8 Greenland halibut in subareas 1 and 2 (ghl.27.1-2).

The stock is assessed by a GADGET length-based model since 2015. The stock has biennial advice and the last advice was given in 2017 for 2018 and 2019. A new stock assessment is run in 2019 to provide advice for 2020 and 2021. General information about this stock is in the Stock Annex, which was updated after the last benchmark.

8.1 Status of the fisheries

8.1.1 Landings prior to 2019 (Tables 8.1–8.8)

Nominal landings by country for subareas 1 and 2 combined are presented in Table 8.1. Tables 8.2—8.4 give the landings for Subarea 1 and divisions 2.a and 2.b separately, and landings separated by gear type are presented in Table 8.5. For most countries, the landings listed in the Tables are similar to those officially reported to ICES. Some of the values in the Tables vary slightly from the official statistics and represents those presented to the Working Group by the members. Catch per unit of effort is presented in Table 8.6 and total catch from 1935-till now in Table 8.7 and Figure 8.1.

The preliminary estimate of the total landings for 2018 is 28 544 t. This is 2164 t more than the landings in 2017 and about 5544 t more than the ICES advised maximum catch for 2018 (23 000 t). There was a large increased in both Norwegian and Russian catches, 1133 and 1358 tonnes, respectively, compared to 2017. Also, Faroese catches decreased substantially, by 508 t. Combined landings exceeded the quotas set by the Joint Russian-Norwegian Fisheries Commission for 2018 by 1544 t (total TAC 27 000 t). One explanation is the difficulties in bycatch regulation.

Some fishing for Greenland halibut has taken place in the northern part of Division 4.a during the past 20–30 years, varying between a few tonnes and up to 1670 t in 1995. From 2005 to 2011 this catch was mostly below 200 t, taken mostly by Norway, France, and UK. Preliminary numbers show 532 t in 2018, mainly due to contribution of the Norwegian trawl fleets (Table 8.8, figures 8.2 and 8.3). Although there is a continuous distribution of this species from the southern part of Division 2.a along the continental slope towards the Shetland area, stock structure is unclear in this area and these landings have therefore not been added to the total from subareas 1 and 2. Recent mark-recapture and genetic investigations indicate that the stock might have a more south and westward distribution than current ICES definition of stock boundaries (Albert and Vollen, 2015, Westgaard *et al.*, 2016).

8.1.2 ICES advice applicable to 2018 and 2019

The advice from ICES for 2018 and 2019 was as follows:

ICES advises that when the precautionary approach is applied, catches in each of the years 2018 and 2019 should be no more than 23 000 tonnes. This corresponds to a harvest rate of ≈0.039. All catches are assumed to be landed.

Additional considerations

The benchmark and data workshop process lead to an agreed analytic assessment in 2015.

A benchmark meeting (WKBUT; ICES 2013/ACOM:44) was held for the Northeast Arctic (NEA) Greenland halibut in 2013, but the benchmark process was prolonged due to problems with data.

A data workshop was conducted in November 2014 (DCWKNGHD ICES CM 2014/ACOM:65), followed by a benchmark by correspondence that ended in 2015. The assessment is reported in the benchmark by correspondence (IBPHALI; ICES CM 2015/ACOM:54) and in the stock annex.

8.1.3 Management

The 38th JRNFC's session in 2009 decided to cancel the ban against targeted Greenland halibut fishery and established the TAC at 15 000 t for the next three years (2010–2012). The 40th JRNFC Session in 2011 decided to increase the TAC for 2012 up to 18 000 t, and at the 42nd JRNFC Session in 2012, the TAC for 2013 was increased to 19 000 t. The 43rd and 44th session kept the same TAC for 2014 and 2015. For 2016 and 2017 TAC was set to 22 and 24 thousand tonnes, respectively. The TAC for 2018 was 27 thousand tonnes and is the same for 2019.

The TAC for Greenland halibut set by JNRFC applies to catches in ICES areas 1, 2.a and 2.b, except the Jan Mayen EEZ and the part of the EU EEZ which is north of 62°N.

In 2018 catches of 210 tonnes were taken in the Jan Mayen area (within ICES Area 2), where Greenland halibut fisheries are not regulated by TAC.

Norway has a quota for Greenland halibut in the EU EEZ which in recent years has been 1100 t and can be fished in ICES areas 2.a and 6. Thus this TAC is given partly within and partly outside the stock boundary. In 2017, 1000 t of this TAC was caught, assumingly mainly in ICES area 2.a. Catches in 2018 were 916 t. There is no ICES separate advice for the fishery in this area. However, this quota has previously not been reported in the advice sheet and when comparing TAC and the total catches in ICES areas 1 and 2 this should be kept in mind.

Further information on regulations is found in the stock annex.

8.1.4 Expected landings in 2018

Catches in 2018 exceeded the TAC and were 28 544 t. The total Greenland halibut landings in the Barents Sea and adjacent waters (ICES Subarea 1 and divisions 2.a and 2.b) in 2019 may thus be higher than the TAC of 27 000 t. Discards at present are not regarded as a problem.

8.2 Status of research

8.2.1 Survey results (Tables 8.9-8.13, Figures 8.4-8.11)

Survey indices from the Russian autumn survey (figures 8.4, 8.5, and 8.6), the Norwegian slope survey (figures 8.4, 8.5, 8.7, and 8.8), the Joint Ecosystem survey (Eco-juv and Eco-south indices) (figures 8.9 and 8.10) and the Joint Winter Survey are given (Figure 8.11). Length distributions from these surveys, along with the Spanish survey are presented in Tables 8.9-8.13.

The Russian bottom-trawl surveys in October-December (ICES acronym: *RU-BTr-Q4*) are important since they usually cover large parts of the total known distribution area of the Greenland halibut within 100–900 m depth. However, it has been considered imprudent to use the 2002, 2003 and 2013 data from this survey series. During the 2002 survey, no observations were available from the Exclusive Economic Zone of Norway (NEEZ). In 2003, observations on the main spawning grounds were conducted three weeks later than usual because access to NEEZ was obtained too late. 1 The number of trawl stations was also insufficient due to the same reason. Due to technical problems indices in 2013 were not obtained. Technical and practical changes

were made in 2003. Length distributions by year for this survey are given in Table 8.9. The biomass indices for this survey increased steeply from 2005 to 2011, fell again until 2014, but have shown a steep increase since then (figures 8.4 and 8.5).

Total biomass indices from the Norwegian autumn slope survey (ICES acronym: *NO-GH-Btr-Q3*) showed an upward trend in biomass estimates between 1994 and 2003, then a downward trend until 2008 until it increased again in 2009 but levelled out again in 2011, 2013, and 2015 (figures 8.4, 8.5, and 8.7). The index for 2017 is the lowest since the start of the survey. The length distributions from this survey show mode that can be followed through the years with a marked change between 2006 and 2007 (Figure 8.12, Tables 8.10 and 8.11). This survey was conducted every year 1994—2009 but is now run biennially.

The Joint Ecosystem Survey covers a large part of the Barents Sea down to 500 m and concerning Greenland halibut it can be regarded to be in the areas where mainly juveniles and immature fish are found. Two indices for Greenland halibut are based on the Joint Ecosystem Survey in the Barents Sea and previous juvenile survey, one for juvenile areas (Figure 8.9) denoted Eco-juv index in the northernmost survey area, and another denoted Eco-south index for adults defined by the survey area south from 76.5°N and in addition west of Spitsbergen (Figure 8.10). The juvenile index indicates a highly variable recruitment success with years between good year classes. The 2015 and 2016 estimates are the lowest registered so far, followed by a large increase in 2017. The 2018 estimate, however, dropped down to the 2016 level. The Eco-south index for females showed an increasing trend towards 2012, followed by a decrease towards 2015. The index has since then shown an increasing trend. The male index shows a similar trend except the increase started a year later, in 2016. Length distributions by year for this survey are given in Table 8.12.

The Spanish bottom-trawl survey from 1997 to 2005 (Table 8.13, Figure 8.13), ICES acronym: *SP-Svalbard-Q4,* from 2008 the Spanish autumn survey is carried out on a new hired commercial trawler vessel and some changes have been done in the initial standard protocol. One of the most important changes is the increase of the bridle's length now being 300 m instead of 175 m before 2008. This new feature increased the swept-area in the trawl stations making the comparison of the biomass and abundance index before and after 2008 difficult. In Basterretxea *et al.* (WD13 2013) an attempt is made to standardize survey indices for Greenland halibut in earlier Spanish surveys (1997–2005) with recent surveys (2008–2012). The conclusion is that it is considered not possible to obtain a reliable standardization of the surveys. This means that the Spanish index from the survey in autumn is available for years 2008, 2010 and 2012–2014. The Spanish survey is now alternately run every other year in spring and autumn. No new information on the Spanish survey was presented to the meeting.

Polish bottom-trawl surveys on Greenland halibut were carried out in the Svalbard-Bear Island area (ICES 2.b) in October 2006, April 2007, April 2008, June 2009, and March 2011. The main objectives of the survey are to determine the biological structure, distribution, density and standing biomass of Greenland halibut in the survey area (Trella and Janusz, WD6 ICES AFWG 2012).

Polish survey index is shown in Figure 8.14, no new data were available to the meeting.

8.2.2 Commercial catch-per-unit-effort (Table 8.6)

The CPUE series for the stock has been a subject to the benchmark and following data workshops (see reports from WKBUT 2013, DCWKNGHD 2014 and IBPHALI 2015, and working documents by Bakanev (WD14 WKBUT 2013) and Nedreaas (WD 2 DCWKNGHD 2014)). An alternative CPUE series for the Russian fisheries for the years 2004–2015 was presented to the 2016 meeting (Mikhaylov, WD14 ICES AFWG 2016). It shows some discrepancy compared to previous CPUE series used for the Russian fisheries for the same years.

8.2.3 Age readings

Based on the scientific understanding that the species is more slow growing and vulnerable than the previous age readings suggest, the Norwegian age reading methods were changed in 2006. The new Norwegian age readings are not comparable with older data or the Russian age readings.

The report from Workshop on Age Reading of Greenland Halibut (WKARGH) 14—17 February 2011 (ICES CM 2011/ACOM:41) described and evaluated several age reading methods for Greenland Halibut.

The different methods can be classified into two groups: A) Those that produce age–length relationships that broadly compare with the traditional methods described by the joint NAFO-ICES workshop in 1996 (ICES CM 1997/G:1); and B) Several recently developed techniques that show much higher longevity and approximately half the growth rate from 40–50 cm onwards compared to the traditional method.

A second workshop on age reading of Greenland halibut (WKARGH 2) was conducted in August 2016 and worked on further validation on new age reading methods. The workshop recommended that two of the new methods can be used to provide age estimations for stock assessments. Further, recognizing some bias and low precision in methods, the WKARGH2 suggested that an ageing error matrix or growth curve with error be provided for use in future stock assessments (WKARGH2 report 2016, ICES CM 2016/SSGIEOM:16).

WKARGH2 recommends regular interlab calibration exercises to improve precision (i.e. exchange of digital images between readers for each method and between methods). AFWG suggests that Russian and Norwegian scientist and age readers meet to work out issues of disagreements on Greenland halibut aging.

8.3 Data used in the assessment

For the Gadget model, catch data have been split into four aggregated fleets. Longline/gillnet fleet includes landings from gillnet, longline, and handline. Trawl fleet includes landings from bottom trawl, purse-seine and Danish seine. Catch in tonnes and length distributions per quarter per fleet per sex were used from 1992–2018 for tuning the model. Fleets were split between Norwegian (with 3rd countries) and Russian catches, and selectivities were allowed to vary by sex (logistic for gill fleets, asymmetric dome-shaped for trawl fleets), to account for sexually dimorphism influencing vulnerability to fishing. For each fleet listed below, length distributions and reported catch in tonnes were available split by quarter and sex (although length distributions were not available for all quarters for some fleets).

- Russian, trawl and minor gears (split by sex)
- Russian, gillnet and longline (split by sex)
- Norwegian and 3rd countries, trawl and minor gears (split by sex)
- Norwegian and 3rd countries, gillnet and longline (split by sex)

In addition, the model has four surveys, all modelled with asymmetric dome-shaped selectivities (note that in a model context "selectivity" encompasses all aspects of vulnerability to the fishery, including gear effects, vessel effects, area effects etc.). In each case data are used as length distribution and biomass index. The biomass index was not available split by sex for all years, so a combined sex index is used. Four indices go into the current assessment:

- Norway slope – based on the Norwegian Greenland halibut slope survey *(NO-GH-Btr-Q3)* (yearly 1996–2009, biennially since then). Split by sex.

- EcoJuv - a juvenile index based on data from the northern/eastern areas of the Joint Ecosystem survey (Eco-NoRu-Q3 (Btr)) (2003–present) and the precursory Norwegian juvenile Greenland halibut survey north and east of Svalbard (1996—2002) (Hallfredsson and Vollen, WD 1 ICES IBPhali 2015). Split by sex.
- EcoSouth - an index for the Barents Sea south of 76.5°N, based on data from the Joint Ecosystem survey (Eco-NoRu-Q3 (Btr) (2003—present) (Hallfredsson and Vollen, ICES AFWG, WD 20, April 2015). Split by sex.
- Russian - Russian bottom-trawl survey in the Barents Sea (*RU-Btr-Q4*) (1992-2015 and 2017). Sex aggregated (can be split by sex in future work).

No age data or CPUE indices are used in the tuning.

Issues with 2019 assessment data

Landings data in 2019 assessment, compared to data in 2017 assessment:

- Revision of minor discrepancies between the datasets after 2005.
- Implemented revision of split between fleets in Russian data in 2014.
- Implemented revision of split between fleets, and total catch, for Russian data in 2013 and 2016
- Revision "other nations" catch in 2015 and 2016 (preliminary in 2017)

Most of these changes were minor and did not affect the assessment noteworthy. The changes in "other nations" catches were more substantial as it added 1334 t to the total catches in 2016, and in turn to the "Norwegian and 3rd countries" indices.

Survey data in 2019 assessment, compared to data in 2017 assessment:

- EcoJuv and EcoSouth indices (Both based on the Barents Sea Ecosystem Survey)
  - Challenges related to new database solution at IMR
  - Problems with sex-split of G. halibut, especially in 2016-2018

IMR has been moving data from the old SPD format to the new S2D database. During this process some data problems have submerged concerning Greenland halibut data in the Barents Sea Ecosystem survey, both adaption to new format and minor errors in the old data. This has been corrected as good as possible at the current stage (Working Documents 19 and 20). The difference does not affect the assessment in any major way.

The number of sexed length samples of Greenland halibut in the Barents Sea Ecosystem survey in autumn has been gradually decreasing year by year, especially in the area that defines the EcoSouth index (Figure 8.15), and consequently, the proportion sexed of the total catch. Additionally, experience shows that sex identification is uncertain for G. halibut below 20 cm in length, and a substantial part of the attempted sex identification is not successful. Regarding the index in the juvenile area (EcoJuv) expectation is that the ratio between males and females should be 50/50, and available data confirm this assumption (Figure 8.16). Thus, as a solution for the data input for EcoJuv index in the 2019 assessment, it was decided to use 50/50 male-female split for all years. For the EcoSouth index, a sex-split was constructed based on all available data from the survey in the EcoSouth area (Figure 8.17). This will smooth out the proportion of each sex by year in the index, but the trend in proportion females seems to be similar between new and old index (Figure 8.18)

The lack of biological samples also introduced difficulties in the split of biomass between sexes in the Ecosystem survey data. To solve this a length-weight relationship was established based on all available data on Greenland halibut in the IMR database (Figure 8.19).

The changes introduce some discrepancies between old and new calculations of the index (figures 8.9 and 8.10). This is reflected in the biomass estimate of the Gadget model (see section 8.5).

The sex identification issue in the Ecosystem survey needs to be addressed in future.

8.4 Methods used in the assessment

New assessment method with a length-based GADGET model was benchmarked in 2015 (IPHALI 2015) and accepted by ACOM the same year. The model is further described in the IPHALI report and in the stock annex.

8.4.1 Model settings

Model used: Gadget (see ICES, 2015).

Time period: 1992–2018, monthly time-steps

Model structure:

- 1 cm length classes (1—114+ cm) and 1-year age classes (1—30+)
- Two sexes, split into mature and immature
- Logistic maturity estimated for each sex
- Von Bertanlanffy growth estimated separately for males and females
- L-W relationship fixed based on data from the Norwegian slope (Females: a = 1.4E-6 and b = 3.47. Males: a = 5.7E-6 and b = 3.12)
- Natural mortality set to 0.1 for all fish
- Initial size of recruits fixed at 8.5 cm (necessary to fix this in the absence of age data)
- Recruitment modelled as annual numbers, no relationship with SSB
- Four aggregated fleets (as described above), each with sex-specific selectivity (logistic for gill fleets, asymmetric dome-shaped for trawl)
- Four surveys (as described above), all with asymmetric dome-shaped selectivity

Note that in order to avoid the problem of modelled fish not covered by any fleet (and therefore not tuned to any data) the gillfleets have been assumed to have logistic (flat topped) selectivity.

