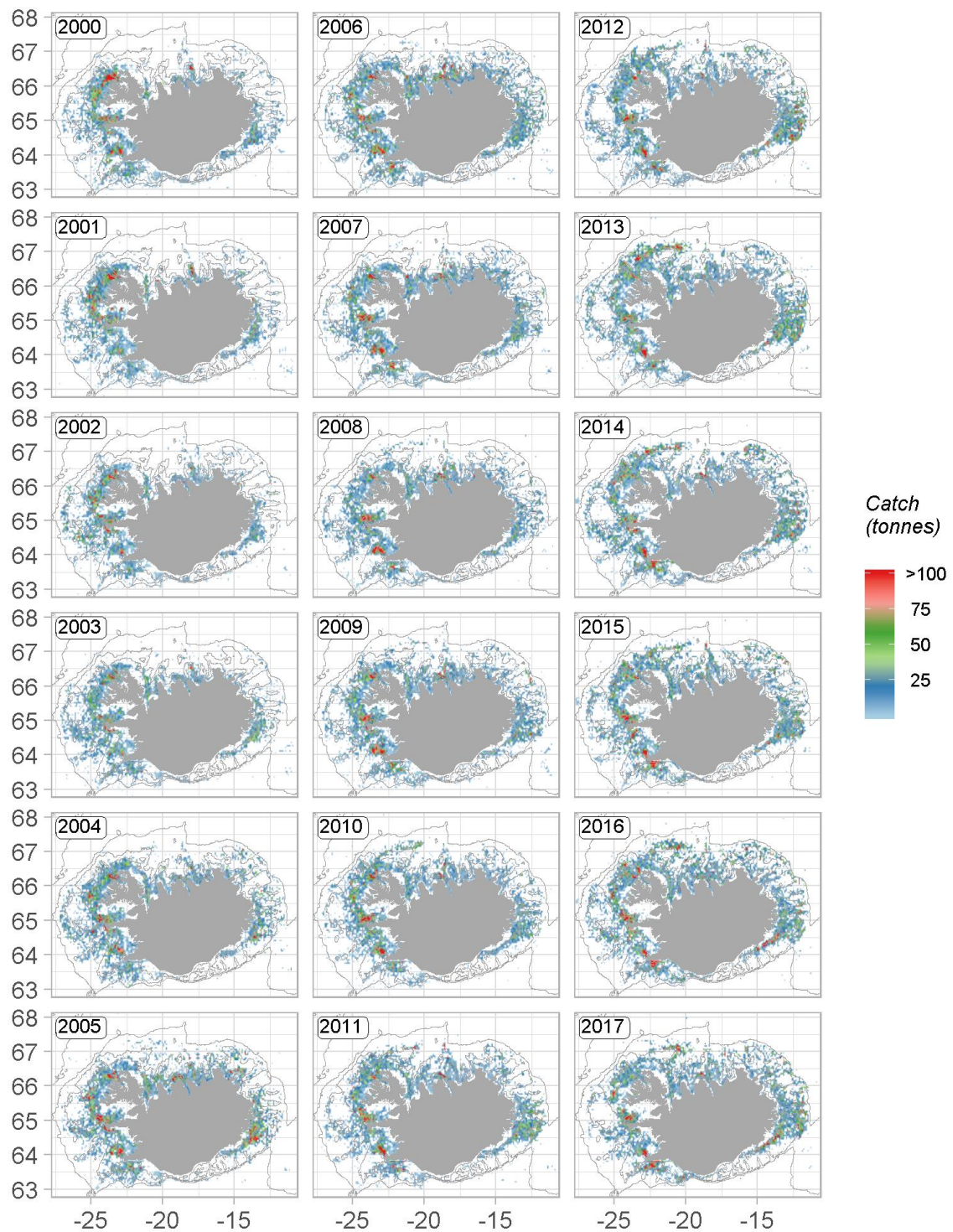
### THE FISHERY

Due to wide spatial distribution of cod in Icelandic waters, the fishing grounds are scattered around the shelf and partially divided by gear type (Figures 1-3). Demersal trawl is the main fishing gear (Table 1, Figure 6). Main fishing grounds for demersal trawl are situated offshore in deeper relatively cold waters to the north-west, northeast and east of the island. In recent years the spatial distribution of demersal trawl fishery has been gradually contracting and aggregating at the previously mentioned trawl fishery hotspots (Figure 1). Longline is the second most important gear type in the cod fisheries and is widely distributed around the Icelandic shelf, with lowest reported catch in the south and southeast coast (Figure 2). The distribution pattern of the catches remains consistent between the years with occasional hotspots. Figure 3 shows the spatial distribution of remaining fishing fleet, i.e. gillnets, demersal seine and jiggers. Those fisheries are also widely distributed in Icelandic waters, but mainly in shallow waters. All cod fishing grounds are illustrated accordingly to registrations in mandatory logbooks for the years 2000-2017.



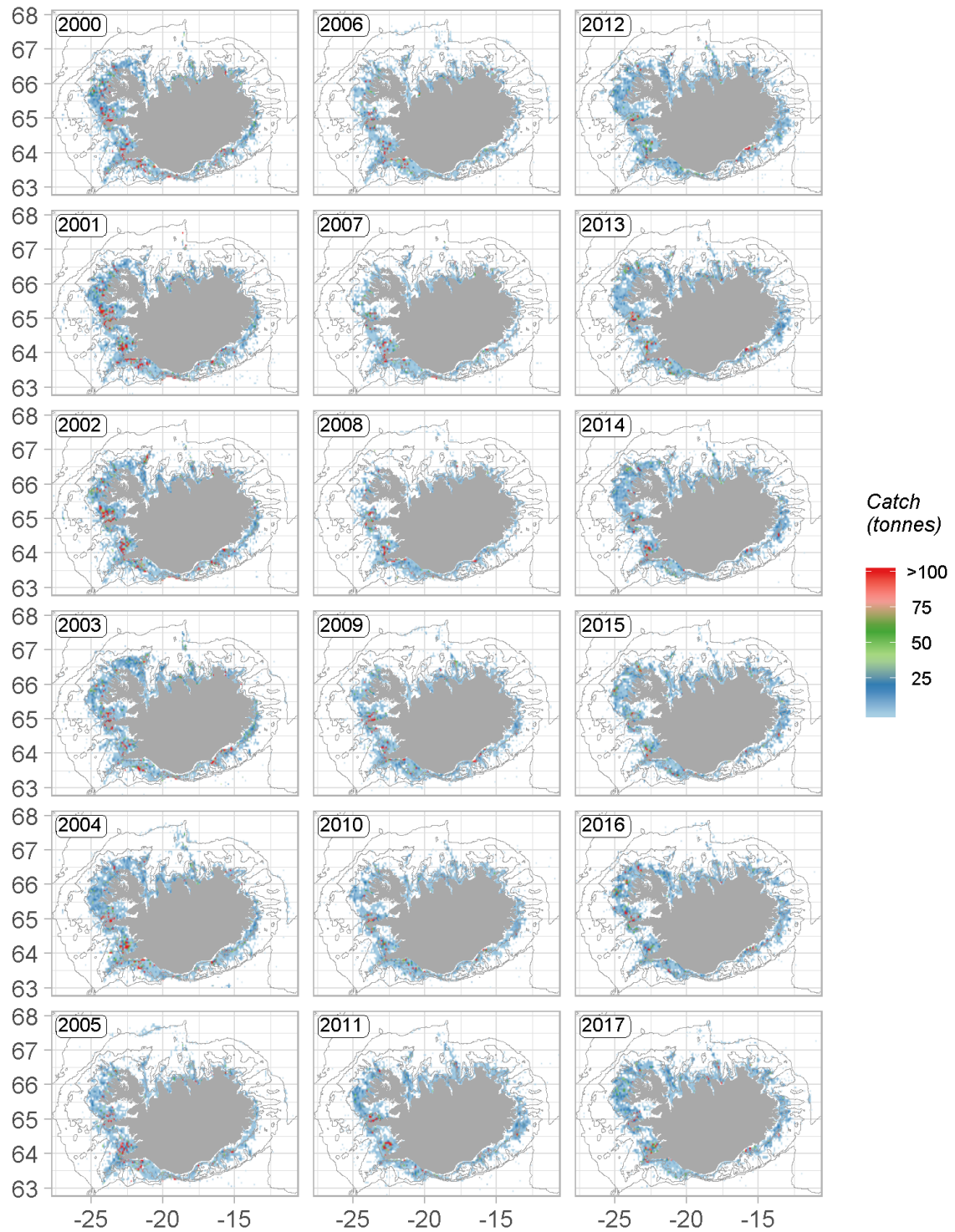
**Figure 1. Cod. Geographical distribution of the Icelandic demersal trawl fishery since 2000. Reported catch from logbooks. The 100, 200, and 500 m isobaths are shown.**

*Mynd 1. Þorskur. Útbreiðsla botnvörpuveiða á Íslandsmiðum frá 2000 samkvæmt afladagbókum. Sýndar eru 100, 200 og 500 m dýptarlínur.*



**Figure 2. Cod. Geographical distribution of the Icelandic longline fisheries since 2000. Reported catch from logbooks. The 100, 200, and 500 m isobaths are shown.**

**Mynd 2. Þorskur. Útbreiðsla línuveiða á Íslandsmiðum frá 2000 samkvæmt afladagbókum. Sýndar eru 100, 200 og 500 m dýptarlínur.**



**Figure 3. Geographical distribution of the Icelandic cod fisheries from gillnets, demersal seine and jiggers since 2000. Reported catch from logbooks. The 100, 200, and 500 m isobaths are shown.**

