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6 Tusk

6.1 Stock description and management units

In 2007, WGDEEP examined the available evidence of any stock discrimination for tusk. Based on genetic investigations (references), the group suggested the following stock units for tusk:

- Area5.a and 14;
- Mid-Atlantic Ridge;
- Rockall (6.b);
- Areas 1, 2.

All other areas (4.a,5.b, 6.a, 7,…) be assessed as one combined stock, until further evidence of multiple stocks become available in these areas purposes.

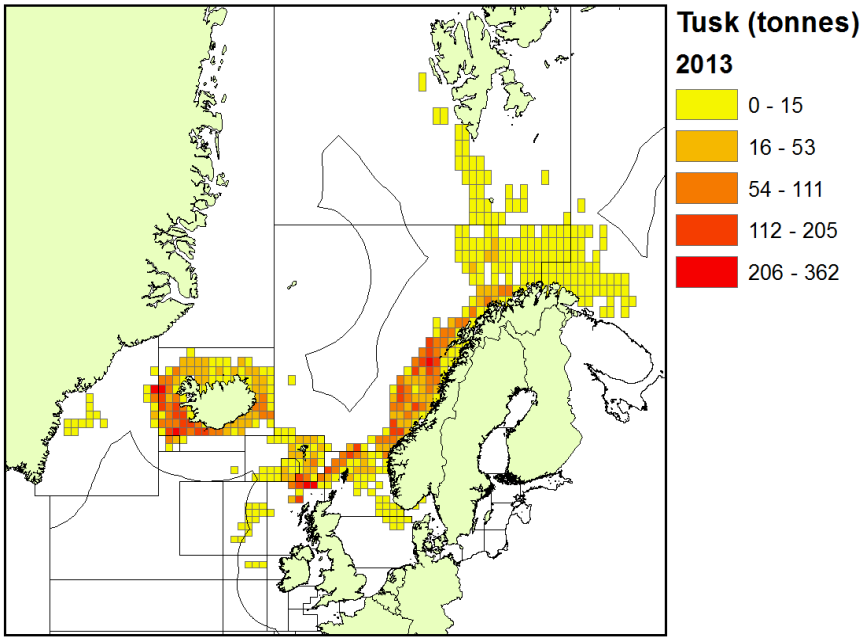

Figure 6.1. Reported landings of tusk in the ICES area by statistical rectangle, 2013. Data from Norway, Faroes, Iceland, France, UK (England and Wales) and Spain. Landings shown in this figure account for 99% of all reported landings in the ICES area.

6.2 Tusk (*Brosme Brosme*) in Division 5.a and Subarea 14

6.2.1 The fishery

Tusk in 5.a is caught in a mixed longline fishery, conducted in order of importance by Icelandic, Faroese and Norwegian boats. Between 150 and 240 Icelandic longliners report catches of tusk, but much fewer gillnetters and trawlers. The number of longliners reporting tusk catches in 2016 decreased to 138 from 163 the previous year (Table 6.2.1). Most of tusk in 5.a is caught on longlines or around 97% of catches in tonnes and this has been relatively stable proportion since 1992 (Table 6.2.1).

Table 6.2.1. Tusk in 5.a. Number of Icelandic boats reporting catches and their landings from logbooks.

Year	Number of boats			Catches (Tonnes)			
	Longliners	Gillnetters	Trawlers	Longline	Trawl	Other	Sum
2000	244	20	13	4536	91	80	4707
2001	230	36	7	3210	72	98	3380
2002	194	18	11	3703	75	126	3904
2003	202	8	9	3902	55	60	4017
2004	192	6	10	2996	84	44	3124
2005	231	7	17	3324	164	46	3534
2006	228	11	12	4908	92	54	5054
2007	205	8	17	5834	95	57	5986
2008	170	16	30	6756	113	60	6929
2009	158	20	38	6754	107	91	6952
2010	165	25	34	6760	93	66	6919
2011	165	18	36	5744	67	34	5845
2012	173	22	37	6255	59	27	6341
2013	177	16	36	4873	73	27	4973
2014	181	19	37	4878	88	28	4994
2015	163	13	39	3913	67	20	4000
2016	138	15	37	2207	22	2	2231

Most of the tusk caught in 5.a by Icelandic longliners is caught at depths less than 300 meters (Figure 6.2.1). The main fishing grounds for tusk in 5.a as observed from logbooks are on the south, southwestern and western part of the Icelandic shelf (Figures 6.2.2 and 6.2.3).

The main trend in the spatial distribution of tusk catches in 5.a according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf. Around 50–60% of tusk is caught on the south and western part of the shelf (Figure 6.2.3).

Tusk in 14 is caught mainly as a bycatch by longliners and trawlers. The main area where tusk is caught in 14 is 63°–66°N and 32°–40°W, well away from the Icelandic EEZ.

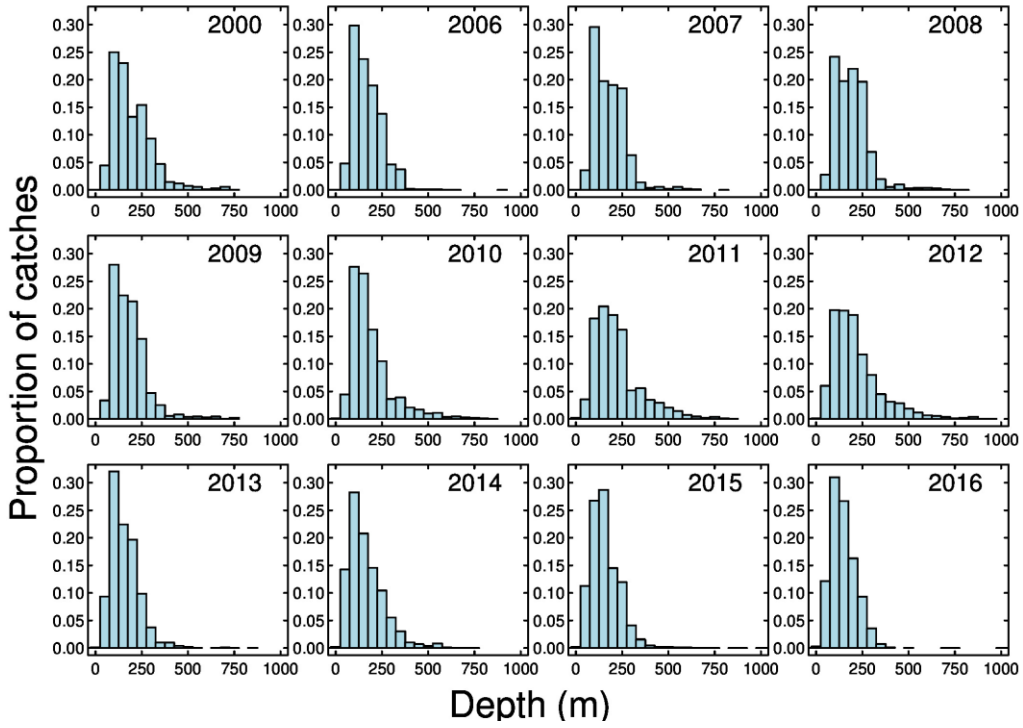

Figure 6.2.1. Tusk in 5.a and 14. Depth distribution of longline catches in 5.a according to logbooks.

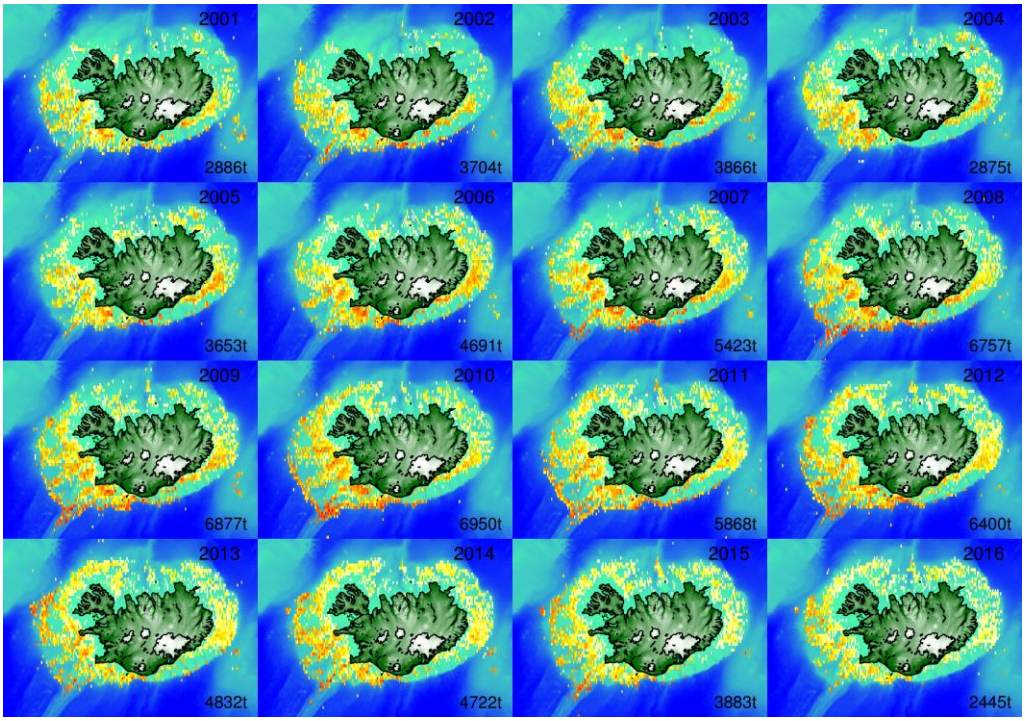

Figure 6.2.2. Tusk in 5.a and 14. Geographical distribution of the Icelandic fishery since 1999 as reported in logbooks. All gears combined.