Estimated parameters:

L_{50} and slope for the maturation (male and female separately), two growth parameters per sex, two maturation parameters per sex, one annual recruitment parameter per year, two parameters for s.d. of length of recruits, parameters governing commercial selectivity (two per sex per gillfleet and three per sex per trawlfleet), one effort parameter per year for each fleet, three parameters per survey per sex governing selectivity, initial population numbers for male and female fish by age, initial population s.d. of lengths by sex and age

Data used for tuning are:

- Quarterly length distribution of the landings from commercial fishing fleets (by sex)
- Quarterly catch in tonnes for each fleet (by sex)
- Length disaggregated survey indices from the four surveys (by sex except for the Russian survey)
- Overall survey index (by biomass) for the four surveys (by sex except for the Russian survey)
- Estimated maturity ogives (maturity at length in the population) for 1992—2014 (by sex)

Note that no age data are used in tuning the model. Although age readings are available for some years there is not a full agreement on which age-reading methodology should be used, and these data are thus not suiTable for inclusion in an assessment model yet.

Concerning the recruitment, it should be noted that age 1 is the age for recruitment to the stock, NOT the age for recruitment to the fishery, which is the quantity normally used to describe recruitment. But since age 1 recruitment is the quantity estimated by the model and the age of recruitment to the fishery can't be defined due to lack of age data, we use age 1 as the recruitment age for this stock. Even if adequate age data were available, the strong sexual dimorphism in growth would make it very difficult to define an appropriate recruitment age.

8.5 Results of the Assessment

The assessment is conducted every two years and advice is to be given this year for catches in 2020 and 2021. Model results are shown in figures 8.20 and 8.21, and Table 8.14. The stock abundance and biomass are presented for fish larger than 45 cm, this corresponds to the minimum legal size and is slightly larger than L_{50} maturity for males. Both 45 cm+ abundance and biomass peaks ca in 2013-2014 and show a slow downward trend since then. There is a retrospective trend to reduce the stock estimate over time. However, the last 4 years of the retrospective for the 45cm+ biomass are very consistent (Figure 8.22). The modelled recruitment is spiky (Figure 8.21), and it is likely that this is exaggerated due to the lack of age data. However, although the real recruitment is likely more spread out, the modelled peaks show reasonably good agreement to the data from the juvenile survey. This stock is dominated by sporadic recruitment events, and the model does a reasonable job of capturing this. The model has been consistently estimating reasonably good recruitment in 2010, which should be entering the fishery in the coming years.

Biological reference points

The last observed year with good recruitment occurred in 1995 at 487 000 tonnes fishable (45+ cm) biomass. There is evidence (in the estimated initial population for the assessment model) that an earlier good recruitment event occurred in the 1980s from lower biomass, but the exact biomass level is unknown as this is before the model period. The precautionary reference point is therefore taken at 487 000 tonnes, with a note that this is likely to be on the high (precautionary) side. Using 45+ cm biomass (rather than total or female SSB) avoids uncertainty around maturation sizes and the different distributions of males and females, and relates directly to the fishable stock, but does not directly relate to the most vulnerable or critical female SSB.

Further work is planned on biological reference points.

8.5.1 NEA Greenland halibut surplus production models

Results of the assessment of the Barents Sea Greenland halibut stock based on a Bayesian surplus production model was provided by Bakanev in 2013, (WKBUT WD 14). Different sets of abundance indices were used for tuning the model. The analysis of model run results has shown that K is estimated within the range of 810 to 1139 kilotonnes, B_{MSY} of 405 to 570 kilotonnes and MSY of 23 to 47 kilotonnes. However, the model was sensitive to the choice of prior on K. Taking into consideration a high probability of the stock size being at the level which was quite a bit above B_{MSY}, the risk of the biomass being below this optimal one was very small in 2002–2012 (<1%). The risk analysis of the stock size in the prediction years (2013–2020) under the catch of 0 to 30 kilotonnes indicated that probability of the stock size being under the threshold levels (B_{MSY}, B_{lim}) was also minor (less than 1%). It was concluded that further work was needed on historical CPUE series. Based on scrutiny of the CPUE series it was recommended to examine runs with the surplus production model for the period 1964—1991 and 1964—2005, in addition to runs for the whole 1964—2013 period. Fisheries CPUE series were considered less reliable to reflect stock dynamics than survey indices in the period after regulations of the fishery were introduced in 1992. The Bayesian surplus model was not updated for presentation at the current meeting.

A production model was presented to the 2016 meeting (Mikhaylov, 2016, WD 14), although this model has not been reviewed at a benchmark, nor were biomass trends presented at this meeting. The model has been proposed as a possible method for estimation of long-term reference points. An update was presented to the meeting (Working Document21). In the current version, the MSY would be around 34 ktonnes, the BMSY around 500 ktonnes and F_{MSY} on the level 0.069. It should be noted that these values are not directly transferable to a different model with different biomass levels and in any case a long-term average. The WD concludes that, in general, the stock can withstand the current fishing load and the fishing regime is approaching optimum, indicating that the results of the exploratory surplus production model are in general alignment with the assessment and advice presented here.

F_{MSY} is not appropriate to this stock given the recent extended run of poor recruitment, and such values have not been evaluated for precautionarity. In a plenary, it was concluded that it would be useful for further development of the production model to conduct separate exploratory runs for CPUE split into before and after 1992 and run with CPUE only before 1992 and survey data. This production model was not updated for presentation at the current meeting.

At the 2018 meeting, AFWG results from SPiCT production model was presented (AFWG report 2018). In the run that is presented in this report, all available data up to 2016 were used. For run with default priors applied K = 995 421 t and deterministic reference points were B_{MSY} = 419 955 t, F = 0.07 and MSY = 29 742 t. Stochastic reference points for this run were in a similar range. Run with default priors deactivated gives similar MSY estimate but otherwise rather different estimates; K = 2 504 006, B_{MSY} = 609 410 t, F = 0.05 and MSY = 28 097 t. Further utilization of this approach demands closer scrutiny of model settings in relation to diagnostics. The SPiCT model can be a flexible tool to examine production model approach to G. halibut, however, concerns highlighted below still apply.

In principle, a production model could be used in conjunction with the GADGET assessment model in order to extend the simulations back in time and provide better estimates for $B_{lim.}$ However, the inability of production models to follow variable recruitment, and especially runs of above or below average recruitment, limits their ability to give advice for this stock.

In the benchmark report (IBPHALI 2015) Table 3.3 gives CPUE series and survey estimates that can be helpful for this task (Table 8.15, Figure 8.23).

8.6 Comments to the assessment

The ongoing reduction in sex-split length samples in two survey indices, EcoJuv and EcoSouth required a change in methodology for computing the tuning indices used in the assessment. This increased the absolute biomass estimates about 10% but did not affect the trend in biomass through years (figures 8.20, 8.24 and 8.25). This change has also acted to reduce the retrospective pattern in recent years, likely as a result of the model no longer chasing noise in the data. We stress once again that the absolute biomass levels for this model are rather uncertain. Without age data in the model tuning there is little information on total mortality (Z) at age (number-at-age x in year y minus number-at-age x-1 in year y-1 gives information on Z). Without this, there is little information for the model to translate catch information into F, and hence inform biomass levels. Furthermore, the conflicting survey signals translate into an uncertainty range of several hundred thousand tonnes (IBPHALI 2015). All the exploratory work suggests that the overall trends are robust, but that care should be taken in interpreting the absolute abundance estimates (and hence absolute estimates of harvest rate).

Although there is little retrospective pattern over the last four years, the model exhibits a retrospective pattern in earlier years associated with the biomass peak around 2014 (Figure 8.22). The two coastal shelf surveys (the ecosystem survey and the Russian surveys) showed a more rapid

rise than the other surveys, and then a more rapid reduction. The Russian survey had a very rapid rise and then a rapid decline. The model, therefore, had a series of downward revisions as the peak has been passed, where the model now estimates that it had previously been over-optimistic about the size of the peak. It should be noted (ICES IBPHALI REPORT 2015; ICES CM 2015\ACOM:54) that there is an issue with this stock where different surveys give different signals and choosing one survey over the others could affect the biomass level by several hundred thousand tonnes. Given this, a retrospective pattern is probably to be expected as the different surveys evolve. Note also that one of the surveys is run every two years (in odd-numbered years), this accounts for the grouping of lines in the retrospective pattern into pairs.

To facilitate calculation of spawning-stock biomass, maturity ogives from the Norwegian Slope survey were derived for years 1994–2015. These ogives give approximately identical length at 50% maturation (L_{50}) for males compared L_{50} based on Russian fisheries data (figures 8.27-8.30). L_{50} for females is higher in the Norwegian data due to new definition on when females are considered mature/immature in accordance to resent research (Kennedy *et al.*, 2009, 2011 and 2014, Nunez *et al*., 2015). GLM fitted ogives can be used in future assessment.

Future work

Further development of the assessment is needed and, in consistency with conclusions of the IBPHALI benchmark and report of the external benchmark reviewer.

AFWG suggest a new benchmark on the stock in 2022, and intersessional work will commence on a possible issues list. Such a benchmark, especially if it can extend the model back in time to a period of lower stock biomass, would allow a more accurate determination of precautionary biomass reference points. It would, therefore, be a precursor to a potential MSE to generate an HCR for this stock and move away from precautionary advice.

Table 8.1. GREENLAND HALIBUT in subareas 1 and 2. Nominal Catch (t) by countries (Subarea I, divisions 2.a, and 2.b combined) as officially reported to ICES.

Year	Denmark	Estonia	Faroe Islands	France	Fed. Rep. Germany	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia[3]	Spain	GB	UK (Engl. & Wales)	UK (Scot land)	Total
1984	0	0	0	138	2165	0	0	0	0	0	4376	0	0	15 181	0	0	23	0	21 883
1985	0	0	0	239	4000	0	0	0	0	0	5464	0	0	10 237	0	0	5	0	19 945
1986	0	0	42	13	2718	0	0	0	0	0	7890	0	0	12 200	0	0	10	2	22 875
1987	0	0	0	13	2024	0	0	0	0	0	7261	0	0	9733	0	0	61	20	19 112
1988	0	0	186	67	744	0	0	0	0	0	9076	0	0	9430	0	0	82	2	19 587
1989	0	0	67	31	600	0	0	0	0	0	10 622	0	0	8812	0	0	6	0	20 138
1990	0	0	163	49	954	0	0	0	0	0	17 243	0	0	4764	0	0	10	0	23 183
1991	11	2564	314	119	101	0	0	0	0	0	27 587	0	0	2490	132	0	0	2	33 320
1992	0	0	16	111	13	13	0	0	0	0	7667	0	31	718	23	0	10	0	8602
1993	2	0	61	80	22	8	56	0	0	30	10 380	0	43	1235	0	0	16	0	11 933
1994	4	0	18	55	296	3	15	5	0	4	8428	0	36	283	1	0	76	2	9226
1995	0	0	12	174	35	12	25	2	0	0	9368	0	84	794	1106	0	115	7	11 734
1996	0	0	2	219	81	123	70	0	0	0	11 623	0	79	1576	200	0	317	57	14 347
1997	0	0	27	253	56	0	62	2	0	0	7661	12	50	1038	157	0	67	25	9410
1998	0	0	57	67	34	0	23	2	0	0	8435	31	99	2659	259	0	182	45	11 893
1999	0	0	94	0	34	38	7	2	0	0	15 004	8	49	3823	319	0	94	45	19 517
2000	0	0	0	45	15	0	16	1	0	0	9083	3	37	4568	375	0	111	43	14 297
2001	0	0	0	122	58	0	9	1	0	0	10 896	2	35	4694	418	0	100	30	16 365
2002	0	219	0	7	42	22	4	6	0	0	7143	5	14	5584	178	0	41	28	13 293
2003	0	0	459	2	18	14	0	1	0	0	8216	5	19	4384	230	0	41	58	13 447
2004	0	0	0	0	9	0	9	0	0	0	13 939	1	50	4662	186	0	43	0	18 899
2005	0	170	0	32	8	0	0	0	0	0	13 011	0	23	4883	660	0	29	18	18 834
2006	0	0	204	46	8	0	8	0	0	196	11 119	201	26	6055	29	0	10	2	17 904
2007	0	0	203	41	8	198	15	0	0	0	8230	200	47	6484	8	0	11	8	15 453
2008	0	0	663	42	5	0	28	0	0	0	7393	201	46	5294	94	0	16	10	13 792

Year	Denmark	Estonia	Faroe Islands	France	Fed. Rep. Germany	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia[3]	Spain	GB	UK (Engl. & Wales)	UK (Scot land)	Total
2009	0	0	422	16	19	16	15	2	0	0	8446	204	237	3335	210	0	9	60	12 990
2010	0	0	272	102	14	15	16	0	0	0	7700	3	11	6888	182	0	4	22	15 229
2011	0	0	538	46	80	4	7	0	0	234	8270	169	21	7053	144	0	36	4	16 606
2012	0	0	564	40	40	12	13	0	0	0	9331	22	1	10 041	190	0	21	14	20 288
2013	0	0	783	168	49	22	106	1	0	0	10 403	30	7	10 310	196	0	17	75	22 167
2014	0	0	887	269	33	20	86	0	0	0	11 232	19	0	10 061	206	0	28	184	23 025
2015	0	0	312	227	33	14	53	0	0	5	10 874	13	1	12 953	159	0	25	79	24 748
2016	0	359	483	229	9	17	79	0	0	0	12 932	8	19	10 576	198	0	20	19	24 948
2017	0	523	917	177	21	26	10	0	1	72	13 741	27	13	10 714	56	0	83	0	26 380
2018*	2	574	409	150	51	32	0	0	4	177	14 874	27	6	12 072	60	108	0	0	28 544

* **Provisional figures.**

Table 8.2. GREENLAND HALIBUT in subareas 1 and 2. Nominal catch (t) by countries in Subarea 1 as officially reported to ICES.

Year	Estonia	Faroe Islands	Fed. Rep. Germany	France	Latvia	Lithuania	Greenland	Iceland	Ireland	Norway	Poland	Portugal	Russia[3]	Spain	GB	UK (England & Wales)	UK (Scot land)	Total
1984	0	0	0	0	0	0	0	0	0	593	0	0	81	0	0	17	0	691
1985	0	0	0	0	0	0	0	0	0	602	0	0	122	0	0	1	0	725
1986	0	0	1	0	0	0	0	0	0	557	0	0	615	0	0	5	1	1179
1987	0	0	2	0	0	0	0	0	0	984	0	0	259	0	0	10	0	1255
1988	0	9	4	0	0	0	0	0	0	978	0	0	420	0	0	7	0	1418
1989	0	0	0	0	0	0	0	0	0	2039	0	0	482	0	0	0	0	2521
1990	0	7	0	0	0	0	0	0	0	1304	0	0	321	0	0	0	0	1632
1991	164	0	0	0	0	0	0	0	0	2029	0	0	522	0	0	0	0	2715
1992	0	0	0	0	0	0	0	0	0	2349	0	0	467	0	0	0	0	2816
1993	0	32	0	0	0	0	0	56	0	1754	0	0	867	0	0	0	0	2709
1994	0	17	217	0	0	0	0	15	0	1165	0	0	175	0	0	0	0	1589
1995	0	12	0	0	0	0	0	25	0	1352	0	0	270	84	0	0	0	1743
1996	0	2	0	0	0	0	0	70	0	911	0	0	198	0	0	0	0	1181
1997	0	15	0	0	0	0	0	62	0	610	0	0	170	0	0	0	0	857
1998	0	47	0	0	0	0	0	23	0	859	0	0	491	0	0	2	0	1422
1999	0	91	0	0	0	0	13	7	0	1101	0	0	1203	0	0	0	0	2415
2000	0	0	0	0	0	0	0	16	0	1021	0	0	1169	0	0	0	0	2206
2001	0	0	0	0	0	0	0	9	0	925	0	0	951	0	0	2	0	1887
2002	0	0	3	0	0	0	0	0	0	834	0	0	1167	0	0	0	0	2004
2003	0	48	0	0	0	0	2	0	1	962	1	0	735	0	0	0.3	0	1749
2004	0	0	0	0	0	0	0	0.3	0	866	0	0	633	0	0	3	0	1503
2005	0	0	0	1	0	0	0	0	0	572	0	0	595	0	0	3	0	1171
2006	0	17	1	0	0	0	0	1	0	575	0	0	626	2	0	2	0	1224
2007	0	18	0	1	0	0	198	3	0	514	0	3	438	0	0	4	0	1179
2008	0	13	0	1	0	0	0	5	0	599	0	0	390	0	0	0	0	1008
2009	0	33	0	0	0	0	16	5	0	734	0	0	483	0	0	1	0	1272

Year	Estonia	Faroe Islands	Fed. Rep. Germany	France	Latvia	Lithuania	Greenland	Iceland	Ireland	Norway	Poland	Portugal	Russia[3]	Spain	GB	UK (England & Wales)	UK (Scot land)	Total
2010	0	15	0	0	0	0	0	16	0	659	0	0	708	2	0	0	0	1399
2011	0	63	0	0	0	0	0	6	0	867	0	0	782	0	0	0	0	1718
2012	0	8	5	0	0	0	0	7	0	921	0	0	1368	1	0	7	0	2318
2013	0	39	1	8	0	0	0	100	0	1055	4	0	1442	4	0	8	0	2661
2014	0	143	8	11	0	0	19	38	0	1271	7	0	1261	10	0	14	0	2782
2015	0	96	14	3	0	5	12	47	0	1424	5	0	1681	8	0	4	0	3299
2016	353	84	2	3	0	0	3	38	0	1265	7	0	1172	7	0	20	0	2954
2017	519	125	4	4	1	72	2	8	0	1389	9	1	1124	13	0	21	0	3293
2018*	574	111	9	6	0	169	2	0	0	1008	4	1	1083	2	97	0	0	3076

* **Provisional figures.**

Table 8.3. GREENLAND HALIBUT in subareas 1 and 2. Nominal catch (t) by countries in Division 2a as officially reported to ICES.