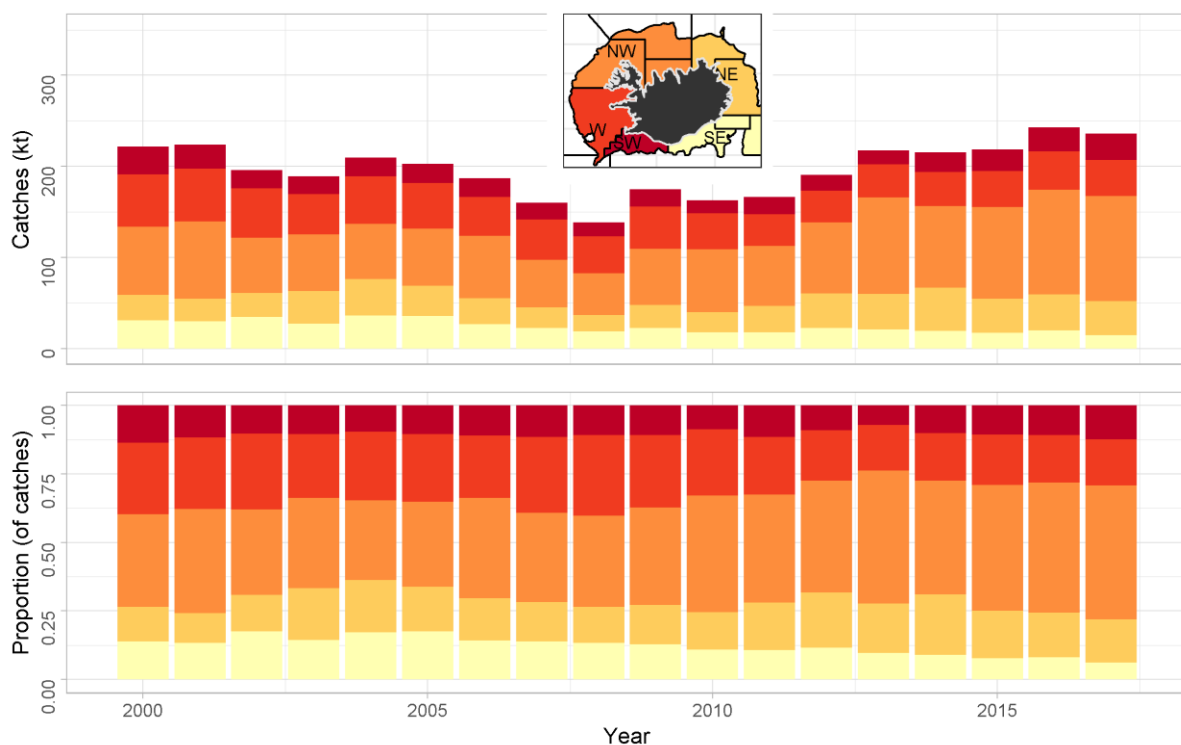
*Mynd 3. Þorskur. Útbreiðsla veiða frá netum, dragnót og handfæri síðan 2000, samkvæmt afladagbókum. Sýndar eru 100, 200 og 500 m dýptarlínur.*

Spatial distribution of the cod fishery has been relatively stable for the past years (Figure 4). Changes in depth and spatial distribution (Figures 4 and 5) are partly caused by changes in gear composition (Figure 6). For cod, the average depth in bottom trawl is 230 m, longline 160 m, but 80 m for demersal seine and gillnets. Mixed fisheries considerations do also affect spatial distribution of the fisheries. For example, haddock TAC (Total Allowable Catch) was 50-80% of the cod TAC from 2003-2008 leading to increased fisheries in areas where haddock was abundant. For comparison, TAC for haddock has been 15-18% of the cod TAC in recent years.

The long term pattern is that gillnets and bottom trawl were the most important gear with most of the bottom trawl catches taken in the northwest, but the gillnet catches in the south and west during spawning time. The share of gillnets has declined continuously in recent decades, while that of longlines has increased (Figure 6). Longline fisheries have the widest spatial distribution of the fleets targeting cod (Figure 2), although most of the catches come from the west and northwest. Introduction of large longliners with automatic baiting in recent decades has expanded the fishing area of longliners to deeper waters.

In some areas, especially in the northwest, cod can be found in dense schools in certain hotspots, a fact exploited by captains when they want to catch large amount of cod in short time just before landing. Condition and size of cod in different areas is also an issue regarding fishing areas, but all those factors have to be weighed against proximity to landing harbour.

In 2017, almost half of the cod catch was taken in bottom trawl, one third on longlines, 7% by gillnets, 6% by jiggers, and 6% by demersal seine. Of the catch by trawlers, 19% was frozen at sea but the rest landed fresh. About one third of the catch was taken in northwest, 29% in southwest and 21% in east. Average depth was 177 m, 10% was caught at depth <55 m and 10% at depth >310 m.



**Figure 4. Cod. Spatial distribution of the Icelandic fishery by fishing area from 2000-2017. All gears combined.**

*Mynd 4. Þorskur. Útbreiðsla veiða á íslensku veiðisvæði árin 2000-2017. Öll veiðarfæri samanlagt.*

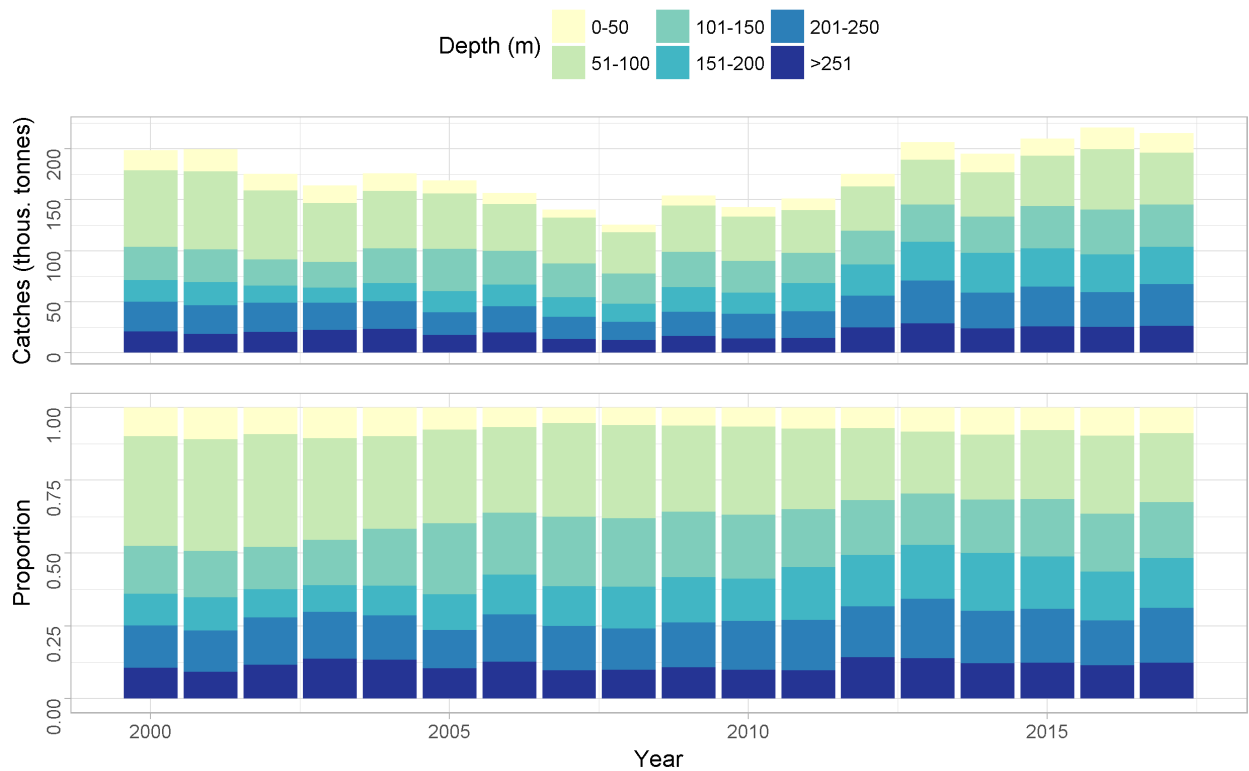


Figure 5. Cod. Depth distribution of catches according to logbooks.

Mynd 5. Þorskur. Afli samkvæmt afladagbókum, skipt eftir dýpi.

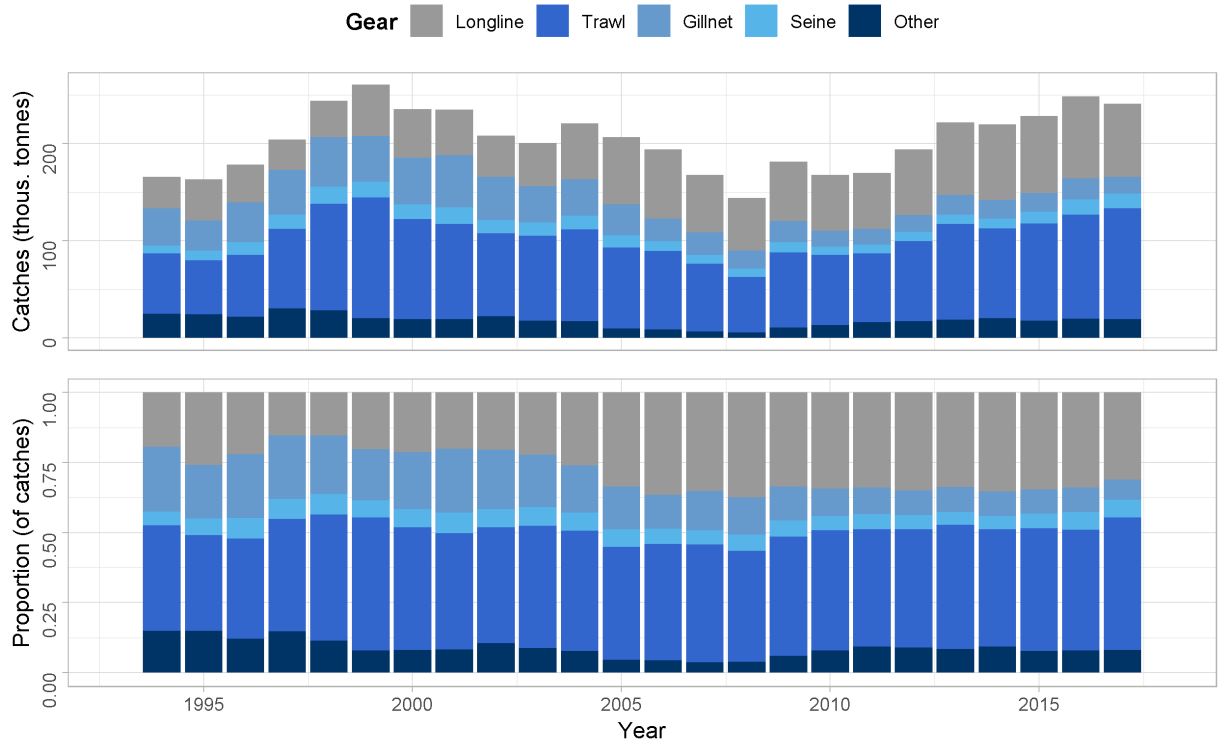


Figure 6. Cod. Total catch (landings) by fishing gear since 1994, according to statistics from the Directorate of Fisheries.