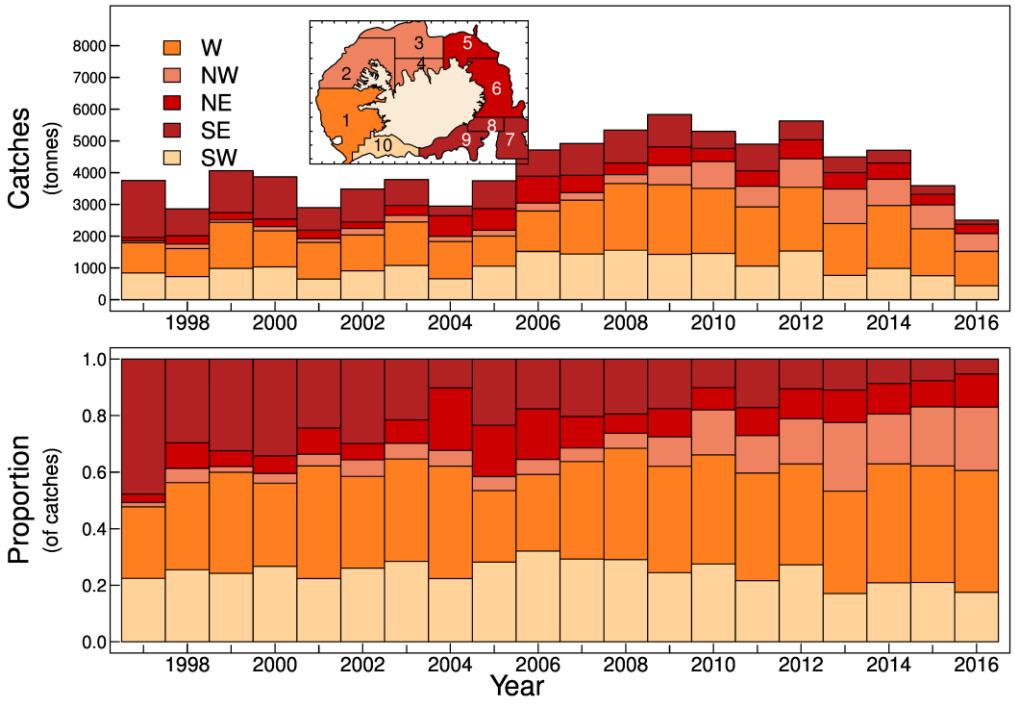

Figure 6.2.3. Tusk in 5.a and 14. Changes in spatial distribution of the Icelandic fishery from 1996 as reported in logbooks. All gears combined.

6.2.1.1 Landings trends

The total annual landings from ICES Division 5.a were around 3500 tonnes in 2016 (Table 6.2.7). This is contrary to the trend in landings from 2000 in which the annual landings gradually increased in 5.a to around 9000 tonnes in 2010 (Figure 6.2.4).

The foreign catch (mostly from the Faroe Islands, but also from Norway) of tusk in Icelandic waters has always been considerable. Until 1990, between 40–70% of the total annual catch from ICES Division 5.a was caught by foreign vessels but has since then been between 15–25%, mainly from the Faroe Islands (Table 6.2.7).

Landings in 14.b have always been low compared to 5.a, rarely exceeding 100 t. However around 900 tonnes in 2015 and around 500 tonnes in 2016 were caught in the 14.b mainly by Faroe and Greenlandic vessels (Table 6.2.8). The spatial distribution of longline operations in 14.b in 2015 is shown in Figure 6.2.3b.

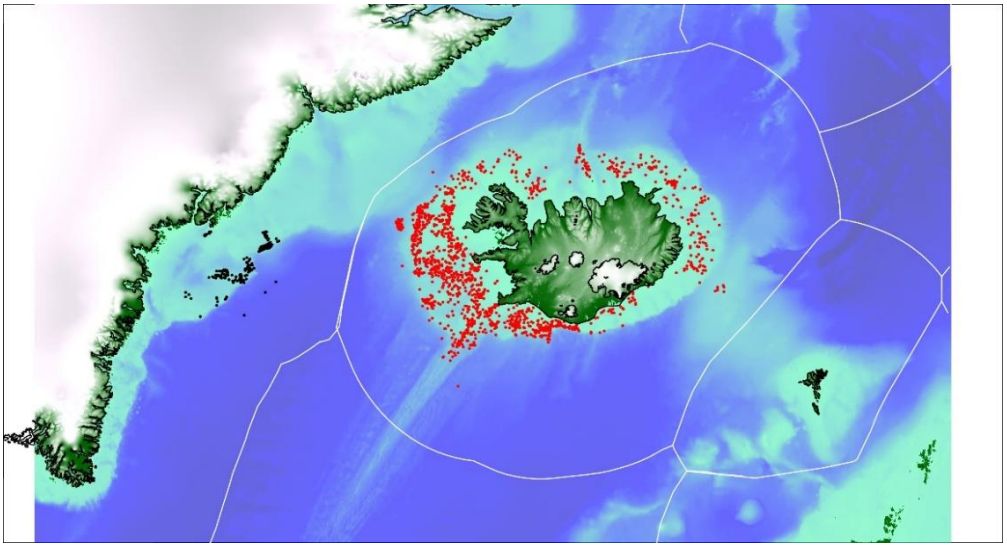

Figure 6.2.3b. Position of longline operations in 14.b and 5.a where tusk was recorded in 2015.

6.2.1.2 ICES Advice

The latest Advice from ICES in May 2016 states: ICES advises that, based on the MSY approach, catches should be no more than 3780 t.

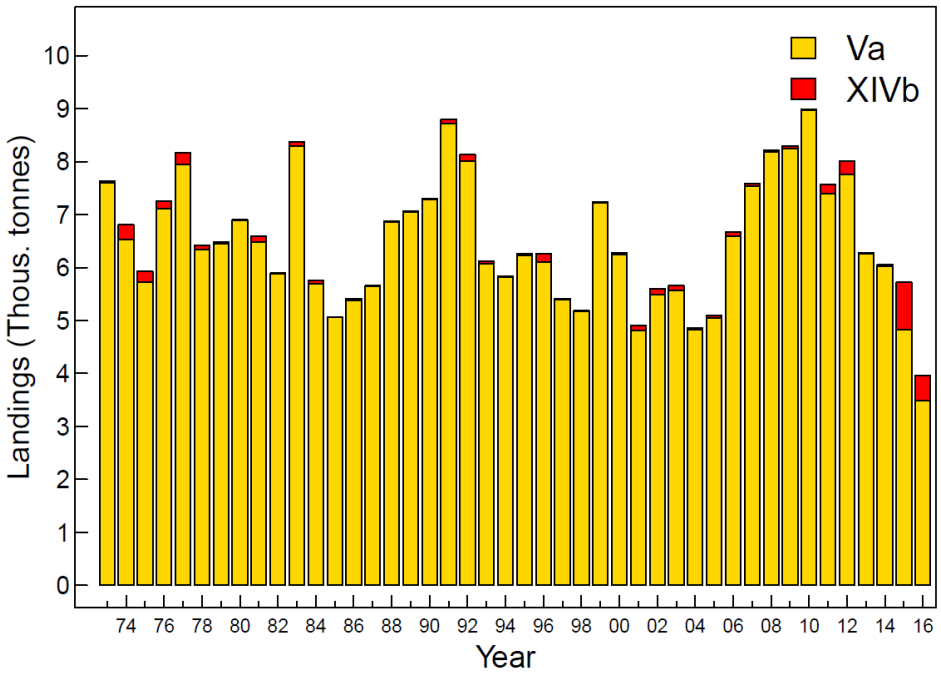

Figure 6.2.4. Tusk in 5.a and 14. Landings in 5.a and 14 (source STATLANT).

6.2.1.3 Management

The Icelandic Ministry of Industries and Innovation (MII) is responsible for management of the Icelandic fisheries and implementation of legislation. Tusk was included in the ITQ system in the 2001/2002 quota year and as such subjected to TAC limitations. At the beginning the TAC was set as recommended by MRI but has often been set

higher than advice. One reason is that no formal harvest rule exists for this stock. The landings, by quota year, have always exceeded the advised and set TAC but the overshot in landings has decreased from 30–40%. However since the 2011/2012 fishing year the overshoot in landings has decreased to 6–16% apart from 2014/2015 when it was 34% (Table 6.2.2).