Year	Estonia	Faroe Islands	Fed. Rep. Germ.	France	Lithuania	Greenland	Ireland	Iceland	Norway	Poland	Portugal	Russia[5]	Spain	GB	UK (Engl. & Wales)	UK (Scot-land)	Total
1984	0	0	265	138	0	0	0	0	3703	0	0	5459	0	0	1	0	9566
1985	0	0	254	239	0	0	0	0	4791	0	0	6894	0	0	2	0	12 180
1986	0	6	97	13	0	0	0	0	6389	0	0	5553	0	0	5	1	12 064
1987	0	0	75	13	0	0	0	0	5705	0	0	4739	0	0	44	10	10 586
1988	0	177	150	67	0	0	0	0	7859	0	0	4002	0	0	56	2	12 313
1989	0	67	104	31	0	0	0	0	8050	0	0	4964	0	0	6	0	13 222
1990	0	133	12	49	0	0	0	0	8233	0	0	1246	0	0	1	0	9674
1991	1400	314	21	119	0	0	0	0	11189	0	0	305	0	0	0	1	13 349
1992	0	16	1	108	0	13	0	0	3586	0	15	58	0	0	1	0	3798
1993	0	29	14	78	0	8	0	0	7977	0	17	210	0	0	2	0	8335
1994	0	0	33	47	0	3	4	0	6382	0	26	67	0	0	14	0	6576
1995	0	0	30	174	0	12	2	0	6354	0	60	227	0	0	83	2	6944
1996	0	0	34	219	0	123	0	0	9508	0	55	466	4	0	278	57	10 744
1997	0	0	23	253	0	0	0	0	5702	0	41	334	1	0	21	25	6400
1998	0	0	16	67	0	0	1	0	6661	0	80	530	5	0	74	41	7475
1999	0	0	20	0	0	25	2	0	13064	0	33	734	1	0	63	45	13 987
2000	0	0	10	43	0	0	0	0	7536	0	18	690	1	0	65	43	8406
2001	0	0	49	122	0	0	1	9	8740	0	13	726	5	0	56	30	9751
2002	0	0	9	7	0	22	0	4	5877	0	3	849	0	0	12	28	6811
2003	0	390	5	2	0	12	0	0	6713	0	10	1762	14	0	5	58	8971
2004	0	0	4	0	0	0	0	9	11704	0	24	810	4	0	1	0	12 556
2005	0	0	3	31	0	0	0	0	11216	0	11	1406	0	0	5	18	12 690
2006	0	175	0	38	0	0	0	7	8897	0	6	950	0	0	6	2	10 081
2007	0	162	2	37	0	0	0	12	6761	0	2	489	1	0	2	8	7475
2008	0	646	4	38	0	0	0	23	5566	1	1	1170	0	0	6	10	7465
2009	0	379	0	13	0	0	0	10	6456	0	9	1531	0	0	0	60	8459

Year	Estonia	Faroe Islands	Fed. Rep. Germ.	France	Lithuania	Greenland	Ireland	Iceland	Norway	Poland	Portugal	Russia[5]	Spain	GB	UK (Engl. & Wales)	UK (Scot-land)	Total
2010	0	255	0	102	0	15	0	0	6426	0	0	4757	0	0	0	22	11 577
2011	0	467	0	45	0	4	0	1	6637	0	0	3643	2	0	0	4	10 803
2012	0	553	0	37	0	12	0	6	7934	0	0	3878	0	0	0	14	12 434
2013	0	739	0	150	0	22	0	6	8215	0	2	4143	0	0	0	75	13 352
2014	0	741	0	255	0	1	0	48	8640	0	0	4800	0	0	0	184	14 669
2015	0	215	2	221	0	2	0	6	8166	0	1	3691	0	0	0	79	12 383
2016	6	380	6	216	0	14	0	41	10073	0	6	1797	7	0	0	19	12 566
2017	0	773	0	161	0	20	0	2	10122	0	7	1852	1	0	16	0	12 955
2018*	0	297	1	104	1	21	0	0	11255	2	5	1399	0	5	0	0	13 092

* **Provisional figures.**

Table 8.4. GREENLAND HALIBUT in subareas 1 and 2. Nominal catch (t) by countries in Division 2b as officially reported to ICES.

Year	Denmark	Estonia	Faroe Islands	France	Fed. rep. Germ.	Greenland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia[4]	Spain	GB	UK (Engl. & Wales)	UK (Scot land)	Total
1984	0	0	0	0	1900	0	0	0	0	80	0	0	9641	0	0	5	0	11 626
1985	0	0	0	0	3746	0	0	0	0	71	0	0	3221	0	0	2	0	7040
1986	0	0	36	0	2620	0	0	0	0	944	0	0	6032	0	0	0	0	9632
1987	0	0	0	0	1947	0	0	0	0	572	0	0	4735	0	0	7	10	7271
1988	0	0	0	0	590	0	0	0	0	239	0	0	5008	0	0	19	0	5856
1989	0	0	0	0	496	0	0	0	0	533	0	0	3366	0	0	0	0	4395
1990	0	0	23	0	942	0	0	0	0	7706	0	0	3197	0	0	9	0	11 877
1991	11	1000	0	0	80	0	0	0	0	14 369	0	0	1663	132	0	0	1	17 256
1992	0	0	0	3	12	0	0	0	0	1732	0	16	193	23	0	9	0	1988
1993	2	0	0	2	8	0	0	0	30	649	0	26	158	0	0	14	0	889
1994	4	0	1	8	46	0	1	0	4	881	0	10	41	1	0	62	2	1061
1995	0	0	0	0	5	0	0	0	0	1662	0	24	297	1022	0	32	5	3047
1996	0	0	0	0	47	0	0	0	0	1204	0	24	912	196	0	39	0	2422
1997	0	0	12	0	33	0	2	0	0	1349	12	9	534	156	0	46	0	2153
1998	0	0	10	0	18	0	1	0	0	915	31	19	1638	254	0	106	4	2996
1999	0	0	3	0	14	0	0	0	0	839	8	16	1886	318	0	31	0	3115
2000	0	0	0	2	5	0	1	0	0	526	3	19	2709	374	0	46	0	3685
2001	0	0	0	0	9	0	0	0	0	1,231	2	22	3017	413	0	42	0	4736
2002	0	219	0	0	30	0	6	0	0	432	5	11	3568	178	0	29	0	4478
2003	0	0	21	0	13	0	0	0	0	541	4	9	1887	216	0	35	0	2726
2004	0	0	0	0	5	0	0	0	0	1369	1	26	3219	182	0	39	0	4840
2005	0	170	0	0	5	0	0	0	0	1223	0	12	2882	660	0	21	0	4973
2006	0	0	12	8	7	0	0	0	196	1647	201	20	4479	27	0	2	0	6600
2007	0	0	23	3	6	0	0	0	0	955	200	45	5557	7	0	5	0	6801
2008	0	0	4	3	1	0	0	0	0	1228	200	45	3734	94	0	10	0	5319
2009	0	0	10	3	19	0	2	0	0	1256	204	228	1321	210	0	8	0	3260

2010	0	0	2	0	14	0	0	0	0	615	3	11	1423	180	0	4	0	2252
2011	0	0	8	1	80	0	0	0	234	766	169	21	2628	142	0	36	0	4085
2012	0	0	2	3	35	0	0	0	0	476	22	1	4795	189	0	14	0	5537
2013	0	0	5	10	48	0	1	0	0	1133	26	5	4725	192	0	9	0	6154
2014	0	0	3	3	25	0	0	0	0	1321	12	0	4000	196	0	14	0	5574
2015	0	0	1	3	17	0	0	0	0	1284	8	0	7581	151	0	21	0	9066
2016	2	0	19	10	1	0	0	0	0	1594	1	13	7608	183	0	0	0	9431
2017	0	4	19	12	17	3	0	0	0	2230	17	5	7737	42	0	46	0	10 132
2018*	2	0	1	30	40	9	0	4	6	2611	21	0	9590	58	6	0	0	12 376

*** Provisional figures.**

Table 8.5. GREENLAND HALIBUT in subareas 1 and 2. Landings by gear (tonnes). Approximate figures, the total maty differs slightly from Table 8.1.

Year	Gillnet	Longline	Trawl	Danish seine	Other
1980	1189	336	11 759	-	-
1981	730	459	13 829	-	-
1982	748	679	15 362	-	-
1983	1648	1388	19 111	-	-
1984	1200	1453	19 230	-	-
1985	1668	750	17 527	-	-
1986	1677	497	20 701	-	-
1987	2239	588	16 285	-	-
1988	2815	838	15 934	-	-
1989	1342	197	18 599	-	-
1990	1372	1491	20 325	-	-
1991	1904	4552	26 864	-	-
1992	1679	1787	5787	-	-
1993	1497	2493	7889	-	-
1994	1403	2392	5353	-	-
1995	1500	4034	5494	-	-
1996	1480	4616	7977	-	-
1997	998	3378	5198	-	-
1998	1327	7395	6664	-	-
1999	2565	6804	10 177	-	-
2000	1707	5029	7700	-	-
2001	2041	6303	7968	-	-
2002	1737	5309	6115	-	-
2003	2046	5483	6049	-	-
2004	2290	7135	8778	599	-
2005	1842	7539	9420	447	-
2006	1503	6146	10 042	205	-
2007	997	4503	9618	119	-

Year	Gillnet	Longline	Trawl	Danish seine	Other
2008	901	3575	9285	9	8
2009	1409	4952	6583	34	18
2010	1449	5427	8165	170	10
2011	1583	5039	9351	239	15
2012	1929	5602	12 130	413	5
2013	2398	5805	13 791	176	0
2014	2647	6166	13 673	183	0
2015	2508	6287	15 445	489	18
2016	2646	7290	14 333	650	304
2017	2677	7221	15 774	679	29
2018*	3021	6542	17 367	842	20

Table 8.6. GREENLAND HALIBUT in subareas 1 and 2. Catch per unit of effort and total effort.

Year	USSR catch/hour trawling (t)		Norway[10] catch/hour trawling (t)		Average CPUE		Total effort (in '000 hrs trawling)[5]	CPUE 7+[6]	GDR[7] (catch/day tonnage (kg)
	RT[1]	PST[2]	A[8]	B[9]	A[3]	B[4]			
1965	0.80	-	-	-	0.80	-	-	-	-
1966	0.77	-	-	-	0.77	-	-	-	-
1967	0.70	-	-	-	0.70	-	-	-	-
1968	0.65	-	-	-	0.65	-	-	-	-
1969	0.53	-	-	-	0.53	-	-	-	-
1970	0.53	-	-	-	0.53	-	169	0.50	-
1971	0.46	-	-	-	0.46	-	172	0.43	-
1972	0.37	-	-	-	0.37	-	116	0.33	-
1973	0.37	-	0.34	-	0.36	-	83	0.36	-
1974	0.40	-	0.36	-	0.38	-	100	0.36	-
1975	0.39	0.51	0.38	-	0.39	0.45	99	0.37	-
1976	0.40	0.56	0.33	-	0.37	0.45	100	0.34	-
1977	0.27	0.41	0.33	-	0.30	0.37	96	0.26	-

Year	USSR catch/hour trawling (t)		Norway[10] catch/hour trawling (t)		Average CPUE		Total effort (in '000 hrs trawling)[5]	CPUE 7+[6]	GDR[7] (catch/day tonnage (kg)
	RT[1]	PST[2]	A[8]	B[9]	A[3]	B[4]			
1978	0.21	0.32	0.21	-	0.21	0.27	123	0.17	-
1979	0.23	0.35	0.28	-	0.26	0.32	67	0.19	-
1980	0.24	0.33	0.32	-	0.28	0.33	47	0.25	-
1981	0.30	0.36	0.36	-	0.33	0.36	42	0.28	-
1982	0.26	0.45	0.41	-	0.34	0.43	39	0.37	-
1983	0.26	0.40	0.35	-	0.31	0.38	58	0.32	-
1984	0.27	0.41	0.32	-	0.30	0.37	59	0.30	-
1985	0.28	0.52	0.37	-	0.33	0.45	44	0.37	-
1986	0.23	0.42	0.37	-	0.30	0.40	57	0.32	-
1987	0.25	0.50	0.35	-	0.30	0.43	44	0.35	-
1988	0.20	0.30	0.31	-	0.26	0.31	63	0.26	4.26
1989	0.20	0.30	0.26	-	0.23	0.28	73	0.19	2.95
1990	-	0.20	0.27	-	-	0.24	95	0.16	1.66
1991	-	-	0.24	-	-	-	134	0.18	-
1992	-	-	0.46	0.72	-	-	20	0.29	-
1993	-	-	0.79	1.22	-	-	15	0.65	-
1994	-	-	0.77	1.27	-	-	11	0.70	-
1995	-	-	1.03	1.48	-	-	-	-	-
1996	-	-	1.45	1.82	-	-	-	-	-
1997	0.71	-	1.23	1.60	-	-	-	-	-
1998	0.71	-	0.98	1.35	-	-	-	-	-
1999	0.84	-	0.82	1.77	-	-	-	-	-
2000	0.94	-	1.38	1.92	-	-	-	-	-
2001	0.82 [11]	-	1.18	1.57	-	-	-	-	-
2002	0.85	-	1.07	1.82	-	-	-	-	-
2003	0.97 [12]	-	0.86	2.45	-	-	-	-	-
2004	0.63 [13]	-	1.16	1.79	-	-	-	-	-

Year	USSR catch/hour trawling (t)		Norway[10] catch/hour trawling (t)		Average CPUE		Total effort (in '000 hrs trawling)[5]	CPUE 7+[6]	GDR[7] (catch/day tonnage (kg)
	RT[1]	PST[2]	A[8]	B[9]	A[3]	B[4]			
2005	0.61 [12]	-	1.30	2.29	-	-	-	-	-
2006	0.57 [12]	-	0.96	2.09	-	-	-	-	-
2007	0.64 [12]	-	-	-	-	-	-	-	-
2008	0.48 [12]	-	-	-	-	-	-	-	-
2009	0.77 [13]	-	-	-	-	-	-	-	-
2010		1.57 [12]	-	-	-	-	-	-	-
2011		2.32 [12]							
2012		2.06 [12]							
2013		2.25 [12]							
2014		2.52 [12]							

[1] Side trawlers, 800–1000 hp. From 1983 onwards, stern trawlers (SRTM), 1000 hp. From 1997 based on research fishing.

[2] Stern trawlers, up to 2000 HP.

[3] Arithmetic average of CPUE from USSR RT (or SRTM trawlers) and Norwegian trawlers.

[4] Arithmetic average of CPUE from USSR PST and Norwegian trawlers.

[5] For the years 1981–1990, based on average CPUE type B. For 1991–1993, based on the Norwegian CPUE, type A.

[6] Total catch (t) of seven years and older fish divided by total effort.

[7] For the years 1988–1989, frost-trawlers 995 BRT (FAO Code 095). For 1990, factory trawlers FVS IV, 1943 BRT (FAO Code 090).

[8] Norwegian trawlers, ISSCFV-code 07, 250–499.9 GRT.

[9] Norwegian factory trawlers, ISSCFV-code 09, 1000-1999.9 GRT

[10] From 1992 based on research fishing. 1992–1993: two weeks in May/June and October; 1994–1995: 10 days in May/June

[11] Based on fishery from April-October only, a period with relatively low CPUE. In previous years fishery was carried out throughout the whole year.

[12] Based on fishery from October-December only, a period with relatively high CPUE.

[13] Based on fishery from October-November only.

Table 8.7. GREENLAND HALIBUT in 1 and 2 catch history back to 1935.