Mynd 6. Þorskur. Landaður afli eftir veiðarfærum frá 1994, samkvæmt aflaskráningarkerfi Fiskistofu.

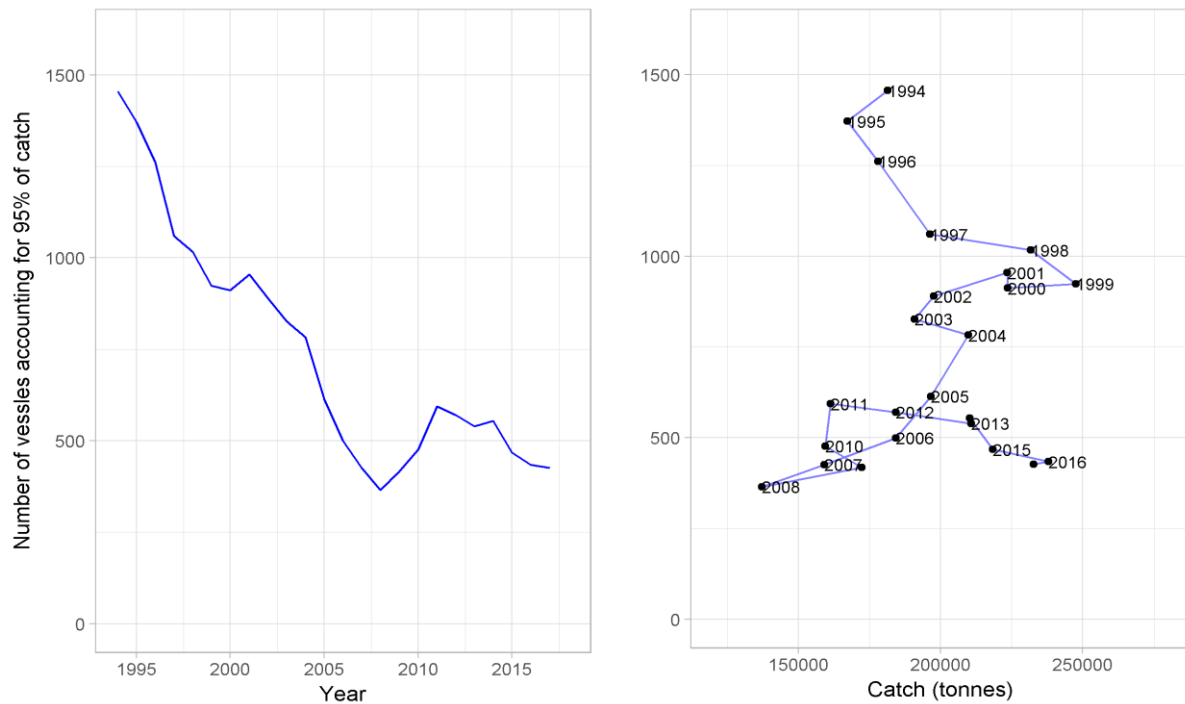
Since 1994, the number of vessels reporting catches over 10 tonnes of cod in total annually, has decreased. This decline is noticeable in all the fleets, as the number of vessels has dropped by more than a half since 1994 (Table 1). However, total catches have been increasing steadily in the past few years and last year's total catch was 241 thousand tonnes (Table 1).

**Table 1. Cod Number of Icelandic vessels landing catch of 10 tonnes or more of cod, and all landed catch divided by gear type.**

*Tafla 1. Þorskur. Fjöldi íslenskra skipa sem landað hafa yfir 10 tonnnum af þorski og allur landaður afli eftir veiðarfærum.*

YEAR	NUMBER OF VESSELS					CATCHES (THOUS. TONNES)					
	Long-liners	Gill-netters	Trawlers	Seiners	Other	Line	Gillnet	Trawl	Seine	Other	Sum
1994	430	240	143	83	642	32	38	62	8	25	165
1995	427	193	140	93	653	42	31	55	10	24	163
1996	424	217	132	106	634	39	41	64	13	21	178
1997	345	200	130	108	714	31	46	81	14	30	203
1998	371	244	136	106	687	37	51	108	18	28	242
1999	400	241	137	96	602	53	47	123	16	20	259
2000	381	258	119	86	568	50	48	102	15	19	234
2001	375	325	109	87	546	47	54	97	17	19	234
2002	333	284	97	85	537	42	44	86	25	11	208
2003	341	237	99	81	482	45	37	87	13	18	200
2004	343	231	99	83	488	57	37	94	14	18	220
2005	350	187	97	77	321	69	32	83	13	9	206
2006	317	138	89	72	258	71	23	80	10	9	193
2007	273	116	89	63	185	59	23	70	9	6	167
2008	237	89	79	59	169	54	19	57	8	6	144
2009	221	90	80	63	333	61	22	77	10	11	181
2010	209	80	72	52	388	57	17	72	8	13	167
2011	202	77	70	49	565	58	16	71	9	16	170
2012	208	76	74	50	592	68	17	82	10	17	194
2013	215	78	75	50	616	45	20	98	10	19	222
2014	218	71	67	43	645	78	19	92	10	20	220
2015	204	76	64	45	599	79	19	100	12	18	228
2016	191	70	65	44	625	84	21	107	16	19	248
2017	176	63	65	44	613	57	17	114	15	37	241

The number of vessels accounting for 95% of the annual catch of cod in Icelandic waters reduced from almost 1500 to about 900 vessels in 1994-1999 (Figure 7). This reduction occurred despite annual catch increasing by almost 100 thousand tonnes. In 1999-2008, the number of vessels accounting for 95% of the cod catch reduced with reduced total catches to about 400 vessels. Since 2009 the number of vessels has remained relatively constant between 400-600, but at the same time annual catches have increased by about 70 thousand tonnes (Figure 7).



**Figure 7. Cod. 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 7. Þorskur. 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.*



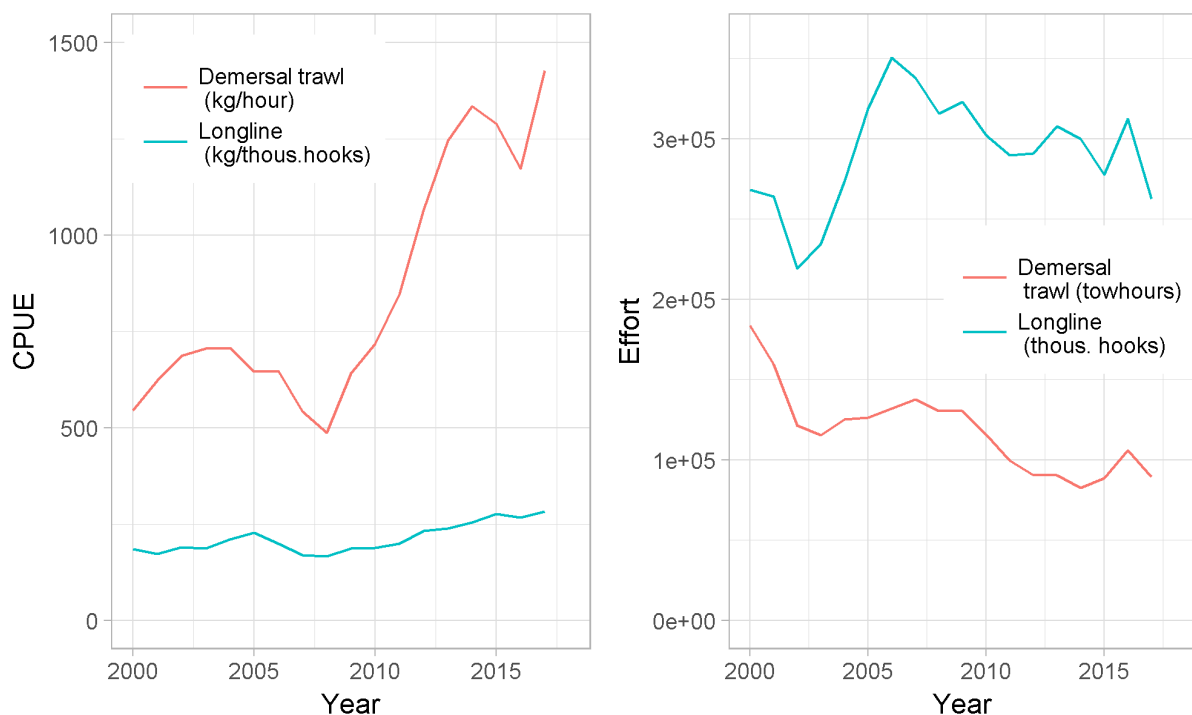
## CATCH PER UNIT EFFORT (CPUE) AND EFFORT.

CPUE estimates of cod 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-standardized estimates of CPUE of demersal trawl (kg/hour) in hauls where cod is more than 10% of the catch, increased considerably since the lowest CPUE in 2008 with 500 kg/hour to the highest with approximately 1400 kg/hour last year (Figure 8, left).

CPUE in longline (kg/1000 hooks), is calculated as the total weight in sets in which cod was more than 10% of the catch. According to logbooks, cod CPUE remained quite stable since 2000 with slightly under 250 kg of cod on average per 1000 hooks. However, since 2012 CPUE has increased slightly and was just above 250 kg/1000 hooks last year.

Total fishing effort (number of towing hours where cod was 10% or more of the total catch) for cod in demersal trawl has gradually decreased since 2000 and has fluctuated around 100 thous. tow-hours (Figure 8). Fishing effort in longline increased rapidly between 2003 and 2006 from approximately 120 million hooks in 2003 to 350 million hooks in 2006. Since then the effort decreased slightly but fluctuated around 300 million hooks (Figure 7).