The reasons for the large difference between annual landings and both advised and set TACs are threefold:

1) It is possible to transfer unfished quota between fishing years;

2) It is possible to convert quota shares in one species to another;

3) The national TAC is only allocated to Icelandic vessels. All foreign catches are therefore outside the quota system.

However for the last three fishing years, managers have to some extend taken into account the foreign catches (see below). The tusk advice given by MRI and ICES for each quota year is, however, for all catches, including foreign catches. Figure 6.2.5 shows the net transfers in the Icelandic ITQ-system. During the 2005/2006 to 2010/2011 fishing years there was a net transfer of other species quota being converted to tusk quota, this however reversed during the following three fishing years. In the 2014/2015 and 2015/2016 fishing years there was again net transfer of other species being changed to tusk quota.

Table 6.2.2. Tusk in 5.a and 14. TAC recommended for tusk in 5.a by the Marine Research Institute, national TAC and total landings from the quota year 2001/2002.

Fishing year	MRI advice	National TAC	Landings
2001/02		4500	4876
2002/03	3500	3500	5046
2003/04	3500	3500	4958
2004/05	3500	3500	4901
2005/06	3500	3500	5928
2006/07	5000	5000	7942
2007/08	5000	5500	7279
2008/09	5000	5500	8162
2009/10	5000	5500	8382
2010/11	6000	6000	7777
2011/12	6900	7000	7401
2012/13	6700	6400	6833
2013/14	6200	5900	5881
2014/15	4000	3700	4958
2015/16	3440	3000	3494

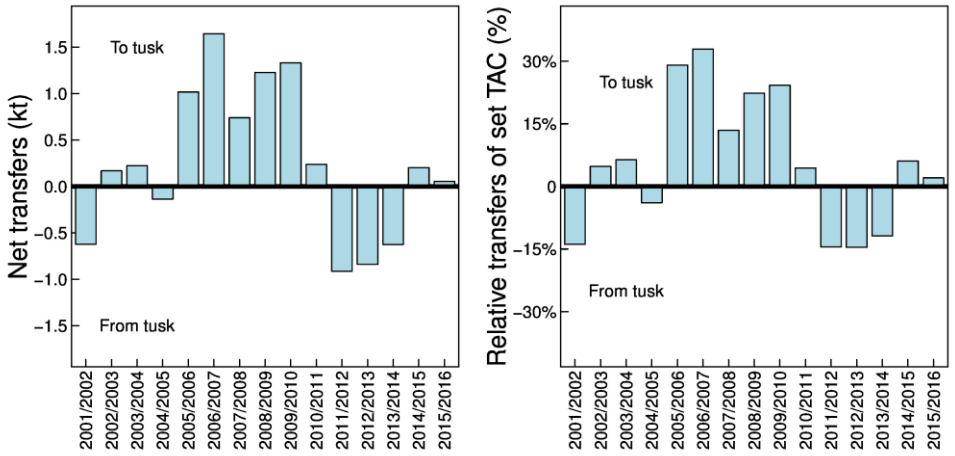

Figure 6.2.5. Tusk in 5.a and 14. Net transfers of tusk quota to other species in the Icelandic ITQ system by fishing year. Positive values indicate that other species are being changed to tusk but negative mean that tusk quota is being converted to other species.

There are bilateral agreements between Iceland, Norway and the Faroe Islands relating to a fishery of vessels in restricted areas within the Icelandic EEZ. Faroese vessels are allowed to fish 5600 t of demersal fish species in Icelandic waters which includes maximum 1200 tonnes of cod and 40 t of Atlantic halibut. The rest of the Faroese demersal fishery in Icelandic waters is mainly directed at tusk, ling, and blue ling. Further description of the Icelandic management system can be found in the stock annex.

6.2.2 Data available

In general sampling is considered good from commercial catches from the main gear (longlines). The sampling does seem to cover the spatial distribution of catches for

longlines and trawls but less so for gillnets. Similarly sampling does seem to follow the temporal distribution of catches (WGDEEP, 2012).

6.2.2.1 Landings and discards

Landings by Icelandic vessels are given by the Icelandic Directorate of Fisheries. Landings of Norwegian and Faroese vessels are given by the Icelandic Coast Guard. Discarding is banned by law in the Icelandic demersal fishery. Based on limited data, discard rates in the Icelandic longline fishery for tusk are estimated very low (<1% in either numbers or weight) (WGDEEP, 2011:WD02). Measures in the management system such as converting quota share from one species to another are used by the fleet to a large extent and this is thought to discourage discards in mixed fisheries. A description of the management system is given in the stock annex for tusk in 5.a and 14.

Landings for tusk in 14 are obtained from the STATLANT database. No information is available on discards in 14.

6.2.2.2 Length compositions

An overview of available length measurements from 5.a is given in Table 6.2.3. Most of the measurements are from longlines, number of available length measurements increased in 2007 from around 2500 to around 4000 and were close to that until 2016 when they decreased to around 1700.

Length distributions from the longline fishery are shown in Figures 6.2.6 (abundance) and 6.2.7 (biomass). In the figures the length distributions are multiplied with a maturity ogive to get estimates of the proportion of catches mature.

No length composition data from commercial catches in 14 are available.

Table 6.2.3. Tusk in 5.a and 14. Number of available length measurements from Icelandic (5.a) commercial catches.

Year	Longline		Gillnets		Trawls	
	Samples	Measured	Samples	Measured	Samples	Measured
2005	12	1775	0	0	0	0
2006	15	2225	0	0	3	450
2007	22	3154	2	167	1	150
2008	32	4722	0	0	0	0
2009	27	3945	0	0	0	0
2010	29	4354	0	0	0	0
2011	28	4141	0	0	0	0
2012	35	5105	0	0	1	150
2013	22	3278	0	0	0	0
2014	28	3384	0	0	0	0
2015	26	3115	0	0	0	0
2016	14	1671	0	0	0	0

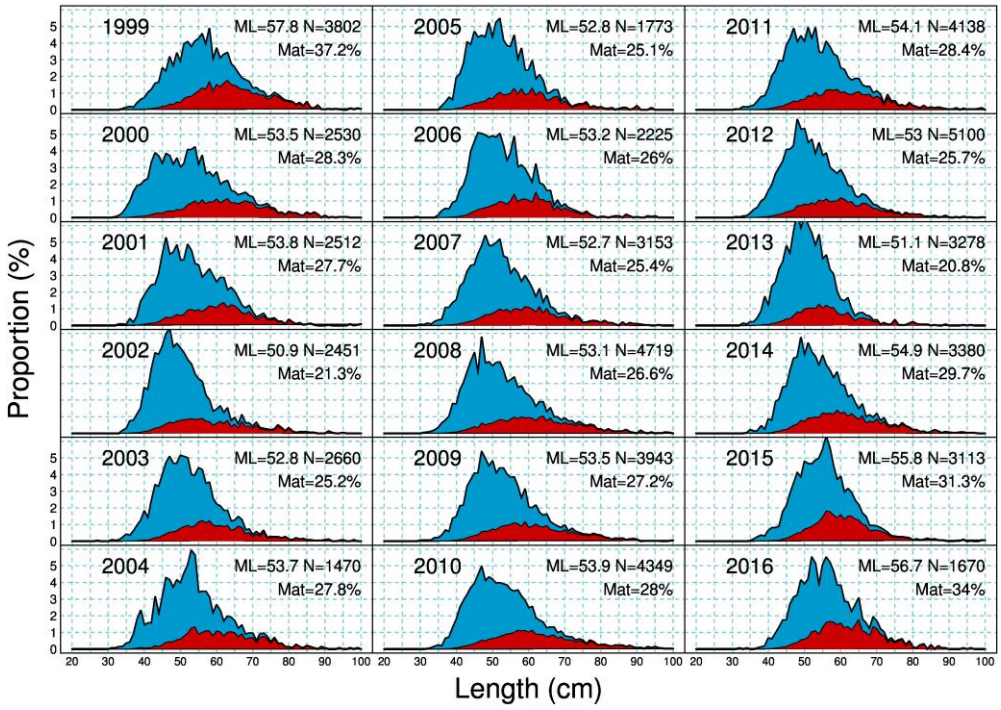

Figure 6.2.6. Tusk in 5.a and 14. Length distributions from Icelandic commercial longline catches in abundance. Blue areas are immature tusk and red represent mature tusk. Small numbers to the right refer to mean length (ML), number of samples (N) and percentage of mature individuals (Mat).