Year	Norway	Russia	Others	Total	Year	Norway	Russia	Others	Total
1935	1534	n/a	-	1534	1979	2843	10 311	4088	17 312
1936	830	n/a	-	830	1980	3157	7670	2457	13 284
1937	616	n/a	-	616	1981	4201	9276	1541	15 018
1938	329	n/a	-	329	1982	3206	12 394	1189	16 789
1939	459	n/a	-	459	1983	4883	15 152	2112	22 147
1940	846	n/a	-	846	1984	4376	15 181	2326	21 883
1941	1663	n/a	-	1663	1985	5464	10 237	4244	19 945
1942	955	n/a	-	955	1986	7890	12 200	2785	22 875
1943	824	n/a	-	824	1987	7261	9733	2118	19 112
1944	678	n/a	-	678	1988	9076	9430	1081	19 587
1945	1148	n/a	-	1148	1989	10 622	8812	704	20 138
1946	1337	25	-	1362	1990	17 243	4764	1176	23 183
1947	1409	28	-	1437	1991	27 587	2490	3243	33 320
1948	1877	110	-	1987	1992	7667	718	217	8602
1949	198	177	-	375	1993	10 380	1235	318	11 933
1950	1853	221	-	2074	1994	8428	283	515	9226
1951	2438	423	-	2861	1995	9368	794	1572	11 734
1952	2576	377	-	2953	1996	11 623	1576	1148	14 347
1953	2208	393	-	2601	1997	7661	1038	711	9410
1954	3674	416	-	4090	1998	8435	2659	799	11 893
1955	3010	290	-	3300	1999	15 004	3823	690	19 517
1956	3493	446	-	3939	2000	9083	4568	646	14 297
1957	4130	505	-	4635	2001	10 896	4694	775	16 365
1958	2931	1261	-	4192	2002	7143	5584	566	13 293
1959	4307	3632	-	7939	2003	8216	4384	847	13 447
1960	6662	4299	-	10 961	2004	13 939	4662	298	18 899
1961	7977	3836	-	11 813	2005	13 011	4883	940	18 834
1962	11 600	1760	-	13 360	2006	11 119	6055	730	17 904
1963	11 300	3240	-	14 540	2007	8230	6484	739	15 453

Year	Norway	Russia	Others	Total	Year	Norway	Russia	Others	Total
1964	14 200	26191	-	40 391	2008	7393	5294	1105	13 792
1965	18 000	16682	-	34 751	2009	8446	3335	1210	12 990
1966	16 434	9768	119	26321	2010	7700	6888	641	15 229
1967	17 528	5737	1002	24 267	2011	8270	7053	1283	16 606
1968	22 514	3397	257	26 168	2012	9331	10 041	916	20 288
1969	14 856	19 760	9173	43 789	2013	10 403	10 310	1454	22 167
1970	15 871	35 578	38 035	89 484	2014	11 232	10 061	1732	23 025
1971	9466	54 339	15 229	79 034	2015	10 874	12 953	921	24 748
1972	15 983	16 193	10 872	43 055	2016	12 932	10 576	1440	24 948
1973	13 989	8561	7349	29 938	2017	13 741	10 714	1925	26 380
1974	8791	16 958	11 972	37 763	2018*	14 874	12 072	1598	28 544
1975	4858	20 372	12 914	38 172					
1976	6005	16 580	13 469	36 074					
1977	4217	15 045	9613	28 827					
1978	4082	14 651	5884	24 617					

* **Provisional figures.**

Table 8.8. GREENLAND HALIBUT in ICES Division 4.a (North Sea). Nominal catch (t) by countries as officially reported to ICES. Not included in the assessment.

Year	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Norway	Russia	GB	UK England & Wales	UK Scotland	Total
1973	0	0	0	4	0	0	9	8	0	28	0	49
1974	0	0	0	2	0	0	2	0	0	30	0	34
1975	0	0	0	1	0	0	4	0	0	12	0	17
1976	0	0	0	1	0	0	2	0	0	18	0	21
1977	0	0	0	2	0	0	2	0	0	8	0	12
1978	0	0	2	30	0	0	0	0	0	1	0	33
1979	0	0	2	16	0	0	2	0	0	1	0	21
1980	0	177	0	34	0	0	5	0	0	0	0	216
1981	0	0	0	0	0	0	7	0	0	0	0	7
1982	0	0	2	26	0	0	17	0	0	0	0	45
1983	0	0	1	64	0	0	89	0	0	0	0	154
1984	0	0	3	50	0	0	32	0	0	0	0	85
1985	0	1	2	49	0	0	12	0	0	0	0	64
1986	0	0	30	2	0	0	34	0	0	0	0	66
1987	0	28	16	1	0	0	35	0	0	0	0	80
1988	0	71	62	3	0	0	19	0	0	1	0	156
1989	0	21	14	1	0	0	197	0	0	5	0	238
1990	0	10	30	3	0	0	29	0	0	4	0	76
1991	0	48	291	1	0	0	216	0	0	2	0	558
1992	1	15	416	3	0	0	626	0	0	+	1	1062
1993	1	0	78	1	0	0	858	0	0	10	+	948
1994	+	103	84	4	0	0	724	0	0	6	0	921
1995	+	706	165	2	0	0	460	0	0	52	283	1668
1996	+	0	249	1	0	0	1 496	0	0	105	159	514
1997	+	0	316	3	0	0	873	0	0	1	162	1355
1998	+	0	71	10	0	10	804	0	0	35	435	1365
1999	+	0		1	0	18	2 157	0	0	43	358	420

Year	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Norway	Russia	GB	UK England & Wales	UK Scotland	Total
2000	+		41	10	0	19	498	0	0	67	192	827
2001	+		43	0	0	10	470	0	0	122	202	847
2002	+		8	+	0	2	200	0	0	10	246	466
2003	0	0	1	+	+	+	453	0	0	+	122	576
2004	0	0	0	0	0	0	413	0	0	90	0	503
2005	0	0	2	0	0	0	58	0	0	4	0	64
2006	0	0	3	0	0	0	90	0	0	0	7	100
2007	0	1	0	0	0	0	133	0	0	1	6	141
2008	0	0	0	0	0	0	14	0	0	0	22	36
2009	0	9	22	0	0	0	5	0	0	0	129	165
2010	+	1	38	0	0	0	10	0	0	0	49	98
2011	0	1	39	0	0	0	94	0	0	0	44	178
2012	0	0	14	0	0	0	788	0	0	0	43	845
2013	0	0	25	0	0	0	122	0	0	0	174	321
2014	0	2	27	0	0	0	723	0	0		104	856
2015	0	0	34	1	0	0	1151	0	0	0	127	1313
2016	0	0	31	0	0	0	983	0	0	0	120	1134
2017	0	0	20	0	0	0	753	0	0	0	73	846
2018	0	0	15	0	0	0	472	0	42	0	0	532

Table 8.9. Abundance indices of different length groups in 1984–2017 (in thousands), Russian autumn survey.

Year/Length (cm)	≤30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	>80	Total
1984	4837	5078	11 690	21 171	15 167	10 886	7370	6549	3751	1786	1128	483	89 896
1985	4003	6748	16 858	24 897	23 244	15 702	8376	5704	3776	2054	1028	698	113 088
1986	3482	6062	13 765	18 945	15 997	10 369	4839	3022	2534	1325	440	205	80 985
1987	2010	4828	7228	10 490	8831	5513	2123	1784	1437	645	481	421	45 791
1988	3374	5111	9022	10 147	10 128	5828	2265	1862	1218	511	361	341	50 168
1989	2030	7055	13 962	17 252	16 790	10 028	3789	1916	1279	415	200	388	75 104
1990	2762	6056	12 802	13 061	9527	9829	4967	2094	589	312	115	119	62 233
1991	1036	5012	16 237	20 998	17 418	11 728	8012	4562	814	181	122	174	86 294
1992	184	2153	17 185	32 399	22 481	12 977	6229	3473	1869	502	182	106	99 740
1993	-	290	3593	14 782	21 080	16 013	6743	3341	2031	859	269	164	69 165
1994	49	17	1651	12 582	16 203	12 566	5391	3320	2019	819	188	106	54 911
1995	-	38	1245	13 193	20 571	12 445	5432	2717	1587	579	187	82	58 076
1996*	-	11	786	13 012	30 573	18 294	5730	1795	773	534	169	12	71 689
1997	140	152	1318	7744	18 504	17 221	6932	3079	1952	465	195	142	57 844
1998	2449	2238	2949	10 847	24 266	19 640	11 112	5946	2158	440	172	90	82 307
1999	1070	2815	4632	7886	17 734	18 489	10 158	4827	2043	529	196	74	70 453

Year/Length (cm)	≤30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	>80	Total
2000	1274	1698	5184	14 996	24 170	20 721	12 805	5675	3100	1228	240	143	91 234
2001	1399	2887	7496	18 136	34 752	29 886	13 463	6759	3772	1511	593	369	121 024
2002**	662	2033	6395	13 329	19 810	13 135	7180	3406	1311	381	129	58	67 828
2003***	955	2396	7420	13 006	17 160	11 630	7978	5332	3541	985	485	238	71 126
2004	1431	2705	11 945	16 937	20 155	18 274	12 594	6948	4783	2087	813	536	99 209
2005	830	3970	10 726	17 850	17 547	15 164	9726	5859	3343	1150	453	545	87 163
2006****	293	1981	18 471	35 224	36 563	26 335	14 138	7248	4943	1669	668	488	148 021
2007	376	1431	6937	24 330	26 780	26 086	22 157	15 586	7480	3786	932	628	136 510
2008	463	4626	19 991	28 799	30 062	32 159	23 175	11 326	8368	4198	1872	1089	166 129
2009	152	4919	29 389	48 321	45 833	33 915	24 484	10 227	6568	3032	881	616	208 338
2010	146	5097	37 901	66 086	57 863	46 321	25 428	10 058	8612	3983	1587	1610	264 692
2011	456	1285	22 470	61 115	78 247	64 186	49 620	19 412	11 607	7226	3529	874	320 025
2012	213	798	12 051	49 062	56 704	52 393	36 362	13 622	7533	4213	1944	1611	236 506
2013*****													
2014	17	1697	10 296	34 074	45 287	35 861	22 621	8613	5505	2227	929	427	167 553
2015	318	2099	13 542	35 864	43 551	36 082	21 114	10 924	4472	1342	850	339	170 497

Year/Length (cm)	≤30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	>80	Total
2016*****													
2017	158	2198	10 687	32 464	61 577	71 590	40 700	16 830	7449	3483	1206	1245	249 585

*** Only half of the standard area was investigated**

**** No observations in NEEZ**

***** Observations in the NEEZ on the main spawning grounds were conducted considerably later than usual**

****** Survey was conducted by one vessel with a reduced number of trawls at depths less than 500 m**

*******No indices for 2013 and 2016**

Table 8.10. Abundance indices of different length groups in 1994–2017 (in thousands), Norwegian autumn survey.

Year	<30	30.5	31.5	33	33.5	34.5	35.5	36.5	37.5	38.5	39.5	40.5	41.5	42.5	43.5	44.5	45.5	46.5	47.5	48.5	49.5	51
1994	0	0	0	0	1	15	23	80	197	335	645	1225	1611	2432	3431	3511	3830	3519	3940	3724	2896	3020
1995	0	0	1	3	6	15	29	86	141	242	472	931	1210	2294	3092	3840	4475	4540	4633	4321	3836	3856
1996	0	2	1	6	6	2	18	49	54	166	321	772	957	1787	2912	3769	4728	5199	5944	5644	5224	5132
1997	7	5	11	4	33	27	49	186	250	297	443	862	1009	1814	2888	3578	5451	5402	6132	5206	4125	5455
1998	7	2	6	15	17	22	51	103	174	219	372	504	727	1061	1491	2103	2941	3092	3609	3735	3851	4850
1999	10	4	18	15	20	40	61	75	110	174	202	377	476	862	1175	1655	2397	2543	3485	4214	3694	5274
2000	2	7	11	30	34	46	128	122	163	264	383	677	739	932	1183	1439	2038	2030	2268	2644	2846	3888
2001	21	20	35	37	77	147	274	270	440	462	724	986	1176	1373	1630	1720	2724	2655	3349	3128	3973	3999
2002	97	75	107	122	180	267	399	404	723	669	869	1026	1097	1360	1883	1870	2560	2185	3322	3450	3597	4032
2003	38	27	65	97	172	270	383	692	783	894	1214	1100	1481	1561	2082	1792	2468	2104	3193	3360	3506	3117
2004	27	15	47	125	191	402	636	639	951	1042	1092	1206	1337	1319	1398	1546	2013	1967	2638	2646	3337	3373
2005	66	104	285	317	517	765	861	1220	1492	1540	2053	2295	2293	2588	2262	2677	3041	2446	2854	2095	3056	2336
2006	12	50	80	158	258	456	849	1022	1429	1579	1603	1900	1823	1824	2015	1974	2529	2359	2350	2137	2338	2175
2007	157	96	161	359	766	1423	2508	3142	4411	5679	5346	5639	5502	5038	4600	3632	3667	3628	3278	2571	2882	2597
2008	378	384	723	1323	1763	1793	2441	2911	3249	3685	4229	4300	4257	3568	3911	3534	3020	3066	2769	2582	2639	2284
2009	31	36	93	349	505	934	1663	2660	3050	3680	4138	4885	5567	4148	5327	4639	3688	3752	3682	3410	3553	3215
2011	0	0	20	36	57	124	288	563	646	1414	1454	2228	2680	3174	3649	3750	3532	3031	3299	3991	3251	2454

2013	17	5	3	1	13	64	103	122	324	582	1022	1266	2138	2207	3553	3748	3476	4124	3717	3045	3718	3052
2015	3	24	24	36	131	318	439	721	757	1043	1253	1473	2602	2444	3776	4459	4602	4598	4371	3962	4156	3694
2017	6	20	45	54	63	144	184	328	593	365	928	955	1267	1457	1764	1983	2367	2465	2651	2569	2816	3011

Year	**51.5**	**52.5**	**53.5**	**54.5**	**55.5**	**56.5**	**57.5**	**58.5**	**59.5**	**60.5**	**61.5**	**62.5**	**63.5**	**64.5**	**65.5**	**66.5**	**67.5**	**68.5**
1994	2545	2729	2398	2092	1975	1547	1488	1103	920	788	565	702	576	523	577	370	367	386
1995	3165	3152	2963	2647	2272	1756	1586	1153	970	880	764	690	680	592	525	461	387	334
1996	4106	3638	3571	2752	2177	1568	1443	1017	867	782	512	449	538	404	391	356	281	248
1997	3644	3427	3018	2302	2111	1502	1131	1042	617	849	585	576	537	403	446	481	294	230
1998	4211	3824	3166	2988	2857	1974	1714	1515	981	1172	783	613	598	668	641	569	479	364
1999	4092	5196	4136	3909	4122	2631	2299	1787	1374	1388	895	1037	865	886	923	791	807	594
2000	3692	3681	3512	3016	3197	2388	2007	1545	1227	1327	915	1028	734	630	732	517	509	505
2001	3649	4512	4106	3005	3358	2552	2589	2147	1293	1350	1099	939	1187	684	787	612	751	603
2002	4241	3516	3966	3602	3855	2837	2511	2248	1672	1787	1239	1237	1139	808	882	604	679	474
2003	4400	3465	3808	3512	3907	3368	3035	2319	1896	1705	1612	1384	1542	1130	1350	972	994	675
2004	3535	4405	3614	3801	3249	2751	2252	1911	1493	1455	1372	1360	1284	1162	962	763	891	590
2005	2400	2734	2413	2084	2295	1882	1681	1492	1458	1168	1241	1057	1065	984	903	782	865	479
2006	2493	2125	2290	2025	2189	1790	1668	1542	1337	1159	1188	1009	925	1036	807	798	647	678
2007	2109	2249	2123	2142	1758	1609	1581	1070	1008	1044	625	938	672	558	537	526	394	469

2008	2288	2248	2229	1815	1751	1514	1150	1019	861	668	652	657	508	582	629	523	484	361
2009	2668	2944	2850	2441	2372	2233	1837	1698	1503	1135	845	962	647	858	715	607	653	609
2011	2905	2746	2602	2713	2387	1709	1704	1529	978	1179	577	649	554	440	466	315	440	550
2013	2498	2035	1905	1631	1710	1573	1424	1009	790	671	503	506	400	456	234	266	227	176
2015	3469	2384	2546	2084	2142	1734	1336	1108	1020	899	713	621	605	495	274	289	341	291
2017	2890	2547	2501	2091	1792	1786	1532	1274	1269	1029	765	579	481	446	294	299	247	245

Year	69.5	70.5	71.5	72.5	73.5	74.5	75.5	76.5	77.5	78.5	79.5	>80	SUM
1994	256	253	151	136	122	74	113	47	39	40	30	97	59 436
1995	339	244	181	179	97	100	137	56	53	53	34	101	66 568
1996	232	168	118	123	93	97	61	28	40	39	21	74	70 886
1997	171	207	216	119	109	111	104	61	32	35	40	185	69 818
1998	308	320	235	222	229	144	102	64	65	61	43	192	62 052
1999	478	406	385	319	182	205	223	125	109	145	51	328	69 570
2000	341	376	232	210	168	153	141	77	96	77	47	233	57 187
2001	490	375	279	170	207	178	157	85	133	69	49	306	68 944
2002	469	383	297	251	183	163	134	104	130	48	65	251	72 073
2003	563	632	464	249	244	170	242	201	128	125	114	356	76 964
2004	654	420	373	325	521	248	181	135	121	100	109	431	70 415

2005	523	508	400	262	196	159	156	162	109	82	61	426	69 195
2006	474	508	397	285	185	276	185	140	136	81	96	497	61 893
2007	289	254	261	101	140	130	75	52	80	59	47	278	92 269
2008	313	258	226	201	138	107	59	62	89	66	76	508	82 860
2009	574	541	271	386	219	171	191	112	121	89	100	407	95 773
2011	415	409	200	285	235	193	225	204	175	51	87	503	69 075
2013	162	173	124	114	109	112	66	72	79	34	43	260	57 674
2015	252	265	176	195	186	205	89	78	73	141	53	286	71 252
2017	178	185	88	98	77	51	61	50	35	40	46	184	49193

***Biennial surveys since 2009**

Table 8.11. Abundance indices of females of different length in 1996–2017 (in thousands), Norwegian autumn survey.