**Figure 8. Cod. Non-standardised estimates of CPUE (left) from demersal trawl (kg/h) and longline (kg/1000 hooks). Fishing effort (right) for demersal trawl (tow-hours) and longline (1000 hooks).**

*Mynd 8. Þorskur. Afli á sóknareiningu (vinstri) í botnvörpu (kg/togtími) og línu (kg/1000 krókar). Sókn (hægri) í dragnót (kg í kasti eða fjöldi kasta) rautt og botnvörpu (kg/klst eða togtímar) blátt.*

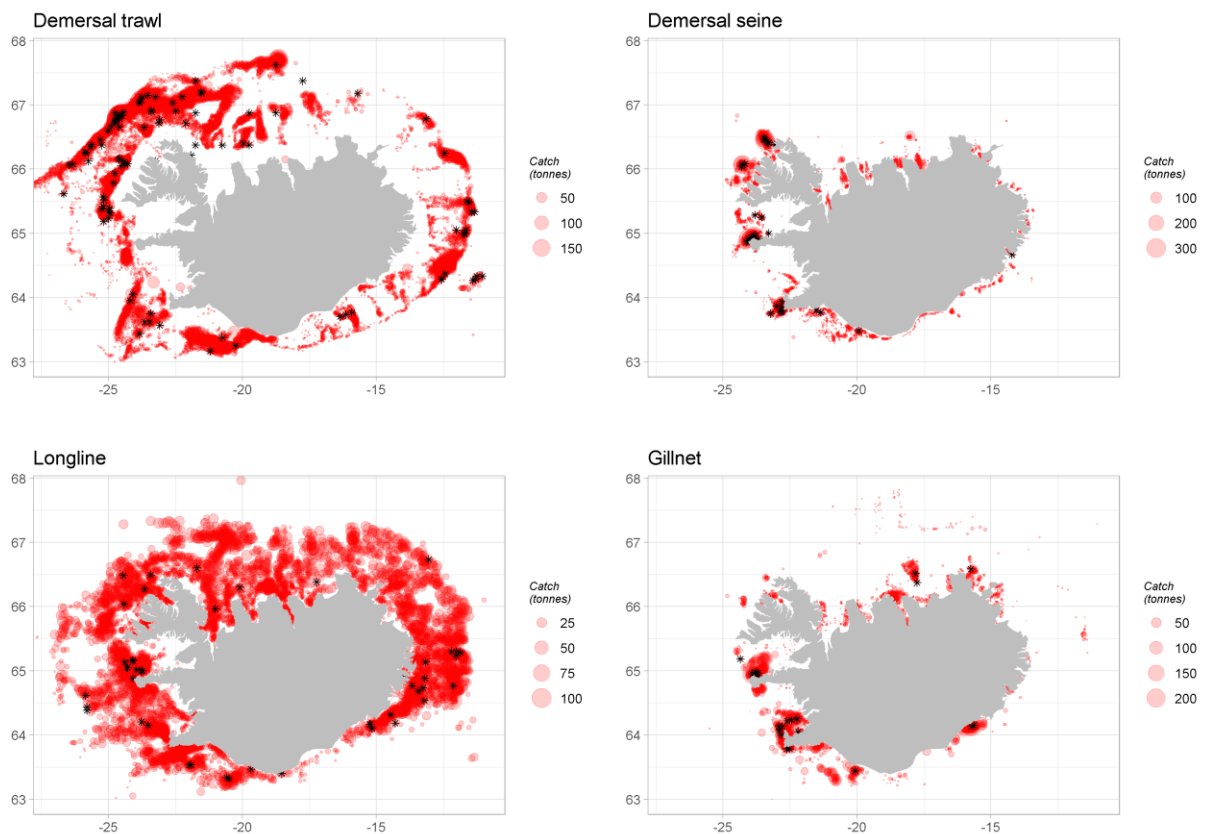
## AGE DISTRIBUTION OF LANDED COD

Table 2 shows the number of otoliths samples and number of age reading in 2010-2017 divided by gear type and Figure 9 shows the location of otoliths sampling in 2017.

**Table 2. Cod. Number of samples and aged otoliths from landed catch.**

*Tafla 2. Þorskur. Fjöldi sýna og aldursgreindra fiska úr lönduðum afla.*

YEAR	DEMERSAL TRAWL		LONGLINE		GILLNET		DEMERSAL SEINE	
	Samples	Otoliths	Samples	Otoliths	Samples	Otoliths	Samples	Otoliths
2010	89	4395	58	2881	16	799	7	350
2011	84	4200	46	2294	14	700	10	500
2012	88	4400	56	2800	21	1031	10	582
2013	71	3550	59	2947	21	1050	7	329
2014	87	2667	58	1725	29	850	20	525
2015	112	3192	52	1453	35	875	28	700
2016	110	2915	60	1544	40	1000	41	1025
2017	84	2106	46	1119	26	644	39	975



**Figure 9. Cod. Fishing grounds in 2017 as reported in logbooks (red) and positions of samples taken from landings divided by gear (asterisks).**

*Mynd 9. Þorskur. Veiðisvæði við Ísland árið 2017 samkvæmt afladagbókum (rautt) og staðsetningar sýna úr lönduðum afla skipt eftir veiðarfærum (stjörnur).*

The age composition of the catch has shifted from younger to older fish in the last few decades. This is likely a result of decreasing fishing pressure (Figure 10).

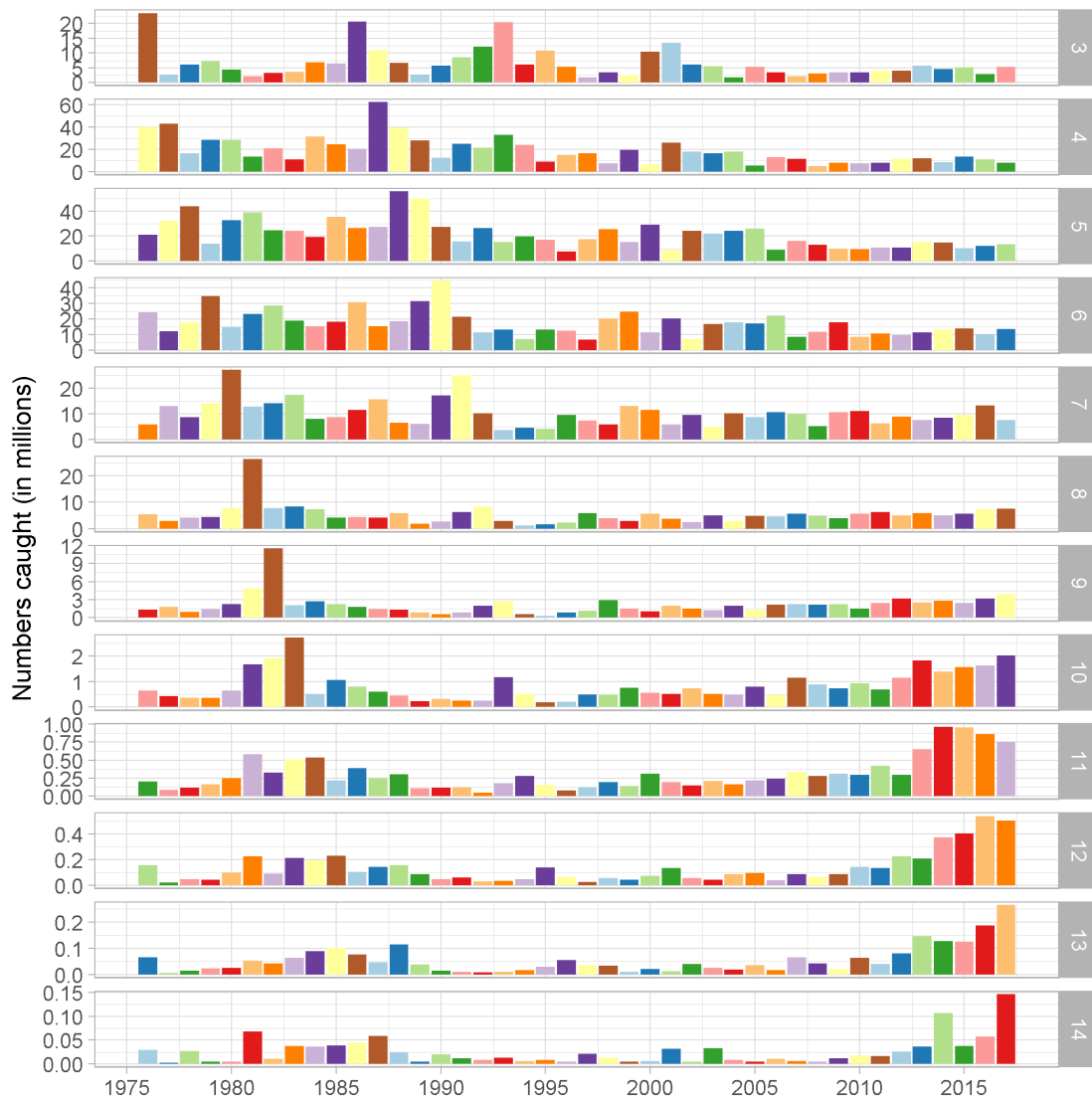
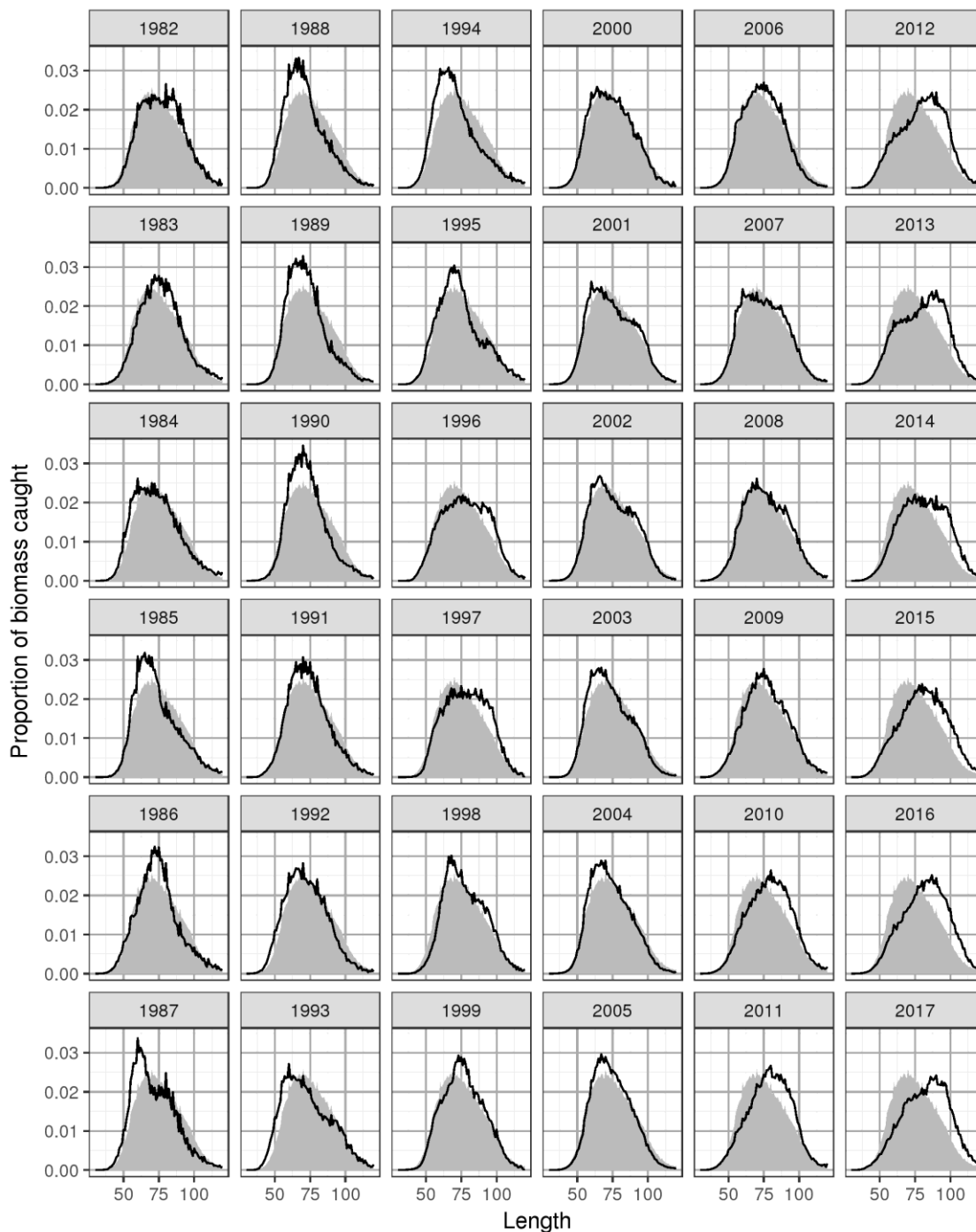