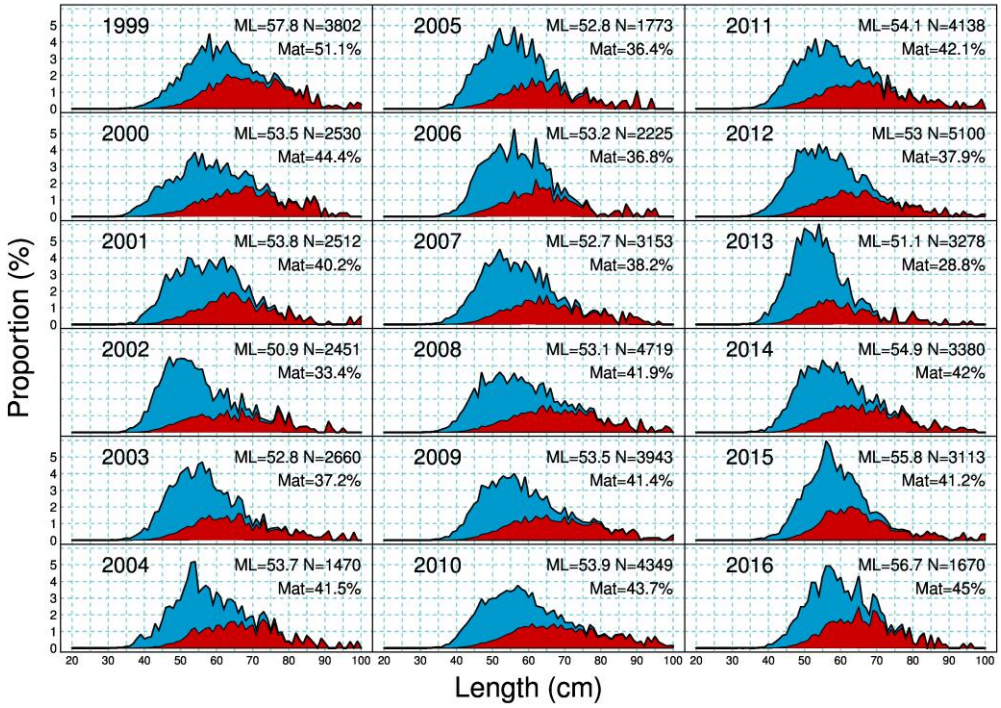

Figure 6.2.7. Tusk in 5.a and 14. Length distributions from Icelandic commercial longline catches in biomass. Blue areas are immature tusk and red represent mature tusk. Small numbers to the right refer to mean length (ML), number of samples (N) and percentage of mature individuals (Mat).

6.2.2.3 Age compositions

Table 6.2.4 gives an overview of otolith sampling intensity by gear types from 2000 to 2016 in 5.a. Since 2010 considerable effort has been put into ageing tusk otoliths, so now aged otoliths are available from 1984, 1995, 2008–2016. The ageing are used as input data for the Gadget assessment (Figure 6.2.8). It is expected that the effort in ageing of tusk will continue.

No data are available from 14.

Table 6.2.4. Tusk in 5.a and 14. Number of available otoliths from Icelandic (5.a) commercial catches and the Icelandic Spring survey and the number of aged otoliths.

Year	Longline			Survey		
	Samples	Otoliths	Aged	Samples	Otoliths	Aged
2000	17	849	0	229	321	0
2001	17	849	0	208	282	0
2002	17	851	0	207	303	0
2003	18	900	0	229	343	0
2004	10	500	0	225	422	399
2005	12	600	0	263	488	148
2006	15	750	0	281	499	457
2007	22	1100	0	290	483	381
2008	32	1600	600	282	489	475
2009	27	1350	1090	277	453	434
2010	29	1449	1373	241	378	363
2011	28	1400	1306	270	738	728
2012	34	1700	1112	285	771	750
2013	22	1100	490	275	744	517
2014	28	620	587	241	585	560
2015	26	555	505	260	614	573
2016	14	290	290	259	689	676

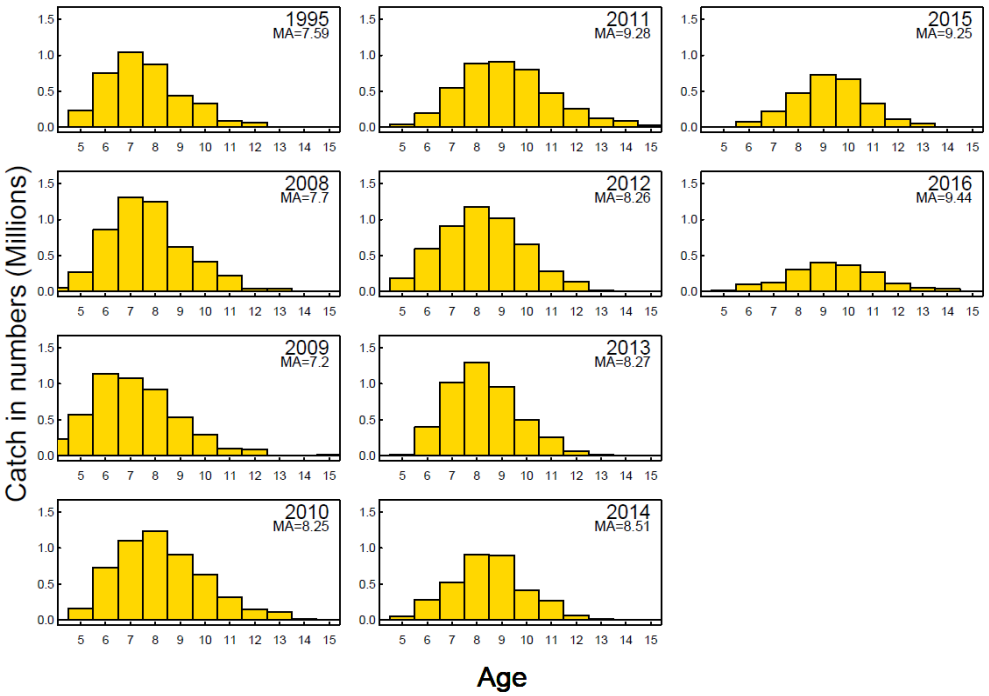

Figure 6.2.8. Tusk in 5.a and 14. Catch in numbers in 5.a (From longlines).

6.2.2.4 Weight-at-age

Weight-at-age data from 5.a are limited to 2008–2016.

No data are available from 14.

6.2.2.5 Maturity and natural mortality

At 54 cm around 25% of tusk in 5.a is mature, at 62 cm 50% of tusk is mature and at 70 cm 75% of tusk is mature based on the spring survey data.

No information is available on natural mortality of tusk in 5.a.

No data are available for 14.

6.2.2.6 Catch, effort and research vessel data

Catch per unit of effort and effort data from the commercial fleets

The cpue estimates of tusk in 5.a are not considered representative of stock abundance.

Cpue estimations have not been attempted on available data from 14.

Icelandic survey data (5.a)

Indices: The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, covers the most important distribution area of the tusk fishery. Detailed description of the spring groundfish survey is given in the stock annex for tusk in 5.a. In 2011 the 'Faroe Ridge' survey area was included into the estimation of survey indices.

In addition, the autumn survey was commenced in 1996 and expanded in 2000 however a full autumn survey was not conducted in 2011 and therefore the results for 2011

are not presented. A detailed description of the Icelandic spring and autumn groundfish surveys is given in the Stock Annex. Figure 6.2.9 shows both a recruitment index and the trends in various biomass indices. Survey length distributions are shown in Figure 6.2.10 (abundance) and changes in spatial distribution in Figures 6.2.11 and 6.2.12.

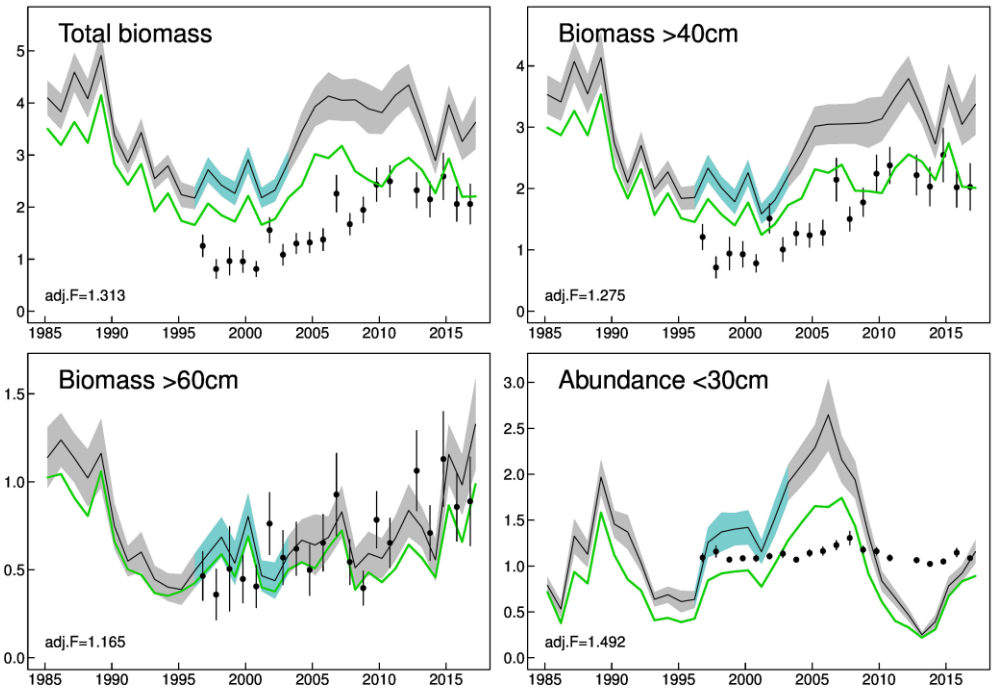

Figure 6.2.9. Tusk in 5.a and 14. Indices in the Spring Survey (March) 1985 and onwards (line shaded area) and the autumn survey (October) 1996 and onwards (No autumn survey in 2011). Green line is the index excluding the Faroe-Iceland Ridge.