Year	<30	30.5	31.5	33	33.5	34.5	35.5	36.5	37.5	38.5	39.5	40.5	41.5	42.5	43.5	44.5	45.5	46.5	47.5	48.5	49.5	51
1994	0	0	0	0	1	15	23	80	196	335	643	1223	1611	2429	3426	3503	3824	3510	3934	3716	2886	3018
1995	0	0	1	3	6	15	29	86	141	242	472	930	1210	2291	3088	3837	4470	4537	4629	4317	3835	3855
1996	0	0	0	4	0	1	10	26	28	64	123	228	233	424	415	773	937	1020	1185	1151	1037	1374
1997	6	5	7	4	17	14	36	134	139	146	187	337	331	419	569	685	899	852	1169	1058	828	1226
1998	5	0	0	11	4	7	26	41	78	77	156	170	190	274	290	364	413	526	605	665	743	970
1999	2	0	1	0	7	14	19	12	41	68	93	137	117	227	285	300	336	313	496	574	533	1049
2000	1	5	6	14	16	16	44	44	65	121	155	201	229	245	268	278	374	311	303	411	410	517
2001	13	6	14	15	38	61	118	123	177	167	293	411	462	355	425	376	544	477	493	379	558	673
2002	51	48	58	60	77	109	178	182	290	275	326	319	306	407	500	378	515	331	483	461	501	575
2003	25	25	27	43	100	124	182	276	413	429	532	504	512	545	610	450	552	394	539	487	523	406
2004	15	3	13	61	83	160	305	278	436	358	434	404	440	384	381	454	413	362	382	309	427	472
2005	30	24	110	99	182	258	322	464	565	537	723	758	619	630	452	633	723	467	593	293	500	329
2006	4	19	48	81	148	187	327	442	595	674	713	686	648	568	649	482	619	501	503	512	468	452
2007	85	67	104	178	371	731	1321	1539	2259	2654	2515	2403	2454	2145	1580	1242	1132	988	851	727	640	554
2008	216	210	432	698	829	958	1190	1372	1529	1597	1720	1516	1625	1069	1180	928	889	948	834	677	773	615
2009	13	19	33	146	210	343	662	1001	1263	1470	1491	1814	1979	1441	1752	1533	1044	1195	1037	988	922	878
2011	0	0	8	22	24	31	103	175	195	469	311	538	642	722	623	645	686	664	528	665	751	298

Year	<30	30.5	31.5	33	33.5	34.5	35.5	36.5	37.5	38.5	39.5	40.5	41.5	42.5	43.5	44.5	45.5	46.5	47.5	48.5	49.5	51
2013	0	0	0	0	3	11	49	30	50	186	261	246	521	286	650	509	621	693	626	664	745	576
2015	0	7	7	19	67	149	183	304	380	358	391	377	491	387	549	490	682	904	632	689	761	766
2017	4	17	16	43	44	79	83	120	267	117	395	312	365	373	288	411	524	444	6277	453	439	579

***Biennial surveys since 2009**

Year	52	53	54	55	56	57	58	59	60	61	61.5	63	64	64.5	65.5	67	68	68.5	69.5	71	72	73	74
1994	####	####	2384	2088	1969	1545	1482	1098	917	785	560	700	571	522	573	368	364	385	254	253	151	136	122
1995	####	####	2958	2646	2271	1752	1586	1152	968	875	761	689	680	592	525	461	387	333	339	244	181	179	97
1996	####	886	895	771	527	547	639	548	508	602	410	401	481	383	387	344	281	230	232	167	118	123	93
1997	911	985	824	650	669	590	523	562	346	633	484	501	506	364	433	437	289	225	171	207	216	119	109
1998	995	####	999	1056	903	758	754	831	667	907	615	543	569	639	638	567	453	362	308	307	235	222	225
1999	830	####	928	1042	1287	1019	1002	955	845	1106	754	927	816	814	890	780	798	582	478	403	384	317	182
2000	590	591	593	663	756	816	704	649	670	839	699	829	620	588	665	487	491	495	328	376	230	210	167
2001	479	632	761	643	680	698	962	877	743	936	928	714	1062	594	772	577	746	598	488	370	279	170	207
2002	610	438	638	694	823	672	824	779	780	989	780	1024	813	705	827	598	656	443	458	383	295	251	183
2003	604	582	662	611	968	854	1111	964	1057	1126	1260	1165	1314	1085	1278	938	962	670	555	625	462	249	242
2004	461	638	570	693	760	937	876	839	966	998	1202	1186	1227	1116	932	749	885	585	639	420	373	325	461
2005	378	411	427	451	597	638	775	718	800	871	935	938	965	904	860	740	860	449	523	465	390	262	192
2006	490	458	461	392	537	523	545	678	805	796	893	865	820	927	775	768	637	633	468	499	376	285	178

Year	52	53	54	55	56	57	58	59	60	61	61.5	63	64	64.5	65.5	67	68	68.5	69.5	71	72	73	74
2007	476	499	471	491	469	533	607	549	566	776	494	790	587	534	517	515	394	469	278	254	261	101	133
2008	509	481	515	495	443	547	441	543	466	490	530	572	482	539	610	514	483	361	309	252	226	201	138
2009	640	665	738	639	733	724	698	783	814	605	653	765	534	776	701	525	616	587	561	526	263	378	219
2011	557	468	480	472	466	369	329	469	324	378	341	523	477	348	450	300	415	550	393	409	192	285	235
2013	518	381	477	308	375	529	526	304	296	334	324	377	329	390	218	260	227	174	159	173	120	114	109
2015	826	770	744	579	811	649	471	494	553	537	470	462	420	450	270	283	339	283	251	265	176	195	186
2017	530	438	516	448	392	555	578	498	563	530	473	330	378	371	271	286	243	245	178	185	88	98	77

***Biennial surveys since 2009**

Year	74.5	75.5	76.5	77.5	78.5	79.5	>80	SUM
1994	74	113	47	39	40	30	95	59 284
1995	100	137	56	53	53	34	99	66 505
1996	92	61	28	40	39	21	74	21 998
1997	111	104	61	29	35	40	185	22 385
1998	144	102	64	65	61	43	192	22 881
1999	205	223	125	109	140	47	328	26 047
2000	153	141	77	96	77	47	233	19 913
2001	178	157	85	131	69	49	306	24 071
2002	163	131	104	130	48	65	251	23 984
2003	170	242	201	128	125	114	356	30 383
2004	241	181	135	119	100	109	431	27 731
2005	149	156	152	109	82	61	426	27 000
2006	259	185	138	136	81	96	491	26 528
2007	124	75	52	80	59	47	275	40 026
2008	107	59	62	89	66	76	506	34 926
2009	171	191	104	121	80	100	385	38 542
2011	193	225	204	175	51	87	503	20 780
2013	112	66	72	79	34	43	260	16 424

Year	74.5	75.5	76.5	77.5	78.5	79.5	>80	SUM
2015	205	89	78	73	141	53	286	22 019
2017	51	61	50	35	40	46	184	14738

***Biennial surveys since 2009**

Table 8.12. Abundance indices (numbers in thousands) from bottom-trawl surveys in the Barents Sea standard area winter 1994-2019 (Mehl *et al.*, WD4 AFWG 2019).

	Length group (cm)																
Year	≤14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	≥80	Total	Biomass (tonnes)
1994	0	0	21	76	148	1117	3139	4740	3615	1941	889	541	21	0	0	16 248	19 228
1995	298	0	0	0	90	129	2877	7182	5739	2027	1622	839	489	86	0	21 378	27 459
1996	4121	0	0	0	62	124	1214	4086	4634	1871	1112	638	337	74	12	18 285	20 256
1997[1]	0	68	0	0	55	163	949	4313	5629	2912	1609	643	300	65	21	16 728	24 214
1998[1]	68	220	945	578	481	487	1088	4016	6591	3076	1798	707	326	93	44	20 518	27 248
1999	43	84	241	436	566	269	784	1701	3097	1669	1094	491	89	75	0	10 640	14 681
2000	140	184	344	836	1722	3857	2253	1560	2144	1714	1191	615	249	76	0	16 883	17 246
2001	68	49	147	179	737	1525	3716	3271	2302	2010	1088	529	160	50	39	15 871	18 224
2002	271	0	70	34	382	1015	1916	3803	3250	2279	1138	976	242	159	114	15 648	21 198
2003	51	0	74	19	304	715	1842	3008	4765	2235	714	561	245	146	0	14 678	19 635
2004	106	104	15	0	319	1253	1229	1717	2277	1227	798	298	148	94	26	9615	11 872
2005	263	70	159	1139	2235	2621	4206	3782	3847	2037	917	585	336	118	0	22 314	22 293
2006[2]	0	72	94	414	1968	5149	4613	5743	4283	2132	891	449	258	34	18	26 118	25 579
2007[1]	0	18	146	1869	1418	3114	5710	5947	4287	2205	963	658	391	80	89	26 896	28 006
2008	0	0	0	243	1708	5974	4654	6136	5198	3403	827	638	174	82	50	29 088	30 153
2009	55	0	0	26	1044	4327	8133	4551	4084	2266	996	627	442	253	154	26 960	28 919

Year	Length group (cm)																Biomass (tonnes)
	≤14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	≥80	Total	
2010	0	0	0	99	678	3648	5729	6560	4897	2467	1064	552	229	128	41	26 092	25 979
2011	51	0	0	0	216	4396	5864	5498	5237	3698	699	936	327	252	97	27 271	31 552
2012[3]	77	0	0	0	51	1145	4524	5366	4517	2774	1147	195	73	0	48	19 917	22 656
2013	0	0	0	0	0	511	5368	4868	5374	3687	1944	939	348	131	154	23 504	31 748
2014	0	0	46	92	156	368	2271	5587	5903	3555	2251	1369	154	260	79	22 090	31 112
2015	367	0	61	0	284	1612	3187	6452	7249	6752	3350	1936	587	334	0	32 172	46 828
2016	205	0	124	511	950	1953	3486	4539	5479	5613	1999	1973	646	98	80	27 657	35 831
2017[4]	52	0	0	78	592	1328	1885	3850	4852	4550	1721	1455	317	190	23	20 827	29 756
2018	0	0	62	0	383	1333	2049	3445	4258	3573	1904	1366	736	196	20	19 325	28 688
2019	0	0	0	375	272	1671	3285	4034	5177	4265	3570	2526	1328	535	137	27 176	45 912

[1] **Indices raised to also represent the Russian EEZ**

[2] **Not complete coverage in southeast due to restrictions, strata 7 area set to default and strata 13 as in 2005**

[3] **Indices not raised to also represent uncovered parts of the Russian EEZ.**

[4] **Indices raised to also represent uncovered parts of the Russian EEZ**

Table 8.13. GREENLAND HALIBUT catch in weight, numbers, and biomass (in tonnes) and abundance (in thousands) estimated from Spanish autumn and spring surveys 1997–2013. NB. Absolute biomass and abundance values must not be compared between spring and autumn surveys due to different gears. The trawl used during the spring surveys is considered less efficient on benthic species as Greenland halibut and skates, and better to catch species less associated with bottom. No update presented at AFWG 2019.

Autumn survey

Year	Catch (Kg)	Catch (numbers)	Biomass™	Abundance ('000)
1997	195 056	211 533	344 014	379 444
1998	180 974	187 259	351 466	373 149
1999	198 781	172 687	436 956	377 792
2000	169 389	140 355	340 619	291 265
2001	152 681	129 289	283 511	249 219
2002	144 335	115 213	256 460	207 466
2003	151 952	132 117	283 644	256 327
2004	153 859	135 631	320 485	283 965
2005	144 573	134 566	317 320	313 459
2006*				
2007*				
2008	91 573	101 578	129 221**	144 561**
2009*				
2010	167 862	182 464	191 510**	216 731**
2011*				
2012	178 607	174 670	336 543**	339 697**
2013	172 762	168 619	264 101**	267 548**
2014	175 553	160 557	321 485**	307 679**
2016	176 015	142 413	247 644**	214 778**

*No survey in 2006, 2007, 2009, 2011, and 2015

**New swept-area estimation method

Spring survey

Year	Catch (Kg)	Catch (numbers)	Biomass™	Abundance ('000)
2008	96 797	109 515	38 406	38 951
2009	200 299	222 018	58 273	65 464
2010*				
2011	136 610	160 566	98 142	117 666
2012*				
2013*				
2014*				
2015**	111 425	105 385	150 385	155 333

*No survey

**Different from the one used during the 2014 Spanish "autumn" survey

Table 8.14. Greenland halibut in subareas 1 and 2. The catch scenarios. Weights in tonnes.

Basis	Catches (2020)	Harvest rate (2020–2024)	Mean catch (2020–2024)	Biomass 45cm+ 1 January 2025	% 45cm+ Biomass change 2020–2024
ICES ADVICE BASIS					
FI_{2018} ^	25 310	0.037	23 930	573 000	-22%
Other options					
F=0	0	0	0	672 000	-9%
$FI_{2018} \times 0.5$	12 770	0.019	12 500	620 000	-16%
$FI_{2018} \times 0.75$	19 070	0.028	18 340	596 000	-19%
$FI_{2018} \times 1.5$	37 630	0.053	37 630	532 000	-28%
$FI_{2018} \times 2$	49 730	0.070	44 000	495 000	-33%
$FI_{2018} \times 3$	73 290	0.099	60 870	432 000	-42%

Table 8.15. Dynamics of indices of the Barents Sea Greenland halibut stock in 1964–2015 (indices are taken divided by corresponding mean to put them in comparable scale; CPUE series divided by two: 1964–1991 and after 1996). In addition to the standardized CPUE three survey indices are shown; the Russian autumn survey (RUS), the Norwegian autumn survey (NOR) and the EcoSouth index (ECO).

Year	CPUE	NOR	RUS	ECO
1964	2.0052083			
1965	1.421875			
1966	1.2760417			
1967	1.4583333			
1968	1.6041667			
1969	1.6770833			
1970	1.3125			
1971	0.9114583			
1972	0.765625			
1973	0.9114583			
1974	0.984375			
1975	0.8020833			
1976	0.6197917			
1977	0.4739583			
1978	0.546875			
1979	0.65625			
1980	0.65625			
1981	1.0572917			
1982	1.09375			
1983	0.9479167			
1984	0.984375		0.8035484	
1985	1.203125		0.9074373	
1986	1.0208333		0.5915304	
1987	0.9114583		0.344176	
1988	0.8385417		0.3462961	
1989	0.765625		0.5378191	
1990	0.5833333		0.4261563	

Year	CPUE	NOR	RUS	ECO
1991	0.5104167		0.6918856	
1992			0.7081403	
1993			0.6077851	
1994		0.790111	0.489055	
1995		0.9115792	0.5060164	
1996	0.7611138	0.9286075	0.6134389	
1997	0.8910601	0.9342836	0.5342855	
1998	0.9189057	0.9388244	0.7236883	
1999	1.0766976	1.1828961	0.6466551	
2000	1.0395701	0.9149849	0.8615	
2001	1.345872	1.0761857	1.1420706	
2002	0.9189057	1.1079717	0.595064	
2003	0.9653151	1.2430626	0.6770443	
2004	0.5661944	1.1760848	0.9371198	0.2915311
2005	0.6126038	0.9876387	0.7858802	0.5696662
2006	0.5476307	0.9286075	1.3060312	0.7983047
2007	0.5476307	1.0023966	1.5074483	0.9095588
2008	0.5476307	0.9637992	1.691904	1.0099145
2009	1.0117245	1.2362513	1.8120476	1.2723833
2010	1.197362		2.2749537	1.3277832
2011	1.8842208	0.9649344	3.0622474	1.0623628
2012	1.3737176		2.250925	1.6202225
2013	1.2437714	0.711781	1.1387631	1.2692046
2014	1.5500733		1.4790874	1.0142284
2015		0.8854692	1.4576736	0.8548399

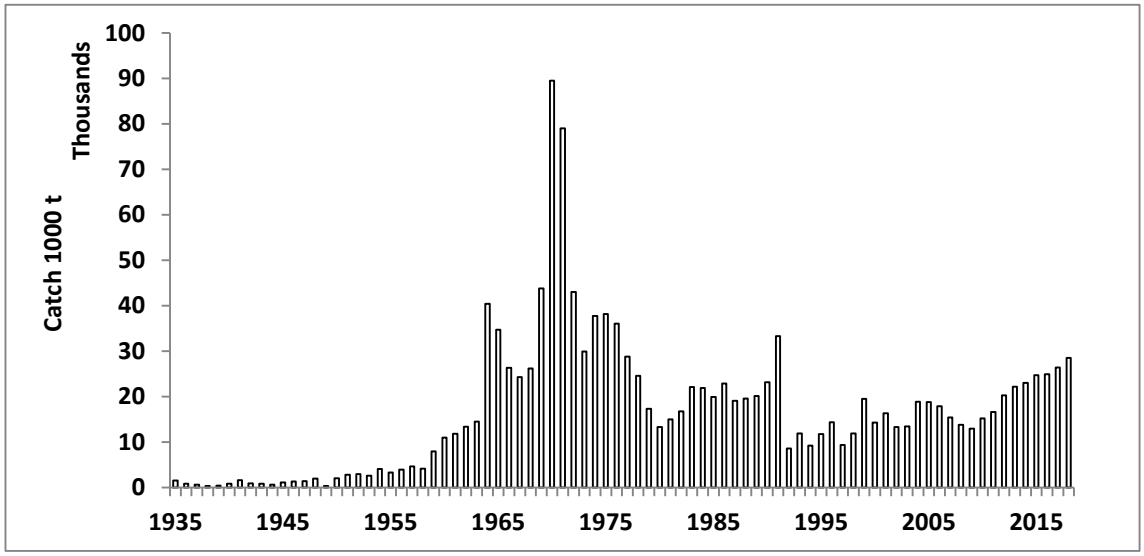


Figure 8.1. NEA Greenland halibut. Historical landings (Nedreaas and Smirnov 2003 and AFWG).