Figure 10. Cod. Estimated age distribution of landed catch based on landings and otoliths collected from landed catch (note different scales on the y-axes).

*Mynd 10. Þorskur. Áætluð aldursdreifing landaðs afla byggð á aldursgreiningum á fiskum úr afla (ath. mismunandi skala á y-ás).*

## LENGTH DISTRIBUTION OF LANDED COD

The length distribution of landed catch has shifted towards larger cod in the last ten years (Figures 11-12). This change is observed for all the main gear, except jiggers (Figure 13).



**Figure 11. Cod. Length distribution from landed catch. The grey area represents the mean length distribution for all years.**

*Mynd 11. Þorskur. Lengdardreifing aflasýna frá árinu 1982 með meðallengdardreifingu fyrir öll árin (gráa svæðið).*

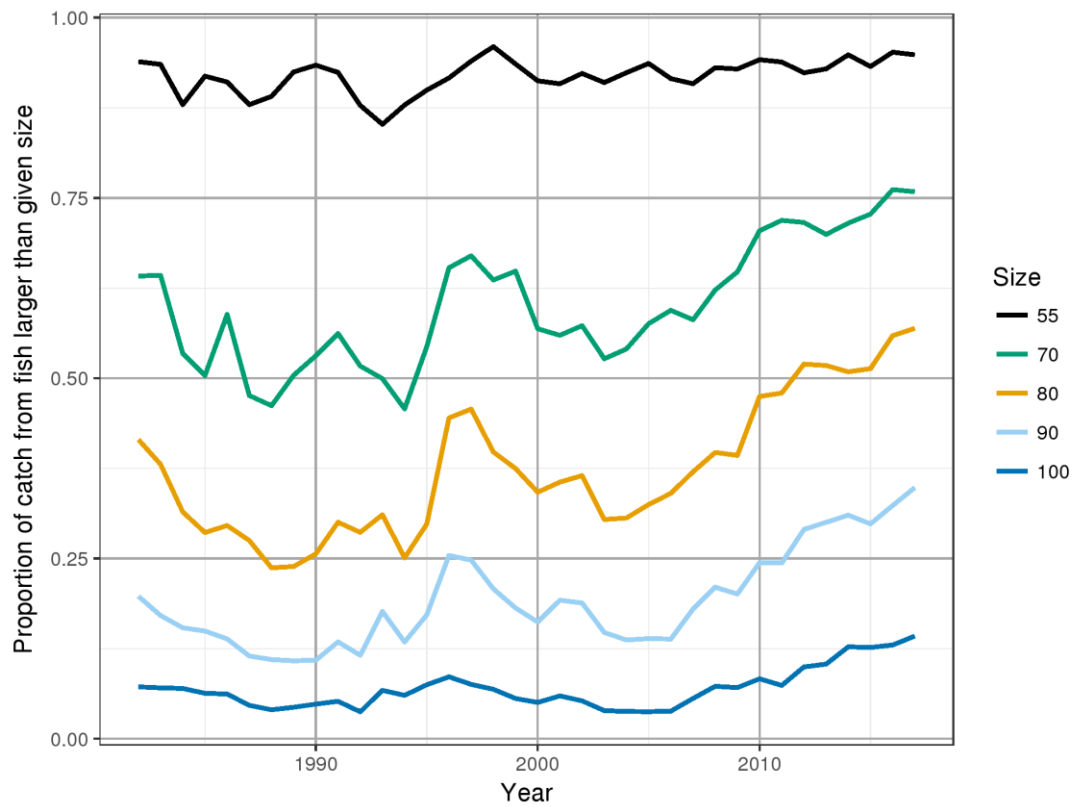


Figure 12. Cod. Proportion of the commercial catch (by weight) from fish larger than a given size (cm).

Mynd 12. Þorskur. Hlutfall aflans (í þyngd) sem tilheyrir fiski stærri en við gefna lengd (cm).

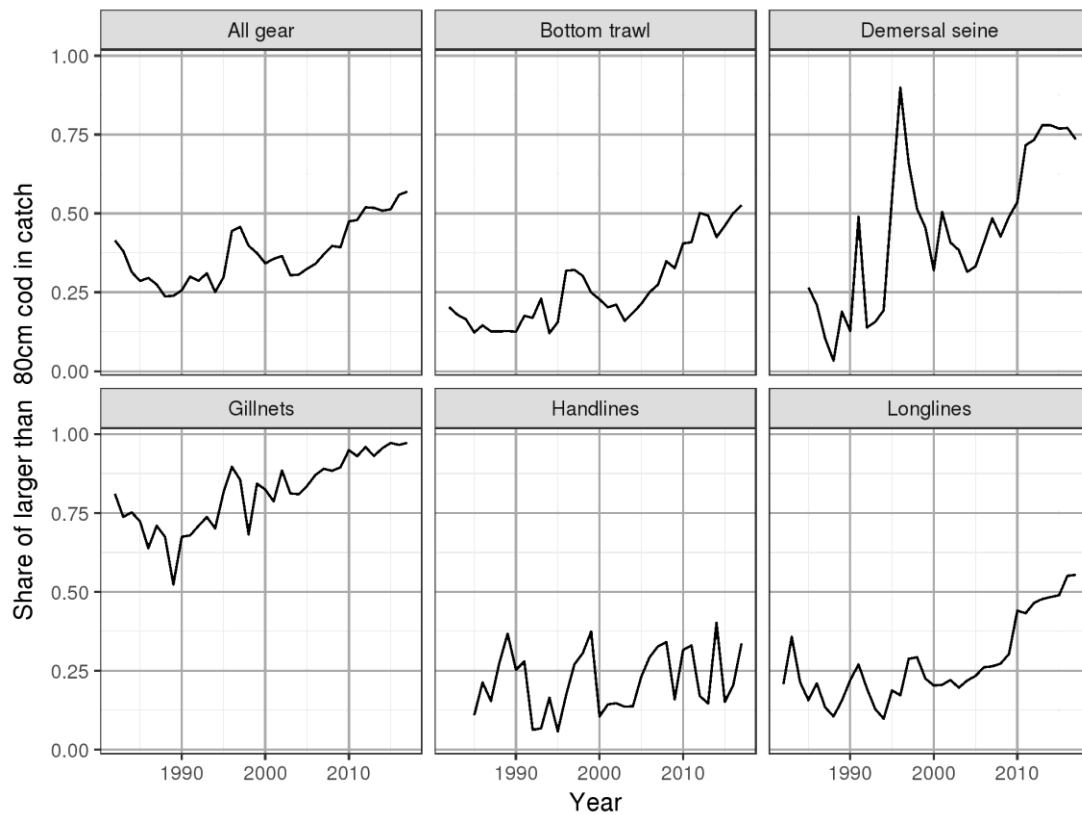


Figure 13. Cod. Proportion of fish larger than 80 cm in the catches (by weight) taken by different gear types.

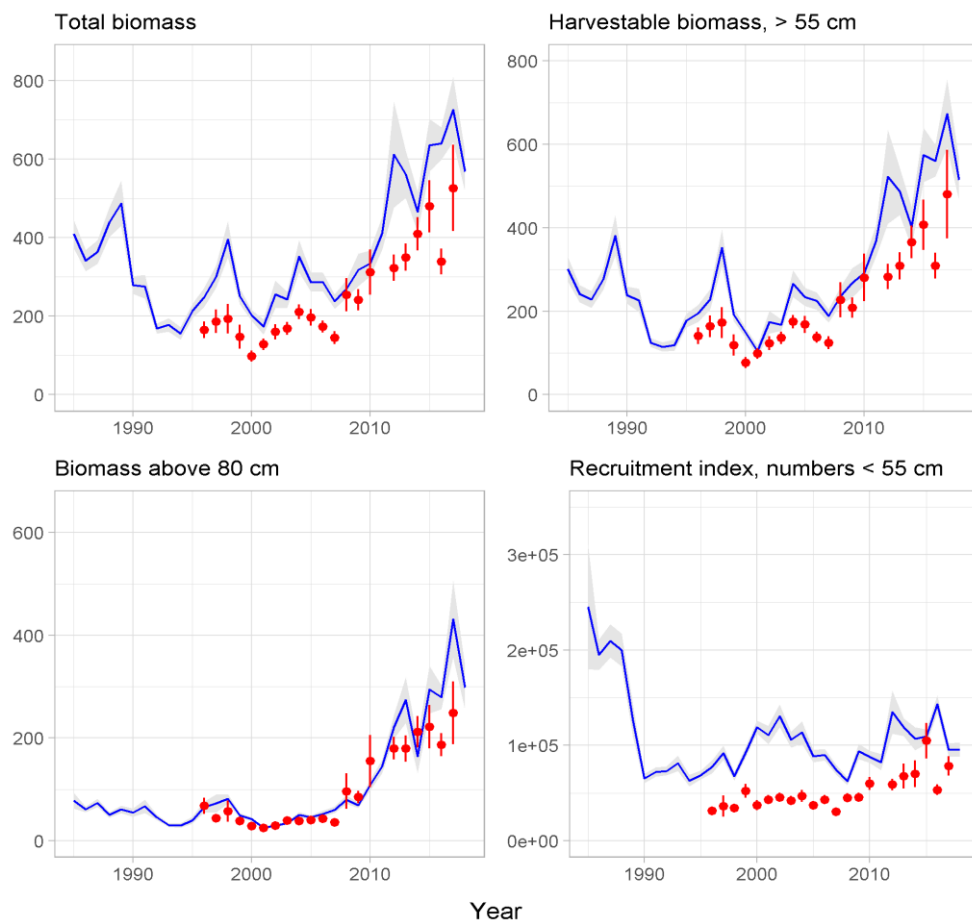
Mynd 13. Þorskur. Hlutfall þorsks stærri en 80 cm í afla (í þyngd) mismunandi veiðarfæra.