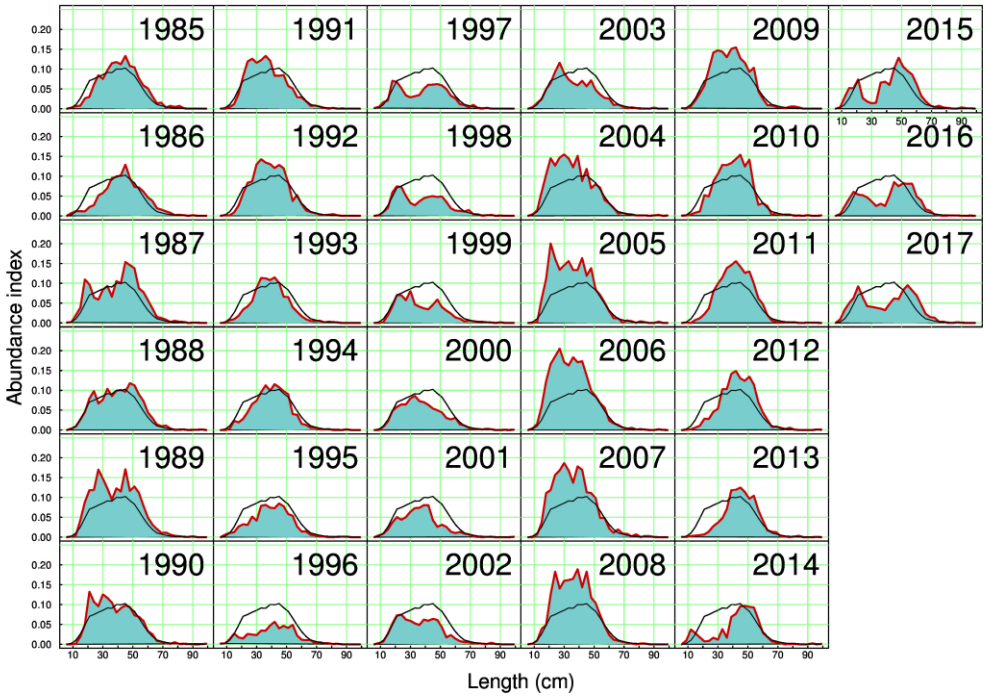

Figure 6.2.10. Tusk in 5.a and 14. Length disaggregated abundance indices from the spring survey (March) 1985 and onwards. Black line is the average over the whole period.

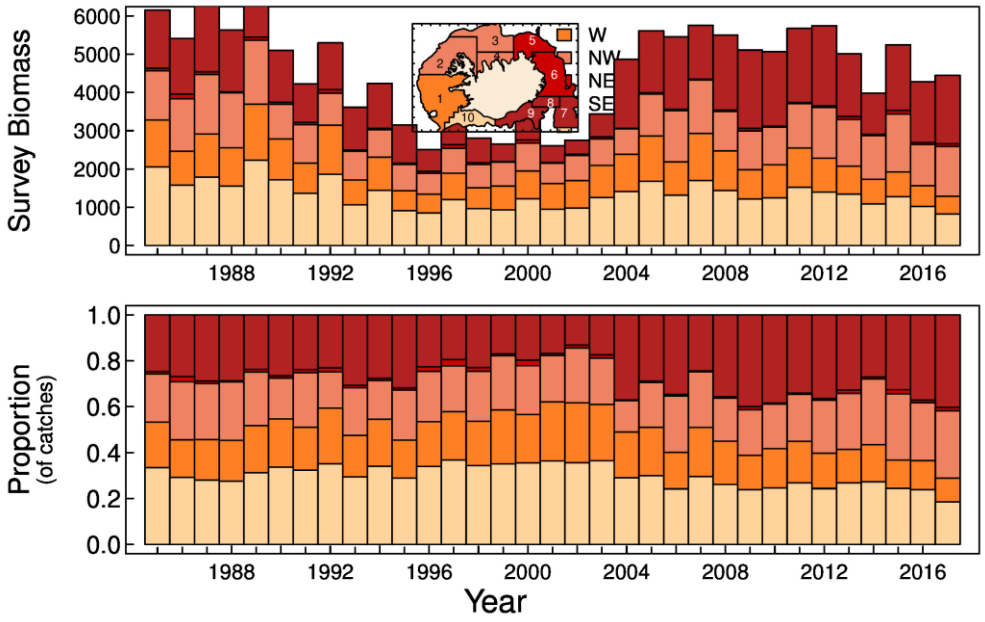

Figure 6.2.11. Tusk in 5.a and 14. Estimated survey biomass in the spring survey (March) by year from different parts of the continental shelf (upper panel) and as a proportion of the total (lower panel).

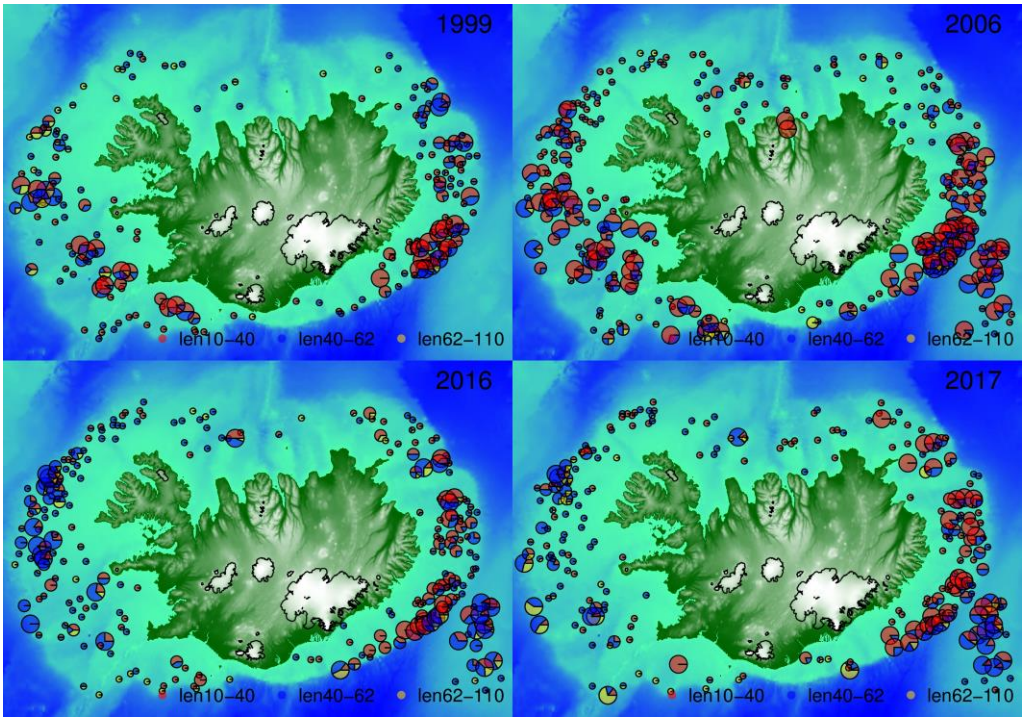

Figure 6.2.12. Tusk in 5.a and 14. Changes in spatial distribution divided by size. Size of pie is indicative of numbers of specimens caught at the tow-station.

German survey data (14)

Indices: The German groundfish survey was started in 1982 and is conducted in autumn. It is primarily designed for cod but covers the entire groundfish fauna down to 400 m. The survey is designed as a stratified random survey; the hauls are allocated to strata off West and East Greenland both according to the area and the mean historical cod abundance at equal weights. Towing time is 30 minutes at 4.5 kn. (Ratz, 1999).

Data from the German survey in 14 were available at the meeting up to 2015. The trend in the German survey catches is similar to those observed in surveys in 5.a. It should however be noted that the data presented in Figure 6.2.12b is based on total number caught each year so it can't be used directly as an index from East Greenland. Length distributions from the survey in recent years are shown in Figure 6.2.12c.

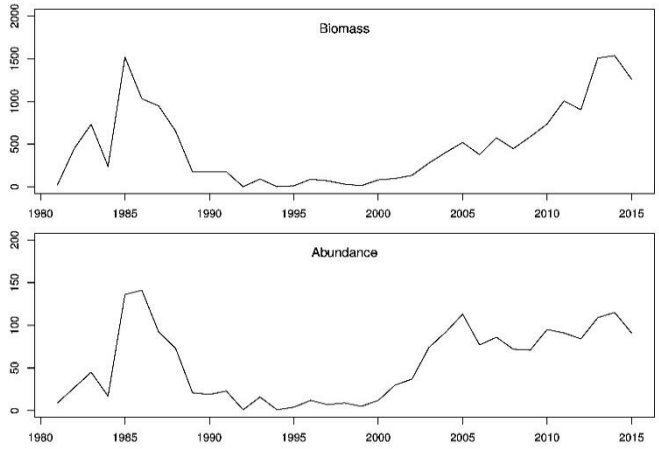

Figure 6.2.12b. Biomass and abundance estimates from the Walter Herwig survey in 14. The data are just the total number caught and then converted to weight.