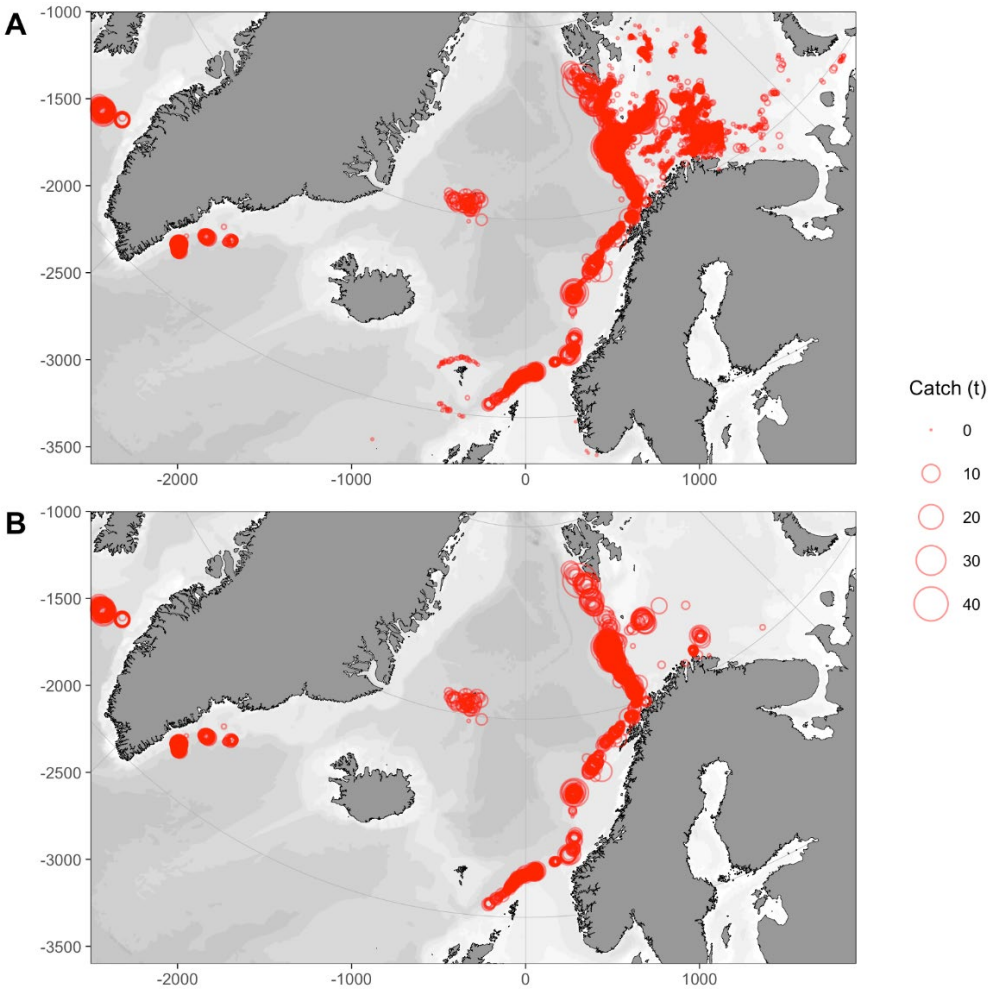


Figure 8.2. Spatial distribution of Greenland halibut catches in 2018 according to Norwegian electronic logbooks. Bubble area is proportional to the size of single catches expressed in metric tonnes. Upper panel (A) shows Greenland halibut catches in all registered fisheries (including bycatch), and lower panel (B) shows catches where Greenland halibut is the target species, i.e. species with the highest mass within a catch.

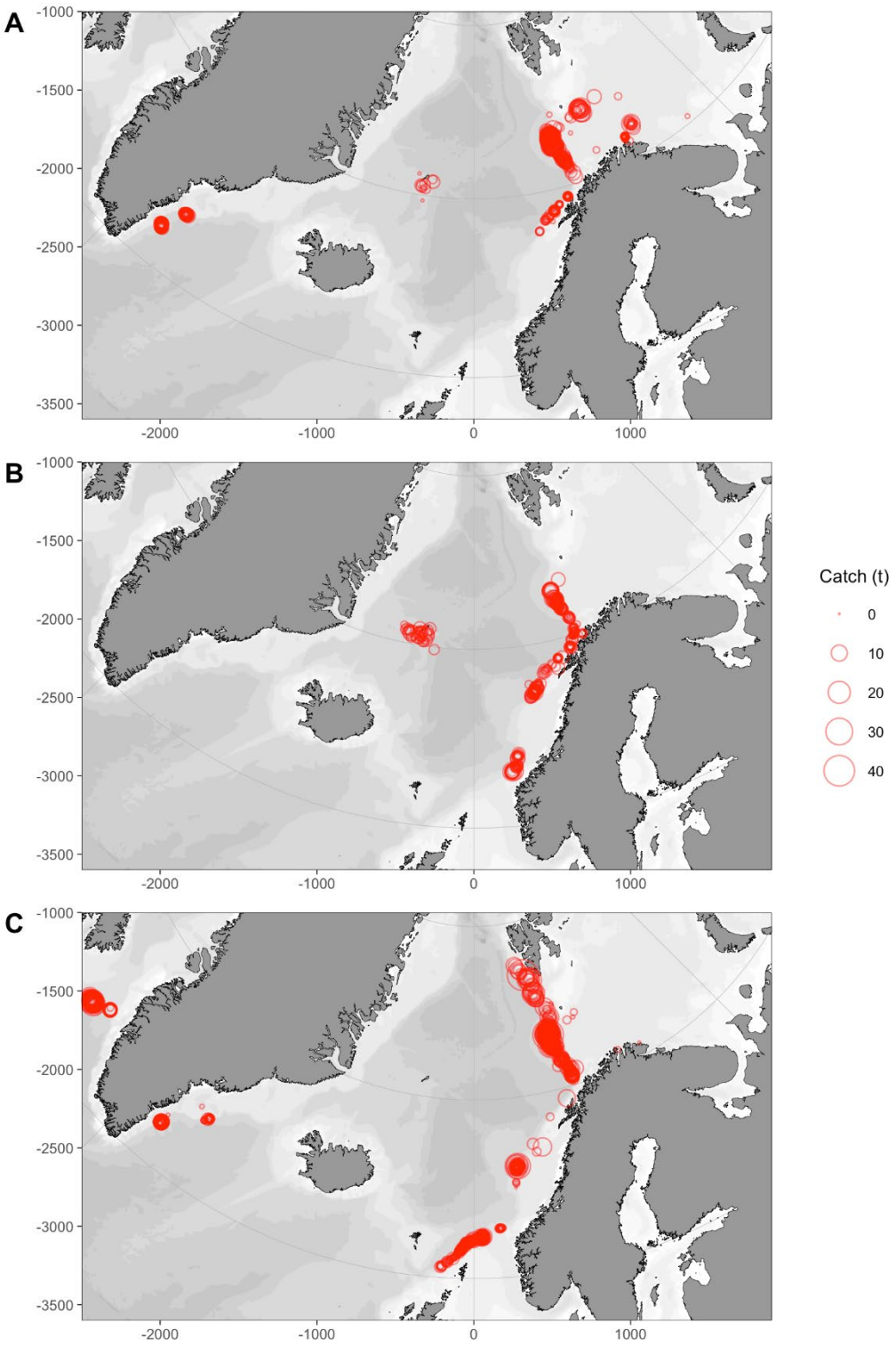


Figure 8.3. Spatial distribution of Greenland halibut as the target species in catches according to Norwegian electronic logbooks from 2018. Bubble area is proportional to the size of single catches expressed in metric tonnes. Uppermost (A), middle (B) and lowest (C) panel show longline, gillnet and trawl catches, respectively.

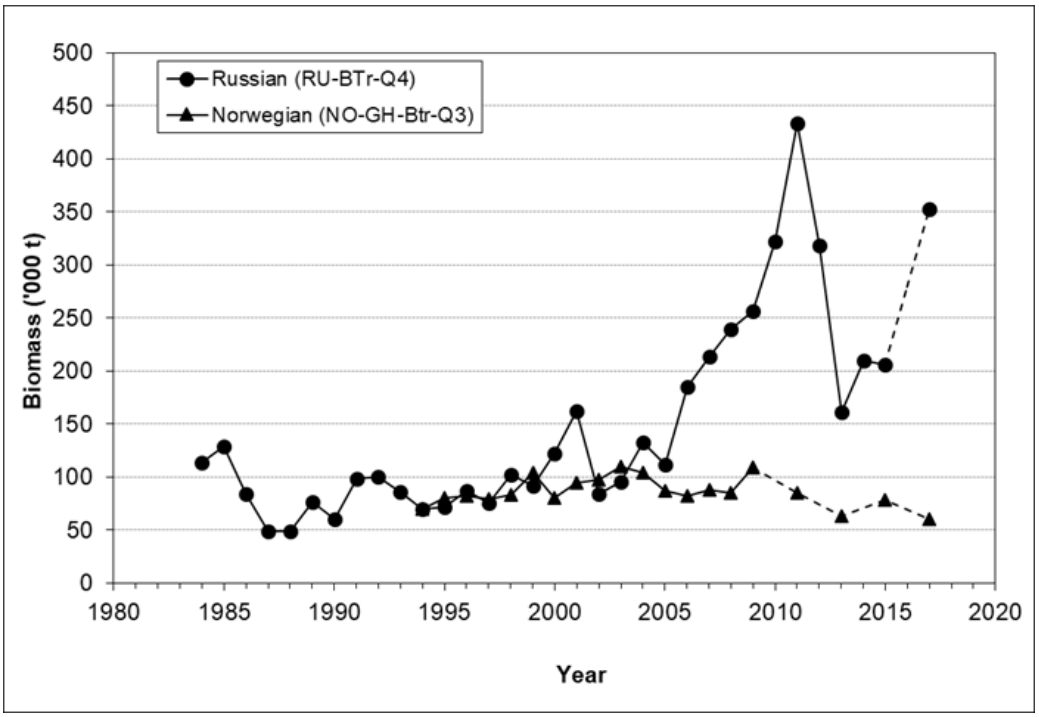


Figure 8.4. NEA Greenland halibut. Total biomass estimates from Russian autumn and the Norwegian slope survey. The Norwegian survey is run every other year since 2009. Uncertain estimate for 2013 from the Russian survey.

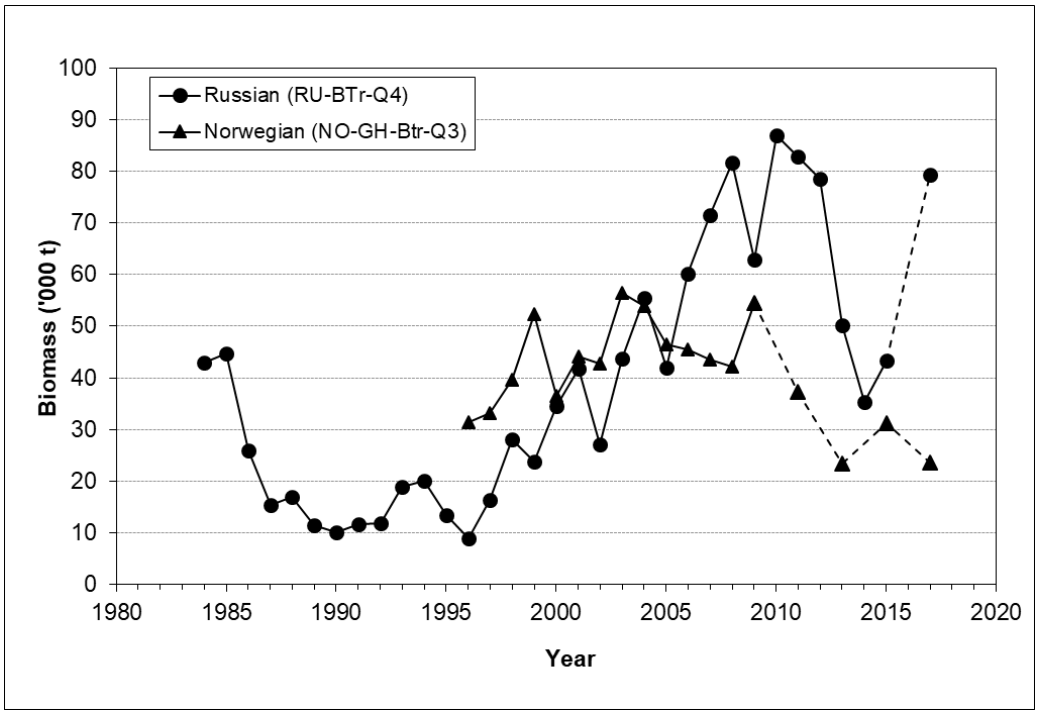


Figure 8.5. NEA Greenland halibut. Swept-area estimate of the mature female biomass based on the data from the Norwegian Greenland halibut survey along the continental slope in August (every other year since 2009) and Russian trawl survey in October-December (compared to previous reports, 2007–2008 recalculated using complete data for these years). Uncertain estimate for 2013 from the Russian survey.

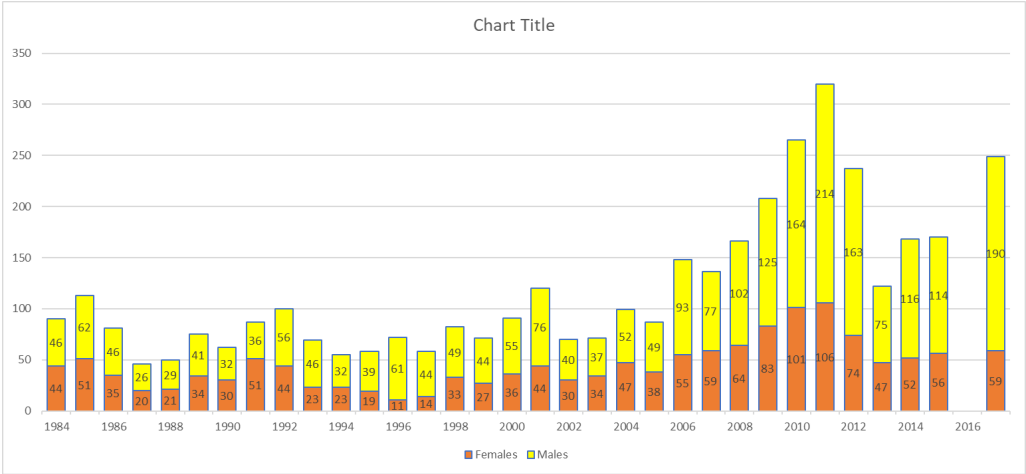


Figure 8.6. Russian autumn survey; Greenland halibut abundance by sex (Russkikh and Smirnov, WD16 AFWG 2016).