## SURVEY DATA

The Icelandic spring groundfish survey (hereafter spring survey) has been conducted annually in March since 1985. In addition, the Icelandic autumn groundfish survey (hereafter autumn survey) was commenced in 1996. However, a full autumn survey was not conducted in 2011 due to a labour dispute and therefore the results for 2011 are not presented.

Figure 14 shows both a recruitment index based on abundance of cod smaller than 55 cm, and trends in various biomass indices. Survey length distributions are shown in Figures 15-16, abundance and changes in spatial distribution in Figures 17-20.

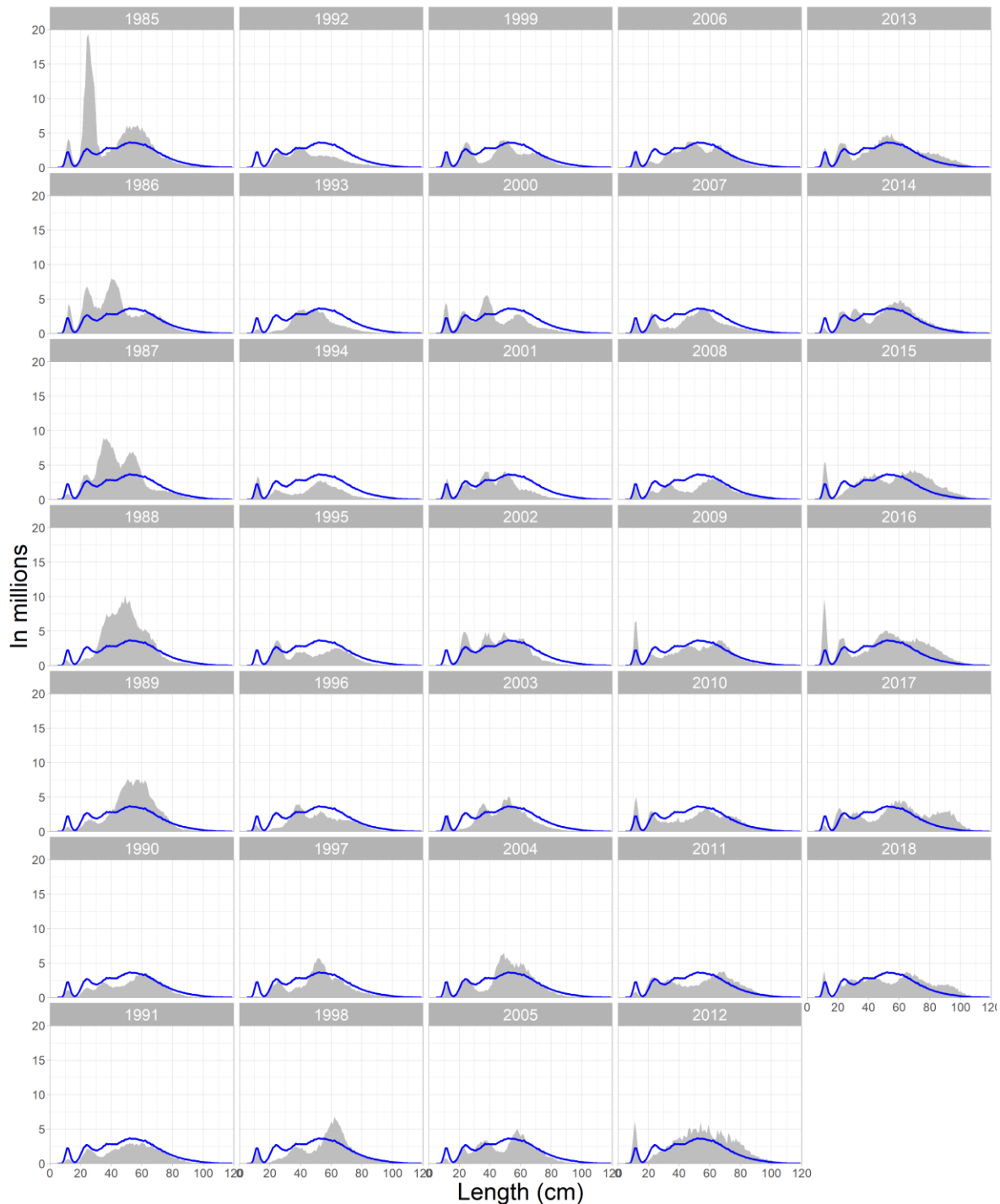
The total biomass index and the harvestable biomass index (cod larger than 55 cm) have increased since a historical low around 2000 (Figure 14). The same holds for the index of cod larger than 80 cm, which increased considerably since 2010 due to a significant decrease in fishing mortality in recent decades. The index of juvenile abundance (<55 cm) has been relatively steady since 1990. The high juvenile abundance values in the late 1980s came from the two large year-classes from 1983 and 1984. Time series from the autumn survey are shorter but show similar trends to those observed from the spring survey.



**Figure 14.** Cod. Total biomass indices (upper left) and harvestable biomass indices (>55 cm) (upper, right), biomass indices of larger ind. (>80cm) (lower left) and juvenile abundance indices (<55 cm) (lower right) from the spring survey (blue) from 1985 and autumn survey (red) from 1996, along with the standard deviation.

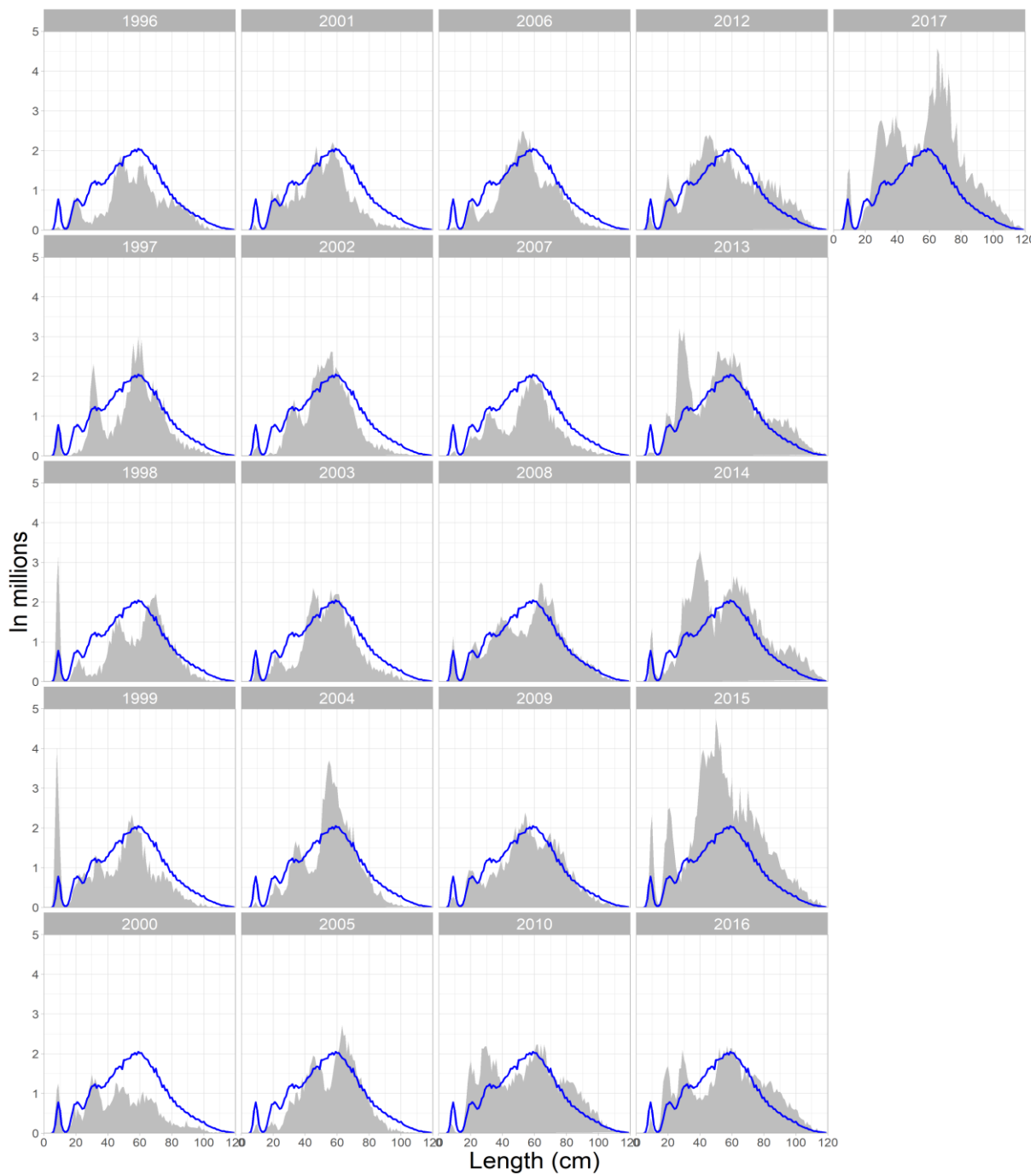
*Mynd 14. Þorskur. Stofnvísitala (efri til vinstri), vísitala veiðistofns (55 cm og stærri, efri til hægri) og vísitala stærri einstaklinga (80 cm og stærri, neðri til vinstri) og nýliðunarvísitala (neðri til hægri), úr stofnmælingu botnfiska að vori (blátt) frá árinu 1985 og hausti (rautt) frá árinu 1996, ásamt staðalfrávik.*

Length distributions from both surveys illustrate quite clearly age groups division, particularly in the youngest age groups (Figures 15-16). Thereafter the division is not quite as clear, due to variability in individual growth and maturity, but some multimodal length distribution can be seen.