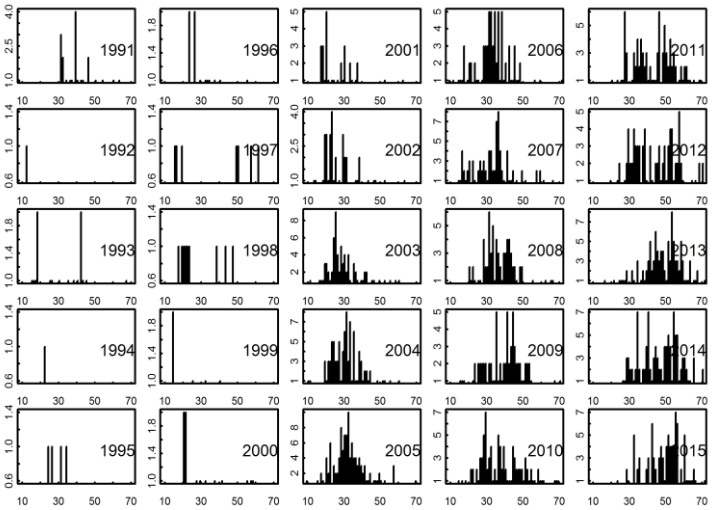

Figure 6.2.12c. Length distributions from the Walter Herwig survey in 14.

6.2.3 Data analyses

There have been no marked changes in the number of boats nor the composition of the fleet participating in the tusk fishery in 5.a (Table 6.2.1). Catches decreased from around 9000 tonnes in 2010 to 4800 tonnes in 2015. This decrease is mainly because of reductions in landings by the Icelandic longline fleet and to a lesser extend Faroese and Norwegian landings (Table 6.2.6). This has resulted in less overshoot of landings relative to set TAC (Table 6.2.2) but species conversions in the ITQ system show that other species were converted to tusk last year compared to tusk being converted to other species in previous fishing years.

There are no marked changes in the length compositions since 2004, mean length in the catches ranges between 52.7 and 54.1 (Figure 6.2.6). According to the available length distributions and information on maturity only around 29% of catches in abundance and 44% in biomass are mature (Figures 6.2.6 and 6.2.7). There does seem to be a shift in the age distribution from commercial catches between 2010 and 2011 where ages are higher. However the age distributions from 2012 and 2015 appear similar as observed in 2010 (Figure 6.2.8). The reason for this is unknown, but given they lack of

distinctive cohort structure in the data the first explanation might be a lack of consistency in ageing. Reasons such as difference in sampling, temporal or spatial are highly unlikely.

At WGDEEP 2011 the Faroe-Iceland Ridge was included in the survey index when presenting the results from the Icelandic spring survey for tusk in 5.a. That index is also used for tuning the Gadget model. Total biomass index and the biomass index for tusk larger than 40 cm (harvestable part of the stock) has remained at similar level as in since 2011 at a relatively high level (Figure 6.2.9). The same holds for the index of tusk larger than 60 cm (spawning–stock biomass index) but that index didn't increase by similar factors as the other two biomass indices. The index of juvenile abundance (<30 cm) decreased by a factor of six between the 2005 survey when it peaked and the 2013 survey when it was at its lowest observed value. Since 2013 juvenile index has increased year on year in the 2014–2016 surveys. The index excluding the Faroe-Iceland Ridge shows similar trends as described above. The result from the shorter autumn survey are by and large similar to those observed from the spring survey except for the juvenile abundance index that is more or less at a constant level compared to the spring survey juvenile index. Due to industrial action the autumn survey did not take place in 2011.

When looking at the spatial distribution from the spring survey around half of the index is from the SE area (Figure 6.2.11). However only around 20 to 25% of the catches are caught in this area (Figures 6.2.2 and 6.2.3). The change in juvenile abundance between 2006 and 2015 can be clearly seen in Figures 6.2.11 and 6.2.12 where in 2006 juveniles (<40 cm) were all over the southern part of the shelf but can hardly be seen in 2014.

Stock assessment on Tusk in 5.a using Gadget

Since 2010 the Gadget model (**G**lobally applicable **A**rea **D**isaggregated **G**eneral **E**cosystem **T**oolbox, see www.hafro.is/gadget) has been used for the assessment of tusk in 5.a (See stock annex for details). As part of a Harvest Control Evaluation requested by Iceland this stock was benchmarked in 2017 (WKICEMSE 2017). Several changes were made to the model setup and settings which are described in the stock annex.

Data used and model settings

Data used for tuning are given in the stock annex.

Model settings used in the Gadget model for tusk in 5.a are described in more detail in the stock annex.

Diagnostics

Observed and predicted proportions by fleets: Overall the fit of the predicted proportional length distributions is close to the observed distributions (Figures 6.2.12 and 6.2.13). In general for the commercial catch distributions the fit is better at the end of the time-series (Figure 6.2.12). The reason for this is there are few data at the beginning of the time-series and the model may be constrained by the initial values.

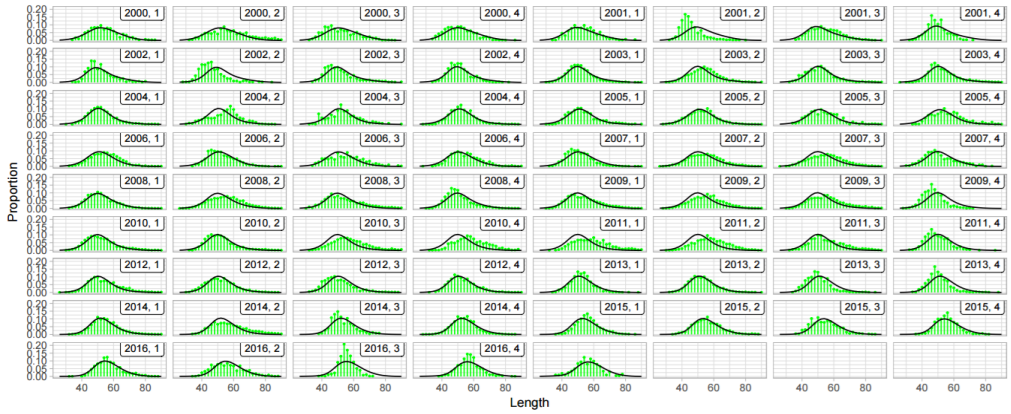

Figure 6.2.12. Tusk in 5.a and 14. Proportional fit (red line) to observed length distributions (points and blue bars) from commercial catches (longlines) by year and quarter from Gadget.

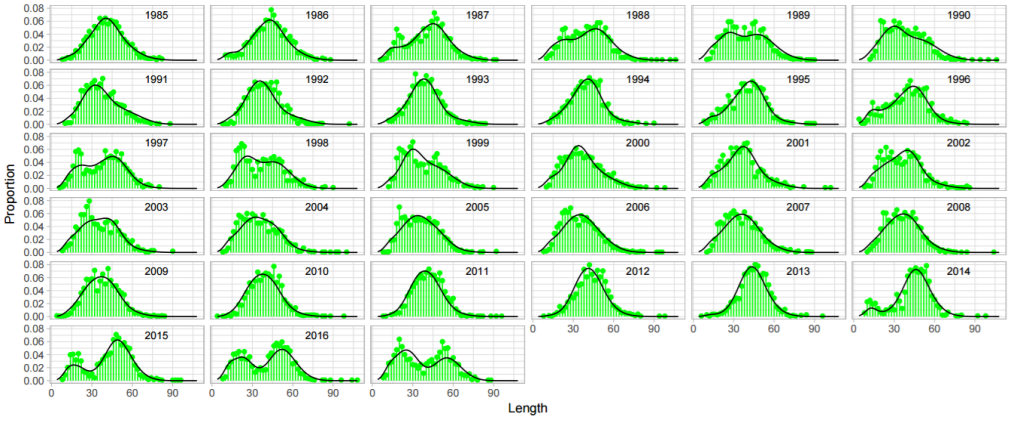

Figure 6.2.13. Tusk in 5.a and 14 Fit (red line) to observed length distributions (points and blue bars) from the Icelandic spring survey by year from Gadget.

Model fit: In Figure 6.2.14 the length disaggregated indices are plotted against the predicted numbers in the stock as a time-series. The correlation between observed and predicted is good for the first five length groups (10–19, 20–29, 30–39, 40–49, 50–59 and 60–69) which the first three to four are the main length groups of tusk caught in the spring survey. In the two larger length groups the fit gets progressively worse. Overall fit, when the disaggregated abundance indices and predictions are converted to biomass and summed over the length intervals is good, however the model is predicting lower biomass than the survey indicates in the terminal year (Figure 6.2.14).