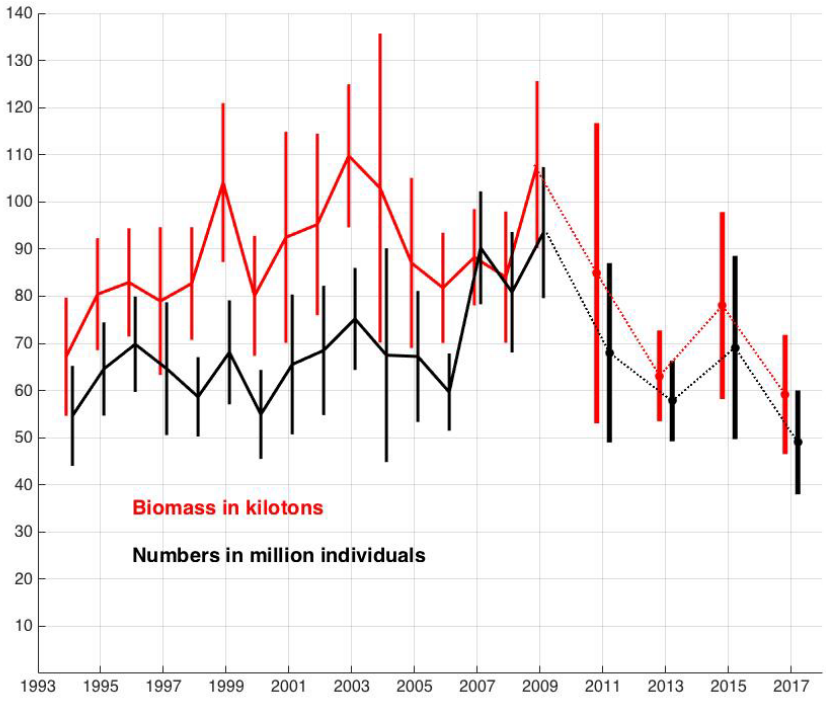


Figure 8.7. Estimated Greenland halibut total abundance in biomass and by number of individuals from the Norwegian slope surveys 1994–2017. The vertical bars show 95% confidence intervals.

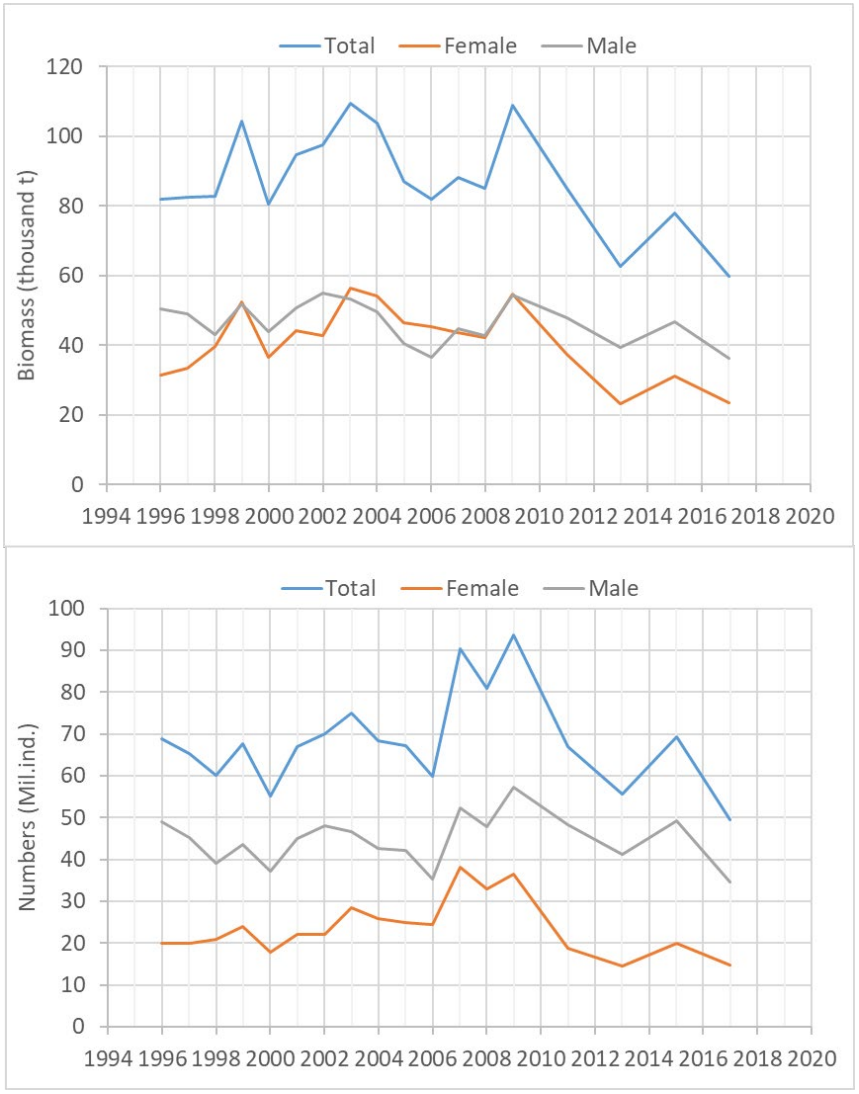


Figure 8.8. Norwegian autumn slope survey; Greenland halibut abundance and biomass estimates by sex.

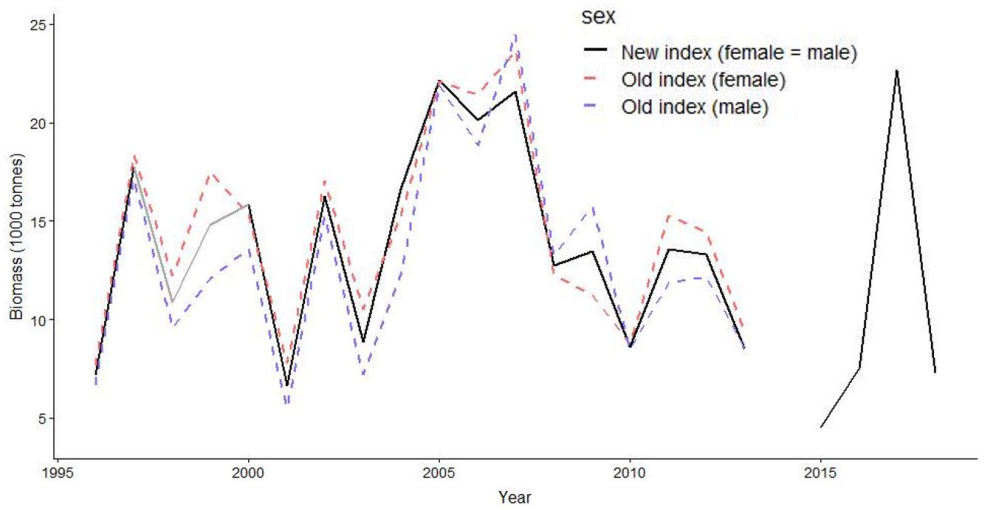


Figure 8.9. Juvenile biomass index (EcoJuv) in total and by sex for Greenland halibut based on the Barents Sea Ecosystem Survey 2003 – 2018 (2014 not included due to poor survey coverage in the juvenile area) and the juvenile survey 1996-2002 (for area see Hallfredsson and Vollen, WD20 AFWG 2015). Comparison of new and old biomass index (see chapter 8.3 about "Issus with 2019 assessment data")

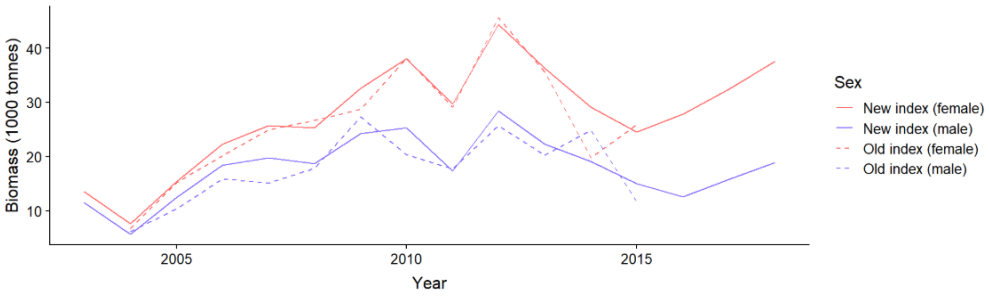


Figure 8.10. Eco-south biomass index by sex for Greenland halibut in the Barents Sea Ecosystem Survey 2004 – 2014, outside the juvenile area (for area see Hallfredsson and Vollen, WD20 AFWG 2015). Comparison of new and old biomass index (see chapter 8.3 about "Issus with 2019 assessment data")

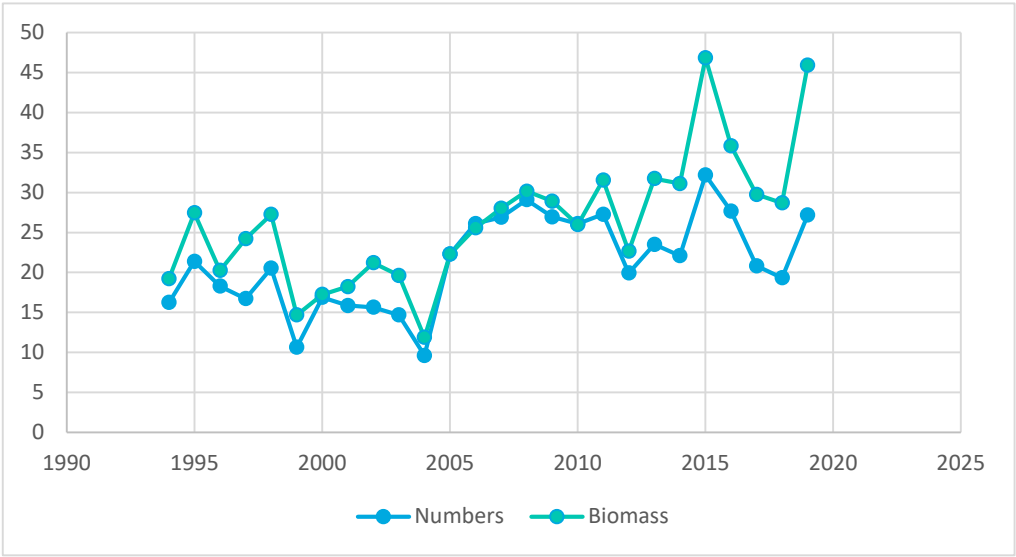


Figure 8.11. Joint winter survey in the Barents Sea; Greenland halibut abundance and biomass estimates.

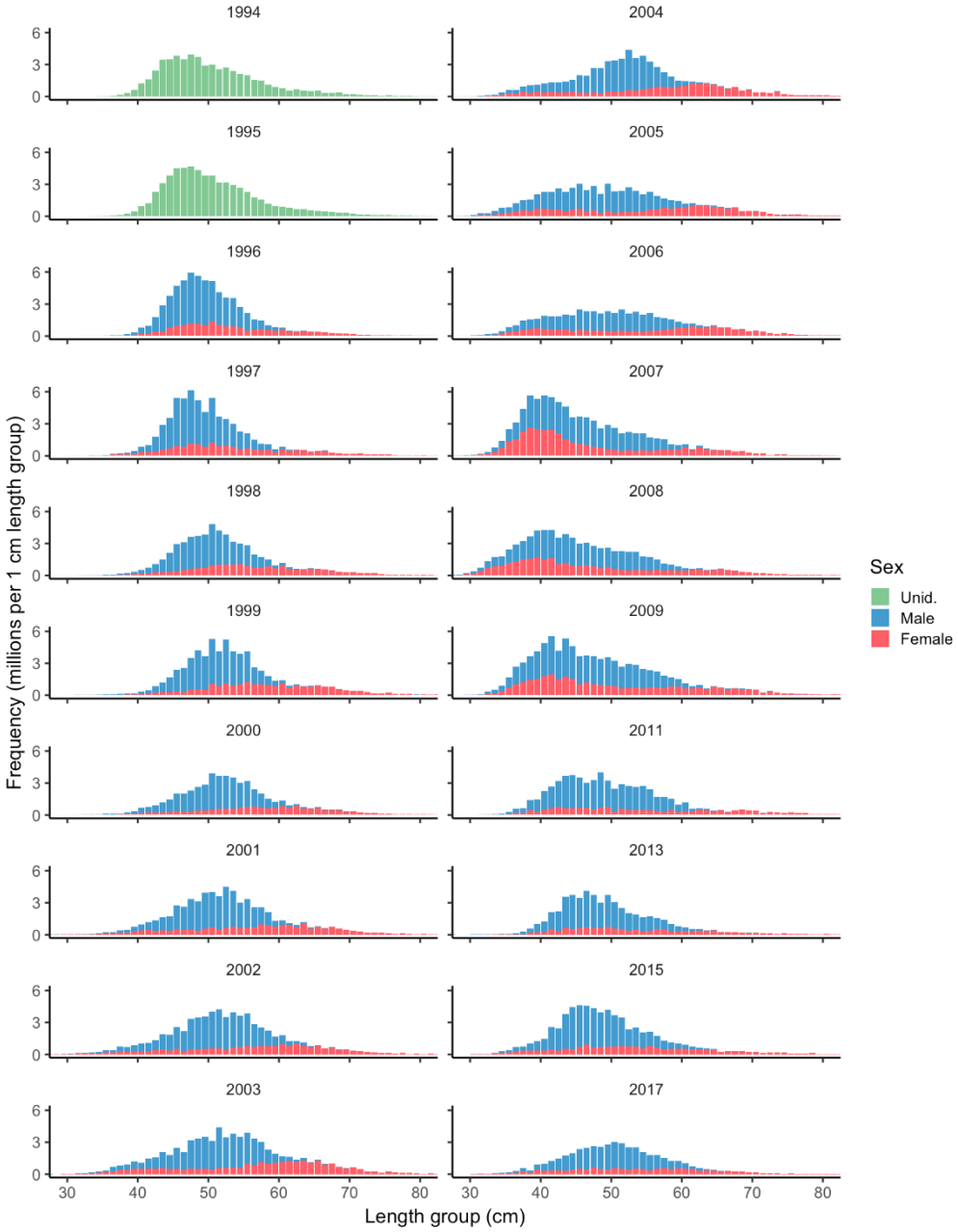


Figure 8.12. Length frequency distribution estimates for the entire area covered by the Norwegian Slope survey during autumns 1994-2017. Note biennial surveys after 2009.

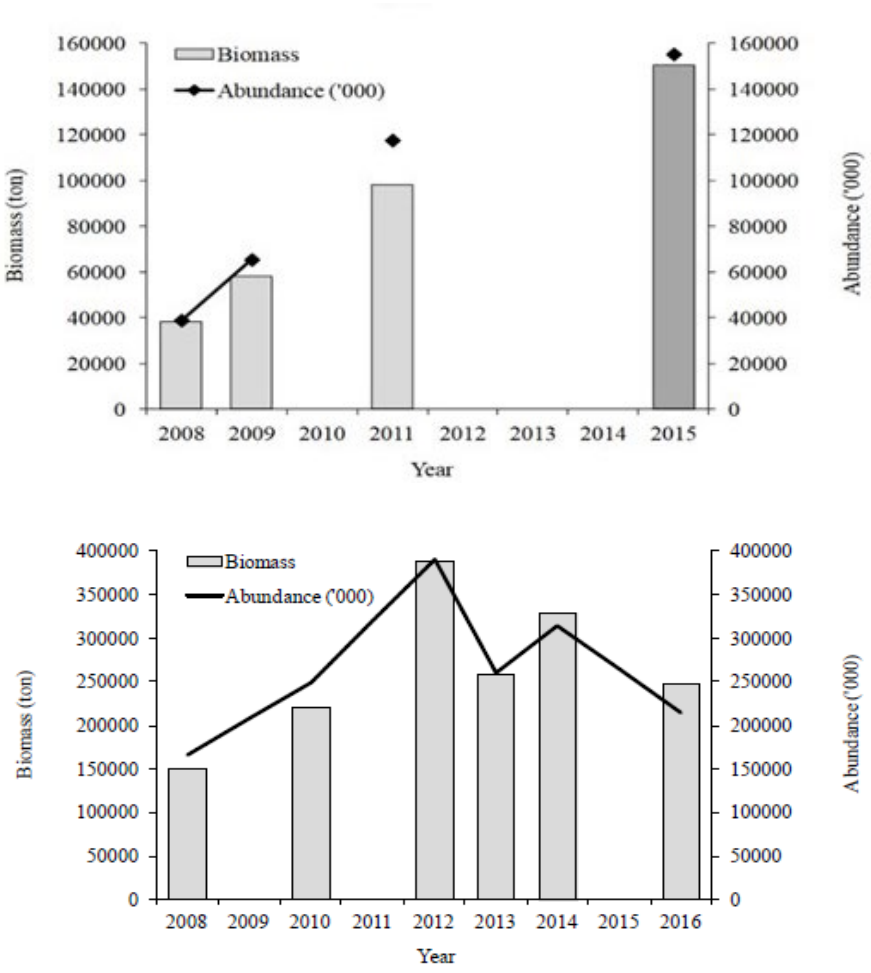


Figure 8.13. Abundance and biomass estimates from Spanish 2008, 2010, 2012, 2013, 2014, and 2016 autumn surveys (lower panel) (Muñoz *et al.,* WD7 AFWG 2017), and abundance and biomass estimates from Spanish 2008, 2009, 2011 and 2015 spring surveys (upper panel) (Muñoz *et al.,* WD10 AFWG 2016). No update presented to the 2019 AFWG.