**Figure 15. Cod. Length distribution from the spring survey. The blue line shows mean length distribution for all years combined.**

**Mynd 15. Þorskur. Lengdardreifing úr stofnmælingu botnfiska að vori frá 1985 ásamt meðallengdardreifingu allra ára (blá lína).**



**Figure 16. Cod. Length distribution from the autumn survey. The blue line shows mean length distribution for all years combined.**

**Mynd 16. Þorskur. Lengdardreifing úr stofnmælingu botnfiska að hausti frá 1996 ásamt meðallengdardreifingu allra ára (blá lína).**

Cod in the spring survey in 2018 caught all around Iceland, with catch hotspots in offshore waters in the north and east, and in shallow waters in the south (Figure 17). The catch on continental slope to the west was lower than in previous years. Spatial distribution of the total biomass index of the catch in the spring survey, shows that the NW and NE areas are dominating in the all years (Figure 18). However, some temporal changes have been occurring in recent years with the catch in the NE area decreasing and increasing in the W area.



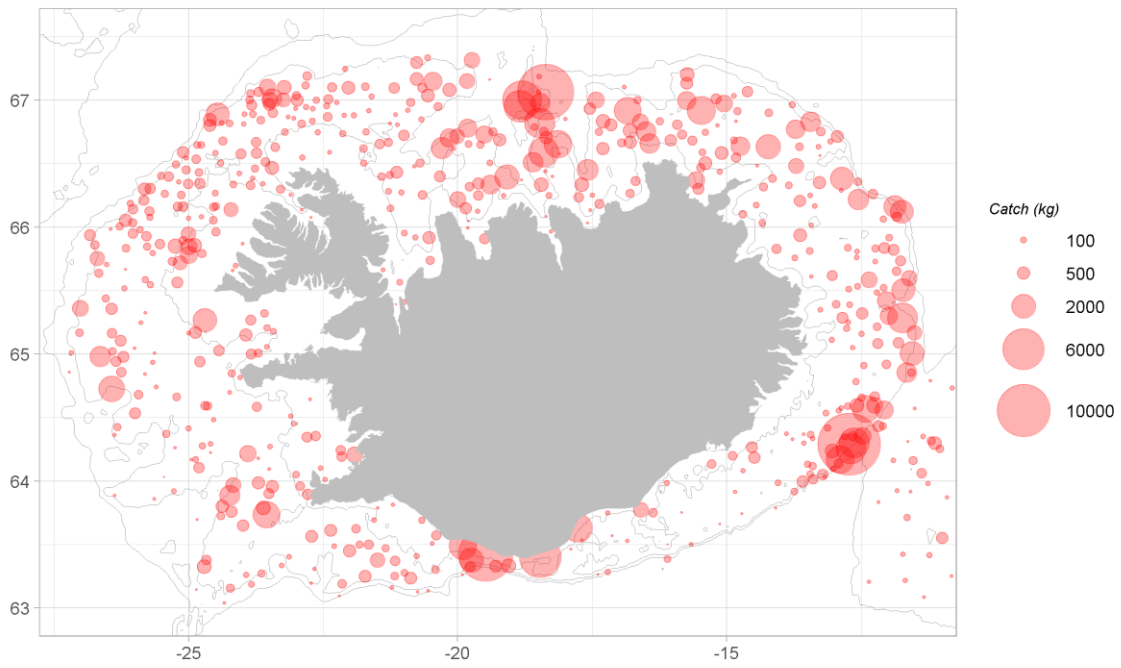


Figure 17. Cod. Spatial distribution in the spring survey in 2018. The 100, 300 and 500 m isobaths are shown.

*Mynd 17. Þorskur. Útbreiðsla í stofnmælingu botnfiska að vori 2018. Sýndar eru 100, 300 og 500 m dýptarlínur.*

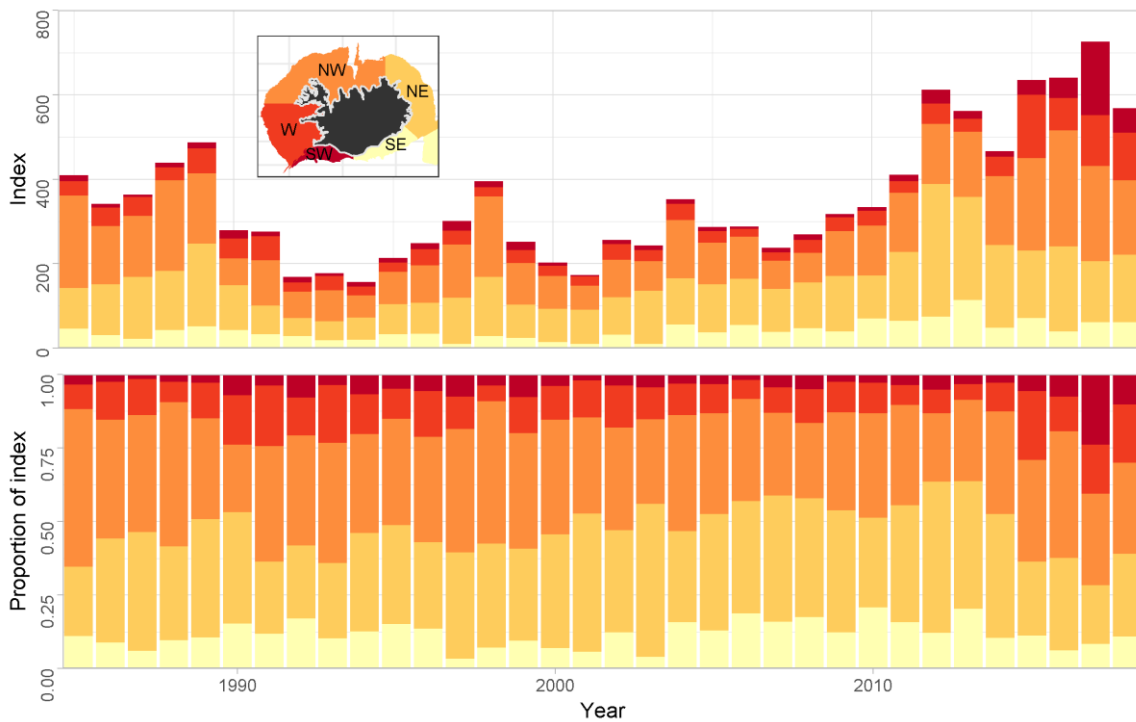


Figure 18. Cod. Spatial distribution of biomass index from the spring survey in 1985-2018.

*Mynd 18. Þorskur. Dreifing lífmassavísitölu í stofnmælingu botnfiska að vori árin 1985-2018.*

Spatial distribution of cod in autumn survey in 2017 was similar as in previous years, with main hotspots in northwestern and northeastern areas (Figure 19). The majority of cod in the autumn survey has been caught on the traditional fishing grounds in the northwest and northeast. There has been an increase in the relative abundance of cod on both the NW and NE areas in recent years (Figure 20), with highest catch near the main fishing area "Halinn" in NW in 2017 (Figure 19).

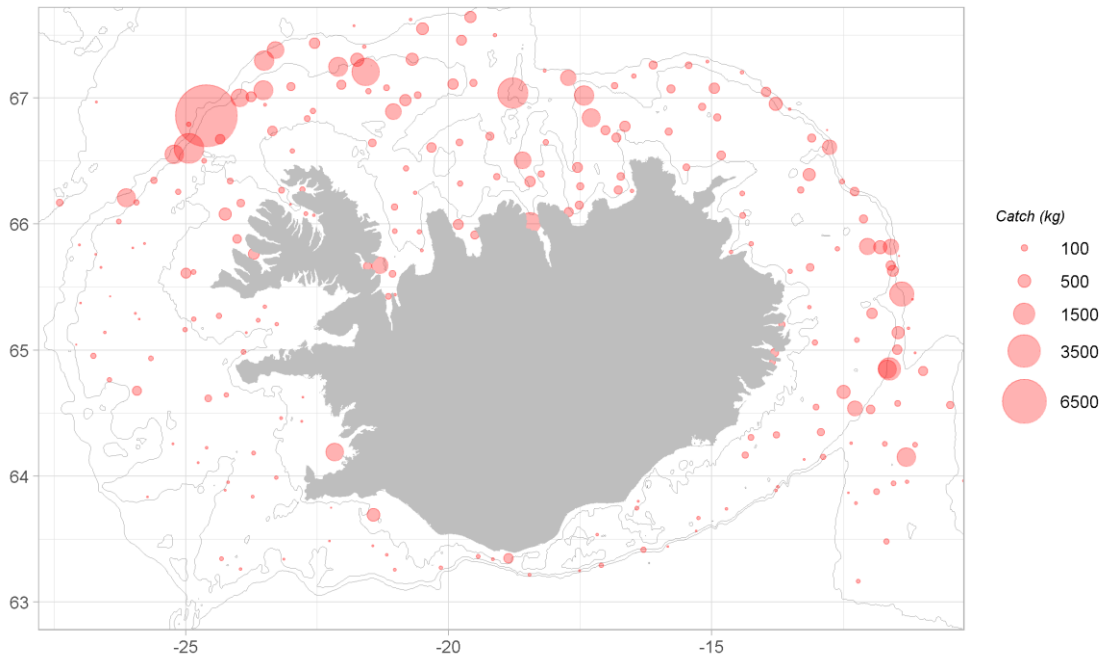


Figure 19. Cod. Spatial distribution of cod in 2017 in the autumn survey. The 100, 300 and 500 m isobaths are shown.

Mynd 19. Þorskur. Útbreiðsla í stofnmælingu botnfiska að hausti árið 2017. Sýndar eru 100, 300 og 500 m dýptarlínur.