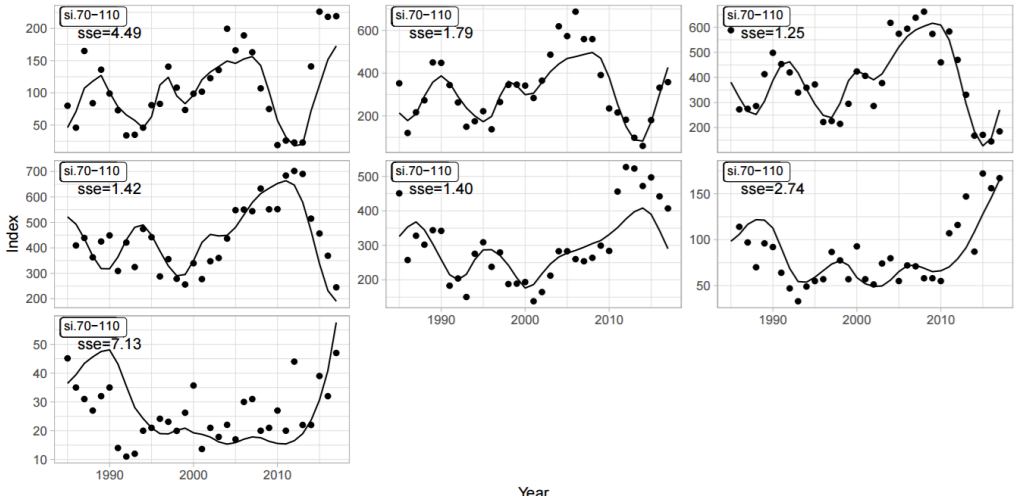

Figure 6.2.14. Tusk in 5.a and 14. Gadget fit to indices from disaggregated abundance by length indices from the spring survey.

Results

The results are presented in Table 6.2.8 and Figure 6.2.16. Recruitment peaked in 2005 to 2006 but has decreased and is estimated in 2013 to have been the lowest observed. Recruitment in 2014–2016 is estimated to be considerably higher than in 2013. Spawning–stock biomass has increased slowly since 2005. Harvestable biomass is estimated at a fairly high level compared to the rest of the time-series. Harvest rate has decreased from 0.29 in 2008 to 0.12 in 2016. Estimates reference biomass (B40+) have been stable for the last three years.

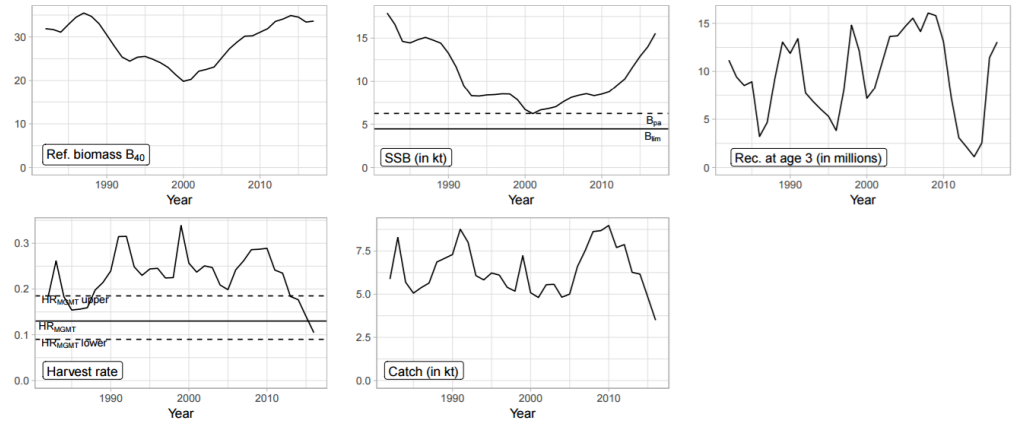

Figure 6.2.16. Tusk in 5.a and 14. Estimates of recruitment, biomass, harvestable biomass and fishing mortality for tusk for the age groups most important in the fishery i.e. ages 7 to 10 (solid line).

Reference points

In the past Yield-per-recruit based reference points estimated as described in the stock annex were used as proxies for F_{MSY}. F_{MAX} from a Y/R analysis is 0.24 and $F_{0.1}$ is 0.15.

WGDEEP 2014 recommended using F_{MSY}=0.2 as the target fishing mortality rather than F_{max}. This was subsequently used as the basis for the advice in 2014 by ICES. (See stock annex for details).

As part of the WKICEMSE 2017, HCR evaluations requested by Iceland the following reference points were defined for the stock.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	6.24 kt	B_{pa}
	H_{msy}	0.17	The harvest rate that maximises the median long-term catch in stochastic simulations with recruitment drawn from a block bootstrap of historical recruitment scaled according to a hockey stick recruitment function with B_{lim} as defined below.
	F_{msy}	0.226	The median fishing mortality when an harvest rate of H_{msy} is applied.
	$H_{p.05}$	0.371	The harvest rate that has an annual probability of 5% of SSB $< B_{l}im$.
	$F_{p.05}$	0.356	The median fishing mortality when an harvest rate of $H_{p.05}$ is applied.
Precautionary approach	B_{lim}	4.46 kt	$B_{pa}/e^{1.645\sigma}$ where $\sigma = 0.2$
	B_{pa}	6.24 kt	SSB(2001), corresponding to B_{loss}
	H_{lim}	0.27	H corresponding to 50% long-term probability of SSB $> B_{lim}$
	F_{lim}	0.41	F corresponding to H_{lim}
	F_{pa}	0.27	$F_{lim}/e^{1.645\sigma}$ where $\sigma = 0.25$
	H_{pa}	0.20	H corresponding to F_{pa}
Management plan	H_{mp}	0.13	

The management plan proposed by Iceland is:

> The spawning–stock biomass trigger (MGT $B_{trigger}$) is defined as 6.24 kt, the reference biomass is defined as the biomass of tusk 40+ cm and the target harvest rate (HR_{MGT}) is set to 0.13. In the assessment year (Y) the TAC for the next fishing year (September 1 of year Y to August 31 of year Y+1) is calculated as follows:
>
> When SSB_Y is equal or above MGT $B_{trigger}$:
>
> $TAC_{Y/y+1} = HR_{MGT} * B_{Ref,y}$
>
> When SSB_Y is below MGT $B_{trigger}$:
>
> $TAC_{Y/y+1} = HR_{MGT} * (SSB_y / \text{MGT } B_{trigger}) * B_{ref,y}$

WKICEMSE 2017 concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

6.2.4 Comments on the assessment

This assessment is conducted in a different manner than last year as the stock was benchmarked in 2017 as part of Harvest Control Rule evaluation request to ICES from Iceland.

WKICEMSE 2017 noted:

> "Catches of tusk in Greenland, within ICES Subarea 14, were discussed. Minor catches (representing <5% of the total catch of tusk in 5.a+14) have always occurred in the Greenland area and were never included in the stock assessment of tusk. However, these catches increased in 2015 and 2016, representing around 10%–15% of the total catches in those years. None of the work presented to WKICEMSE included these catches, which seem to occur well away from the area where the catches included in the stock assessment take place (i.e. in or around ICES Division 5.a). Information about these catches in the

Greenland area is somewhat limited and no biological samples are available; doubts related to population structure, movement and connectivities were also noted during the discussion. It was then decided to conduct a stock assessment run incorporating those catches (just the tonnage), to gain understanding on their potential impact on stock assessment results. Their inclusion in the assessment resulted in minor revisions upwards of the estimated stock biomass (around 1%–4% revision, on average throughout the years in the stock assessment) and downwards of the estimated harvest rate (around 0%–3% revision, on average throughout the years in the stock assessment, although with an increase of the harvest rates estimated for 2015 and 2016); the results of this run are available at the end of Section 2.2. As there are some doubts in relation to these catch data and population structure of tusk in the area, WKICEMSE did not feel that a decision to include these catches in the stock assessment at this point was appropriate before conducting additional explorations and having a better understanding. It is recommended that appropriate stock experts in WGDEEP should explore this issue further."

This was discussed at WGDEEP-2017 and the following points were raised:

- Stock structure is generally unclear when it comes to deep-water stocks and many of the stock units assessed by WGDEEP are defined based on very limited scientific knowledge.
- The current advice units of tusk are not based on genetic studies except for tusk in Rockall and on the Mid Atlantic Ridge.
- The fishing areas for tusk in 5.a and 14 are widely separated (see Section 6.1). However survey data do show continuous distribution between Greenland, Iceland and the Faroe Islands.
- Genetic studies do not detect difference in tusk populations from the Barents Sea down to the Faroe Islands and over to Iceland and Greenland (Knutsen *et al*., 2009).
- Knutsen *et al*. (2009) proposed that the bathymetry over the NE-Atlantic could form a "bridge" between Norway and Greenland. However they point out that tusk are not believed make extensive migrations and actually to be a sedentary species. Larval dispersal could account for the lack of genetic difference in tusk.
- It is highly plausible that the increased abundance of tusk seen in the Walter Herwig survey is of Icelandic origin that might have been dispersed as larvae to Greenland, similar as has been reported for cod in 5.a. However unlike cod it is unlikely that tusk would migrate back to Iceland.
- The tusk population in Greenland is likely to be a "sink" from the Icelandic population and as such should not affect the productivity of tusk in Iceland.

Based on this WGDEEP 2017 concludes that the catches in 14 should not be included in the assessment of tusk in 5.a. Additionally the EG concludes that the division of tusk into different advice units should be reviewed, not only in 5.a and 14 but for all the tusk stocks.

6.2.5 Management considerations

Increased catches in 14.b from less than 100 tonnes in previous year to 980 tonnes in 2015, and about 500 tonnes in 2016 are of concern (See Section 6.2.4).

The signs from commercial catch data and surveys indicate that the total biomass of tusk in 5.a is stable. This is confirmed in the Gadget assessment. Recruitment in 5.a is on the increase again after a low in 2013. However due to reduction in fishing mortality harvestable biomass and SSB seem to be either stable or slowly increasing.

Due to the selectivity of the longline fleet catching tusk in 5.a a large proportion of the catches is immature (60% in biomass, 70% in abundance). The spatial distribution of the fishery in relation to the spatial distribution of tusk in 5.a as observed in the Icelandic spring survey may result in decreased catch rates and local depletions of tusk in the main fishing areas.

Tusk is a slow growing late maturing species, therefore closures of known spawning areas should be maintained and expanded if needed. Similarly closed areas to longline fishing where there is high juvenile abundance should be maintained and expanded if needed.

Table 6.2.6. Tusk in 5.a and 14. Nominal landings by nations in 5.a.

Year	Faroe	Denmark	Germany	Iceland	Norway	UK	Total
1980	2873	0	0	3089	928	0	6890
1981	2624	0	0	2827	1025	0	6476
1982	2410	0	0	2804	666	0	5880
1983	4046	0	0	3469	772	0	8287
1984	2008	0	0	3430	254	0	5692
1985	1885	0	0	3068	111	0	5064
1986	2811	0	0	2549	21	0	5381
1987	2638	0	0	2984	19	0	5641
1988	3757	0	0	3078	20	0	6855
1989	3908	0	0	3131	10	0	7049
1990	2475	0	0	4813	0	0	7288
1991	2286	0	0	6439	0	0	8725
1992	1567	0	0	6437	0	0	8004
1993	1329	0	0	4746	0	0	6075
1994	1212	0	0	4612	0	0	5824
1995	979	0	1	5245	0	0	6225
1996	872	0	1	5226	3	0	6102
1997	575	0	0	4819	0	0	5394
1998	1052	0	1	4118	0	0	5171
1999	1035	0	2	5794	391	2	7224
2000	1154	0	0	4714	374	2	6244
2001	1125	0	1	3392	285	5	4808
2002	1269	0	0	3840	372	2	5483
2003	1163	0	1	4028	373	2	5567
2004	1478	0	1	3126	214	2	4821
2005	1157	0	3	3539	303	41	5043
2006	1239	0	2	5054	299	2	6596
2007	1250	0	0	5984	300	1	7535
2008	959	0	0	6932	284	0	8175
2009	997	0	0	6955	300	0	8252
2010	1794	0	0	6919	263	0	8976
2011	1347	0	0	5845	198	0	7390
2012	1203	0	0	6341	217	0	7761
2013	1092	0.12	0	4973	192	0	6257
2014	728	0	0	4995	306	0	6029
2015	625	0	0	4000	198	0	4823
2016	543	0	0	2649	302	0	3494

Table 6.2.7. Tusk in 5.a and 14. Nominal landings by nations in 14.

Year	Faroe	Denmark	Greenland	Germany	Iceland	Norway	Russia	Spain	UK	Total
1980	0	0	0	13	0	0	0	0	0	13
1981	110	0	0	10	0	0	0	0	0	120
1982	0	0	0	10	0	0	0	0	0	10
1983	74	0	0	11	0	0	0	0	0	85
1984	0	0	0	5	0	58	0	0	0	63
1985	0	0	0	4	0	0	0	0	0	4
1986	33	0	0	2	0	0	0	0	0	35
1987	13	0	0	2	0	0	0	0	0	15
1988	19	0	0	2	0	0	0	0	0	21
1989	13	0	0	1	0	0	0	0	0	14
1990	0	0	0	2	0	7	0	0	0	9
1991	0	0	0	2	0	68	0	0	1	71
1992	0	0	0	0	3	120	0	0	0	123
1993	0	0	0	0	1	39	0	0	0	40
1994	0	0	0	0	0	16	0	0	0	16
1995	0	0	0	0	0	30	0	0	0	30
1996	0	0	0	0	0	157	0	0	0	157
1997	0	0	0	0	10	9	0	0	0	19
1998	0	0	0	0	0	12	0	0	0	12
1999	0	0	0	0	0	8	0	0	0	8
2000	0	0	0	0	11	11	0	3	0	25
2001	3	0	0	0	20	69	0	0	0	92

Year	Faroe	Denmark	Greenland	Germany	Iceland	Norway	Russia	Spain	UK	Total
2002	4	0	0	0	86	30	0	0	0	120
2003	0	0	0	0	2	88	0	0	0	90
2004	0	0	0	0	0	40	0	0	0	40
2005	7	0	0	0	0	41	8	0	0	56
2006	3	0	0	0	0	19	51	0	0	73
2007	0	0	0	0	0	40	6	0	0	46
2008	0	0	33	0	0	7	0	0	0	40
2009	12	0	15	0	0	5	11	0	0	43
2010	7	0	0	0	0	5	0	0	0	12
2011	20	0	0	0	131	24	0	0	0	175
2012	33	0	0	0	174	46	0	0	0	253
2013	1.9	0.3	0	0	0	23.8	0	0	0	26
2014	2	0	0	0	0	26	0	0	0	28
2015	670	0,1	166	0	0	62	0	0	0	898
2016	111	0	182	0	0	178	0	0	0	471

Table 6.2.8. Tusk in 5.a and 14. Estimates of biomass, biomass 40+ cm, spawning–stock biomass (SSB) in thousands of tonnes and recruitment (millions), harvest rate (HR) and fishing mortality from Gadget.

Year	Biomass	B_{40+}	SSB	Rec3	Catch	HR	F
1982	40.44	31.71	18.06	11.54	5.88	0.18	0.25
1983	41.38	32.45	17.38	12.07	8.29	0.26	0.37
1984	39.78	31.14	15.01	4.34	5.69	0.18	0.26
1985	40.32	32.74	14.67	6.31	5.06	0.15	0.21
1986	41.08	34.72	15.09	12.50	5.38	0.15	0.21
1987	41.27	35.71	15.25	17.63	5.64	0.16	0.21
1988	41.15	35.65	15.15	16.04	6.86	0.20	0.26
1989	39.83	33.58	14.63	18.12	7.08	0.22	0.28
1990	38.59	31.00	13.56	10.45	7.30	0.24	0.31
1991	37.23	28.64	12.25	9.23	8.76	0.32	0.43
1992	34.45	25.66	9.85	8.14	8.00	0.31	0.46
1993	32.34	24.18	8.39	7.16	6.07	0.25	0.38
1994	31.93	24.86	8.13	5.17	5.83	0.23	0.35
1995	31.39	25.48	8.35	10.86	6.23	0.24	0.37
1996	30.18	25.02	8.41	20.00	6.10	0.25	0.36
1997	29.19	23.92	8.35	16.41	5.40	0.23	0.32
1998	29.07	22.91	8.38	9.69	5.17	0.23	0.31
1999	29.28	21.97	8.15	11.11	7.23	0.34	0.49
2000	27.58	19.53	6.73	14.77	5.08	0.26	0.38
2001	28.28	20.15	6.30	18.43	4.81	0.23	0.36
2002	29.69	21.60	6.50	18.51	5.55	0.25	0.40
2003	30.76	22.33	6.74	19.81	5.57	0.25	0.39
2004	32.27	22.99	7.02	20.99	4.82	0.20	0.31
2005	35.08	24.79	7.52	19.11	5.01	0.20	0.30
2006	38.21	27.13	8.10	21.71	6.60	0.24	0.37
2007	40.25	28.60	8.33	21.34	7.54	0.26	0.41
2008	41.73	29.70	8.40	17.69	8.63	0.29	0.47
2009	42.28	30.13	8.27	9.89	8.68	0.29	0.47
2010	42.49	30.74	8.37	4.17	8.98	0.29	0.48
2011	41.76	31.26	8.54	2.87	7.70	0.24	0.39
2012	41.44	32.98	9.24	1.50	7.87	0.24	0.37
2013	39.89	33.83	9.96	3.42	6.26	0.18	0.28
2014	38.90	34.89	11.31	15.44	6.16	0.18	0.25
2015	37.53	34.37	12.49	17.63	4.84	0.14	0.19
2016	37.33	33.63	13.77	23.91	3.49	0.10	0.13
2017	38.90	33.28	15.16	24.58	4.44		