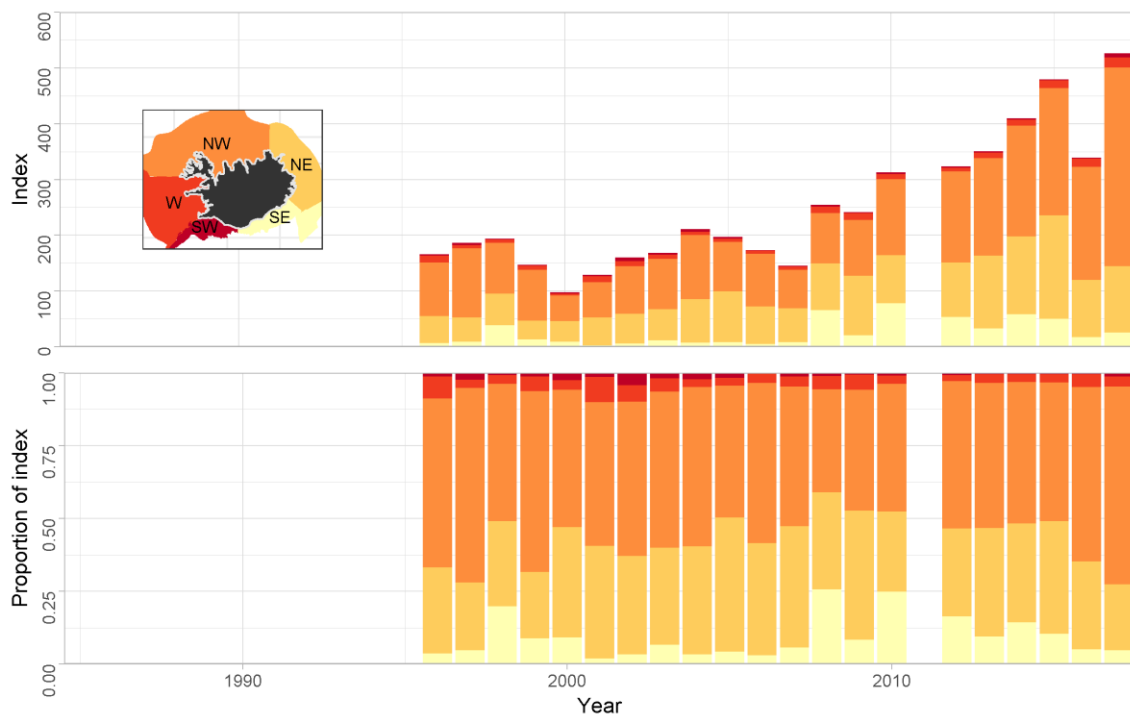


Figure 20. Cod. Spatial distribution of biomass index from the autumn survey in 1996-2017.

Mynd 20. Þorskur. Dreifing lífmassavísitölu í stofnmælingu botnfiska að hausti árin 1996-2017.

## STOCK ASSESSMENT

See ICES NWWG Report 2018:

[https://www.hafogvatn.is/static/files/Veidiradgjof/2018/01-ices\\_nwwg\\_loka.pdf](https://www.hafogvatn.is/static/files/Veidiradgjof/2018/01-ices_nwwg_loka.pdf)

## MANAGEMENT

The Ministry of Industries and Innovation is responsible for management of the Icelandic fisheries and implementation of legislation. Cod was included in the ITQ system in 1984, but effort management was also implemented during the first years of the TAC system, partly to help those that thought they got unfair share of the quota. This "additional effort" management system led to the catches exceeding TAC by 20-30% in the first years of the ITQ system.

In 1990 the law was changed, and effort management eliminated except for the smallest coastal fleet that was managed by fishing days. At the same time, many limitations of the quota transfer were released and the fishing year from 1 September to 31 August was introduced. These laws took effect on 1 September 1991. In the first years, advice by MRI (Marine Research Institute) was based on reducing F (Fishing mortality) by 40%. TAC exceeded advice during those years and catch exceeded TAC.

The cod stock reduced rapidly in the early nineties due to low recruitment and high fishing mortality. The need for more strict control of fisheries was apparent and 2-3 years of work by a group of fisheries scientist lead to an adoption of HCR (Harvest Control Rule) for the fishing year 1995/96. The HCR lead to significant reduction in fishing mortality.

Since the HCR was introduced, TAC has been set according to the HCR, but catch has exceeded TAC by 7.4% on the average, however somewhat less or close to 5% in recent years. The main explanation for catch exceeding advice is that catch in the effort control system exceeded predictions, but the predicted catch is subtracted from the calculated TAC according to the HCR. The current effort control system for the small boats that started in 2009, includes TAC constraint so catches should not exceed TAC by large amount (1-2%).

Table 6. Cod. Advice, recommended TAC, National TAC set by the Ministry, and landings (tonnes).

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

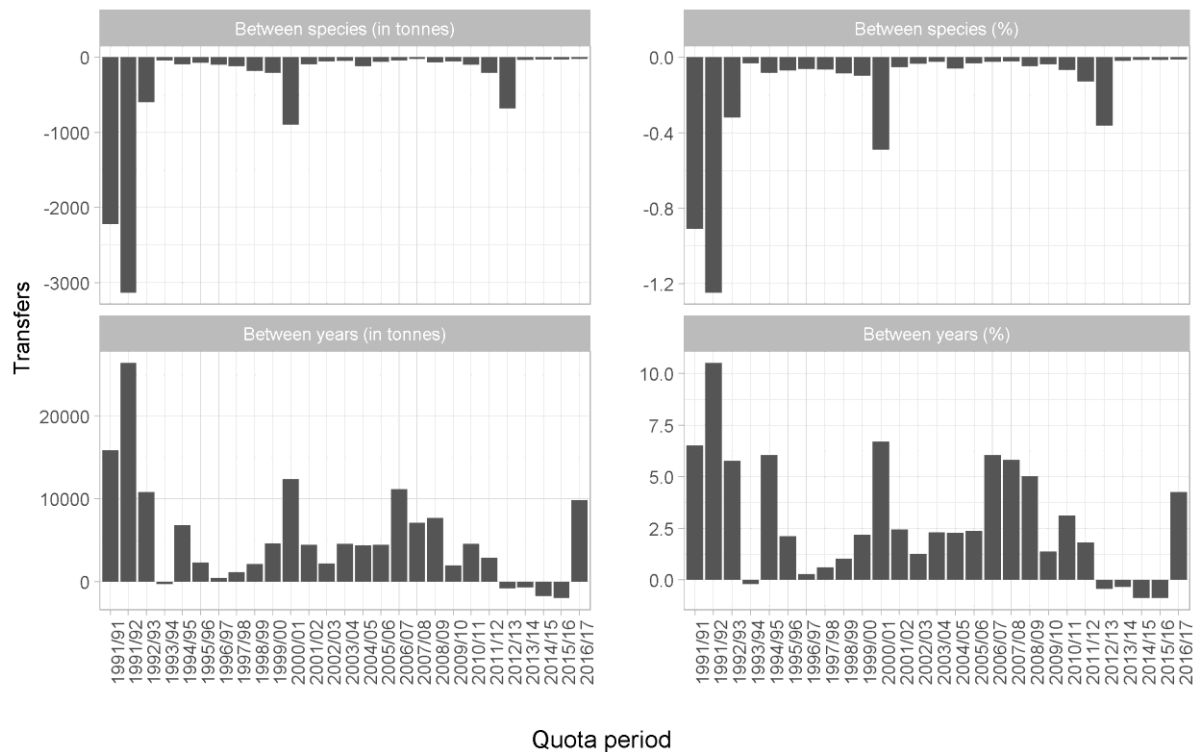
<b>FISHING YEAR</b>	<b>ICES ADVICE</b>	<b>REC. TAC</b>	<b>NATIONAL TAC</b>	<b>CATCH</b>
<b>1991/92</b>	National advice	250000	265000	274000
<b>1992/93</b>	Reduce F by 40%	154000	205000	241000
<b>1993/94</b>	Reduce F by 40%	150000	165000	197000
<b>1994/95</b>	Reduce F by 50%	130000	155000	165000
<b>1995/96</b>	Apply catch rule	25% HCR	155000	170000
<b>1996/97</b>	Apply catch rule	25% HCR	186000	202000
<b>1997/98</b>	Apply catch rule	25% HCR	218000	228000
<b>1998/99</b>	Apply catch rule	25% HCR	250000	254000
<b>1999/00</b>	Apply catch rule	25% HCR	250000	257000
<b>2000/01</b>	Apply catch rule	25% HCR	220000 <sup>1)</sup>	223000
<b>2001/02</b>	Apply catch rule	25% HCR	190000 <sup>1)</sup>	218000
<b>2002/03</b>	Apply catch rule	25% HCR	179000 <sup>1)</sup>	204000
<b>2003/04</b>	Apply catch rule	25% HCR	209000	226000
<b>2004/05</b>	Apply catch rule	25% HCR	205000	214000
<b>2005/06</b>	Apply catch rule	25% HCR	198000	205000
<b>2006/07</b>	Apply catch rule	25% HCR	193000	191000
<b>2007/08</b>	Apply catch rule	25% HCR	130000	141000
<b>2008/09</b>	Apply Fmax	25% HCR	160000 <sup>2)</sup>	169000
<b>2009/10</b>	Apply Fmax	25% HCR	155000 <sup>3)</sup>	168000
<b>2010/11</b>	Apply catch rule	20% HCR (160)	160000	169000
<b>2011/12</b>	Apply catch rule	20% HCR (177)	177000	185000
<b>2012/13</b>	Apply catch rule	20% HCR (196)	195000	215000
<b>2013/14</b>	Apply catch rule	20% HCR (215)	214000	226000
<b>2014/15</b>	Apply catch rule	20% HCR (218)	216000	223000
<b>2015/16</b>	Apply catch rule	20% HCR (239)	239000	251000
<b>2016/17</b>	Management plan	20% HCR (244)	244000	237644
<b>2017/18</b>	Management plan	20% HCR (258)	257572	
<b>2018/19</b>	Management plan	20% HCR (264)	264437	

1) Amended harvest control rule (HCR).

2) Initial TAC set to 130 according to the catch rule, raised to 160 in January 2009.

3) Set according to the catch rule.

Figure 21 shows the net transfers of cod quota in the Icelandic ITQ-system. Quota transfers from other species to cod are not allowed, and net transfers from cod to other species have been relatively low in recent fishing years (Figure 21, upper). Net transfers of unused cod quota from one fishing year to the next have usually been in the range of 0-7%.



**Figure 21. Cod. Net transfers of quota to and from cod in the Icelandic ITQ system by quota year. Between species (upper): Positive values indicate a transfer of other species to cod (not allowed), but negative values indicate a transfer of cod quota to other species. Between years (lower): Transfer of quota from given quota year to the next quota year.**

*Mynd 21. Þorskur. Nettó tilfærsla á kvóta eftir fiskveiðiarum. Tilfærsla milli tegunda (efri myndir): Jákvæð gildi tákna tilfærslu á kvóta annarra tegunda yfir á þorsk (ekki heimilt) en neikvæð gildi tilfærslu þorskkvóta á aðrar tegundir. Tilfærsla milli ára (neðri myndir): Tilfærsla kvóta frá viðkomandi fiskveiðiarí yfir á næsta fiskveiðiar.*

## ADVICE 2018

Recommended TAC for the 2018/2019 fishing year is 264 437 tonnes.