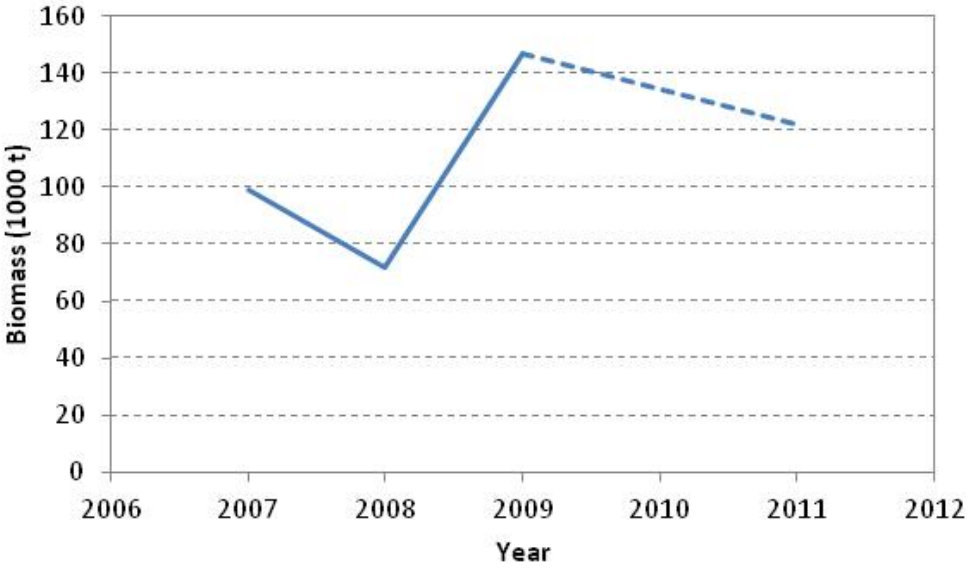


Figure 8.14. Biomass estimates from Polish 2007, 2008, 2009 and 2011 spring survey (based on: Janusz et al., WD8 AFWG 2008; Janusz and Trella, WD10 AFWG 2009; Trella and Janusz, WD6 AFWG 2012). No update presented to the 2019 AFWG

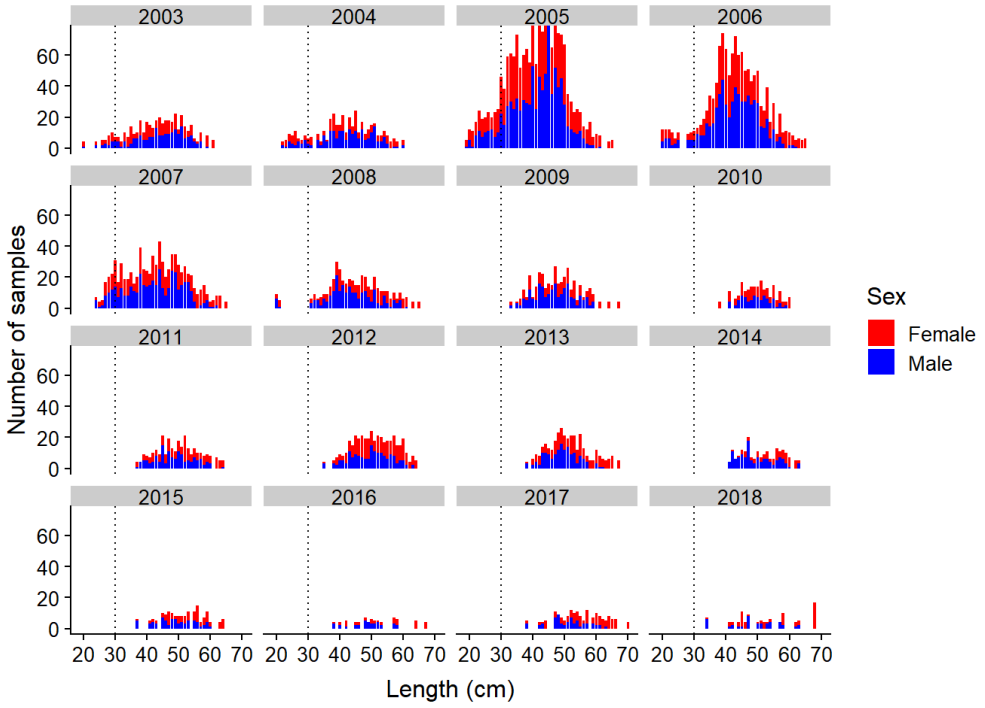


Figure 8.15. Total number of sexed length-samples by year by 1 cm length group and sex in the EcoSouth area.

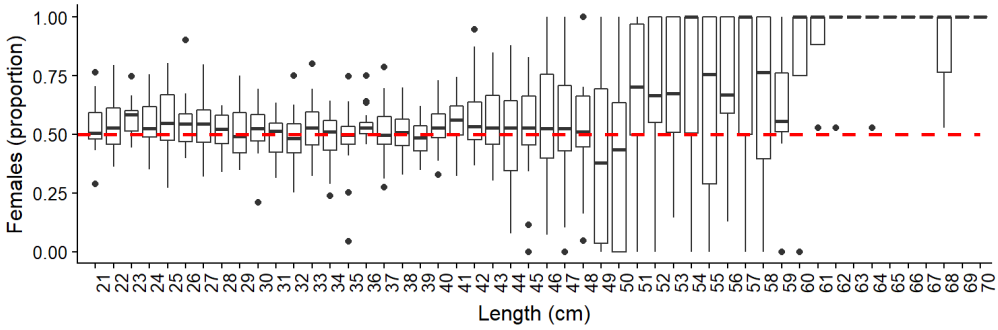


Figure 8.16. Yearly Proportion of female G. halibut by length based on survey data. Individuals <20 cm are removed because sex determination is not trusted. 99.6% of individuals are <50 cm.

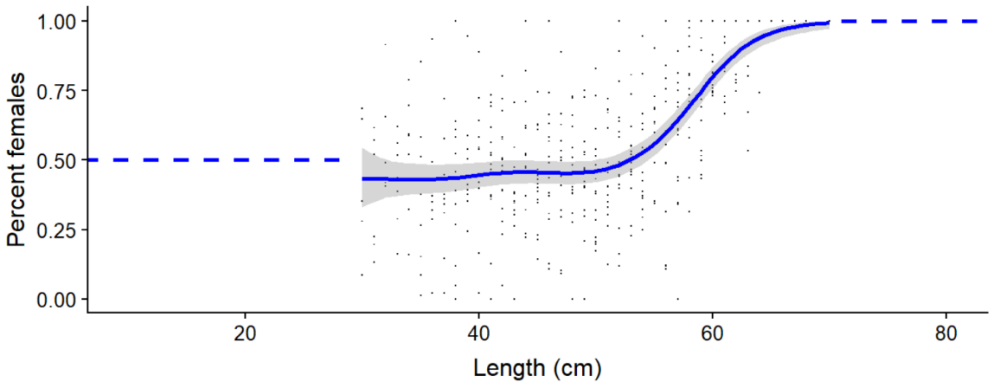


Figure 8.17. Key for splitting on sex in EcoSouth in the 2019 assessment. For 0-30 cm the percent females was set to 50%, and for 70-100 cm was set to 100%. For the interval 30-70 cm, a gam was fitted to all available data from the survey in the EcoSouth area.

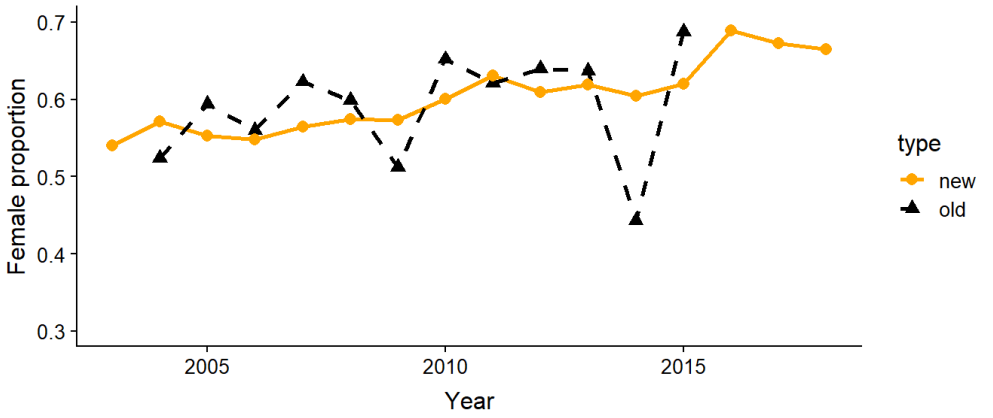


Figure 8.18. Proportion of females in EcoSouth biomass index, comparison of old and new index.

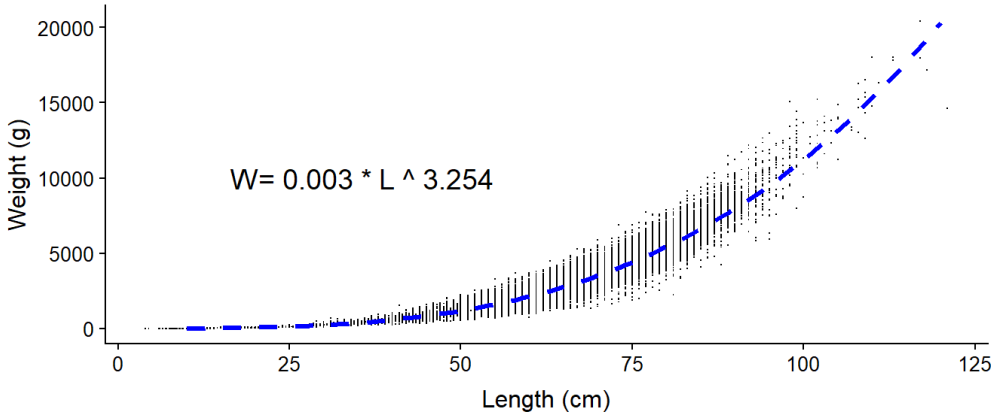
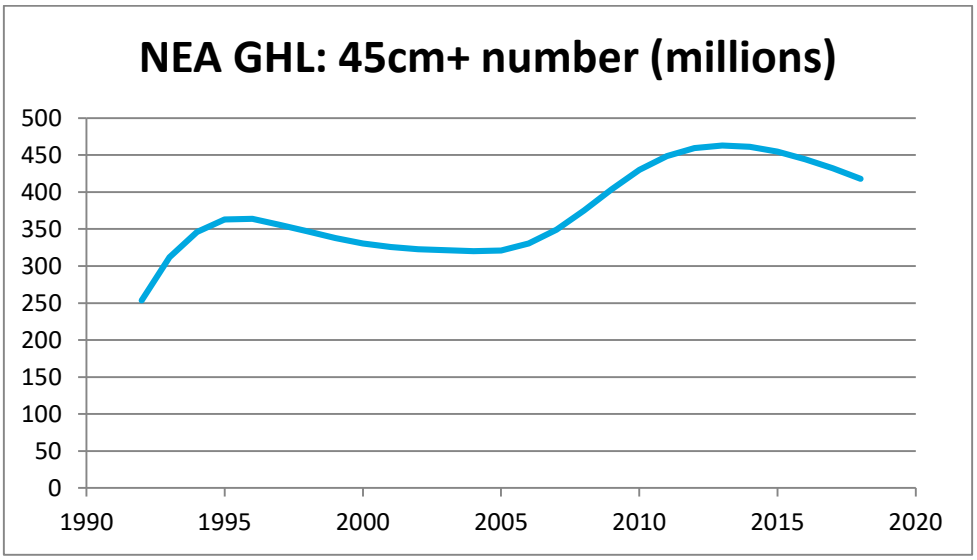
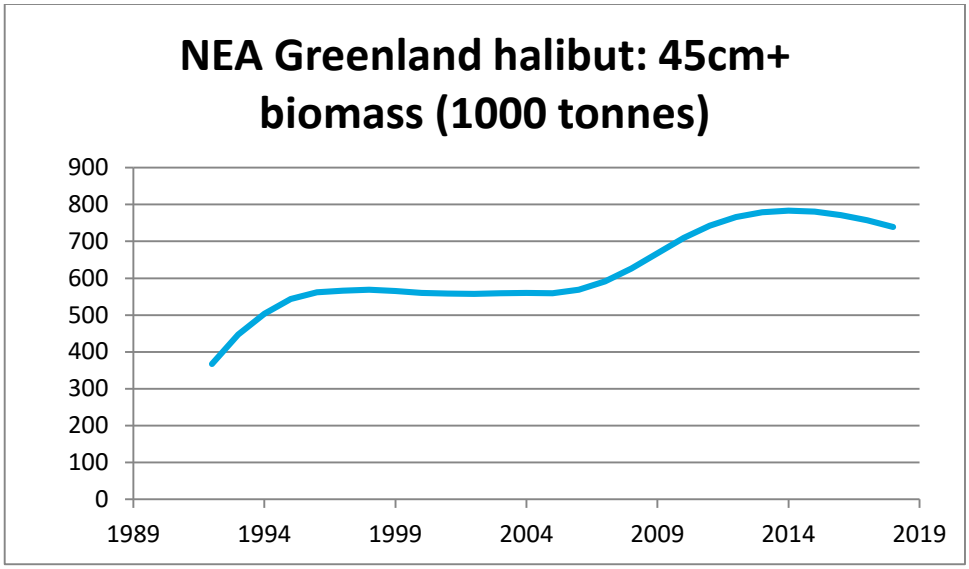


Figure 8.19. Length-weight relationship, linear model: log(W) = + b*log(L), R2 = 0.9814, p<0.001. All available data on G. halibut in IMR databases.





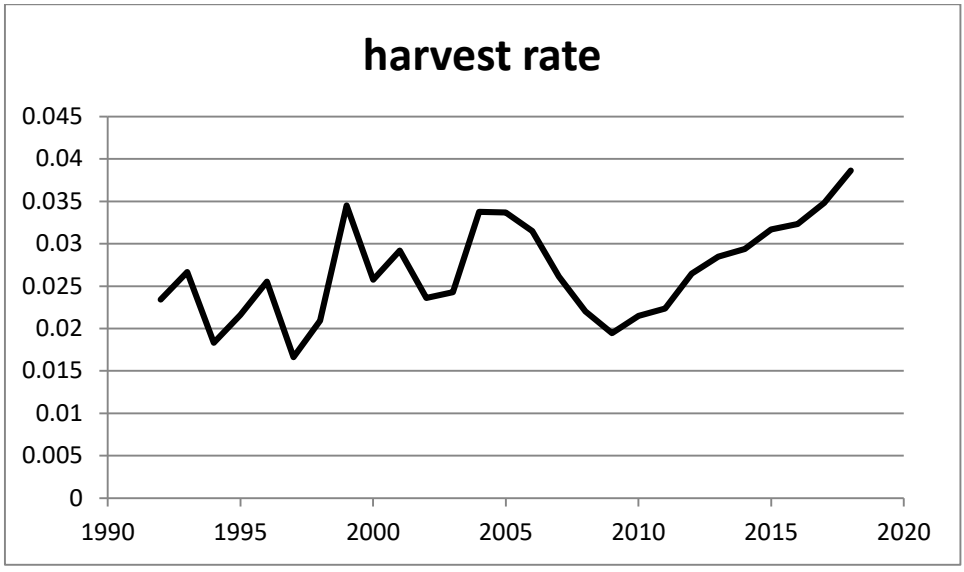


Figure 8.20. Numbers (upper) and biomass (middle) for 45+ cm Greenland halibut as estimated by the GADGET model, and estimated exploitation rates (below).

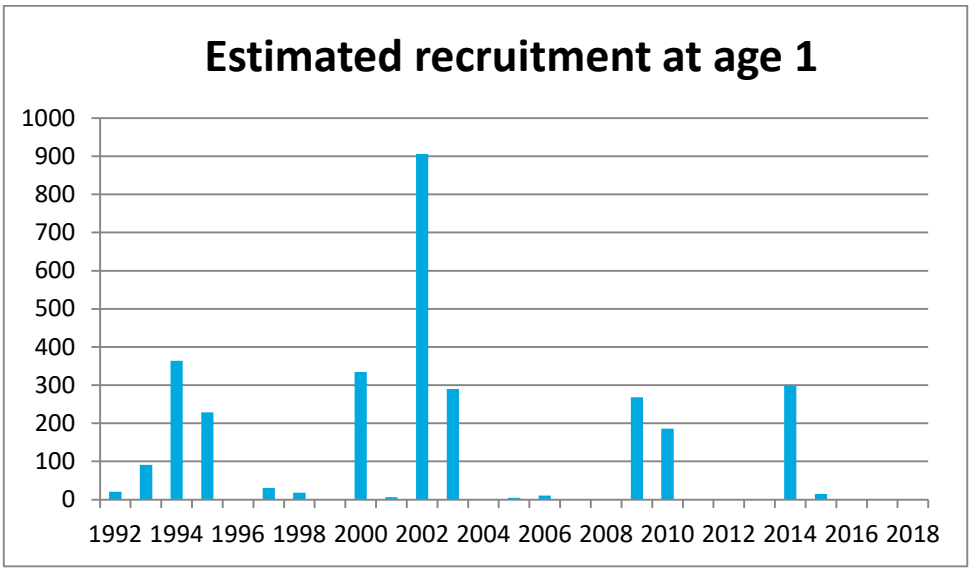


Figure 8.21. Gadget recruitment estimate (in millions) for the Greenland Halibut stock at 1st January. Note that the most recent year(s) of recruitment are tuned by very few data and should be considered tentative.

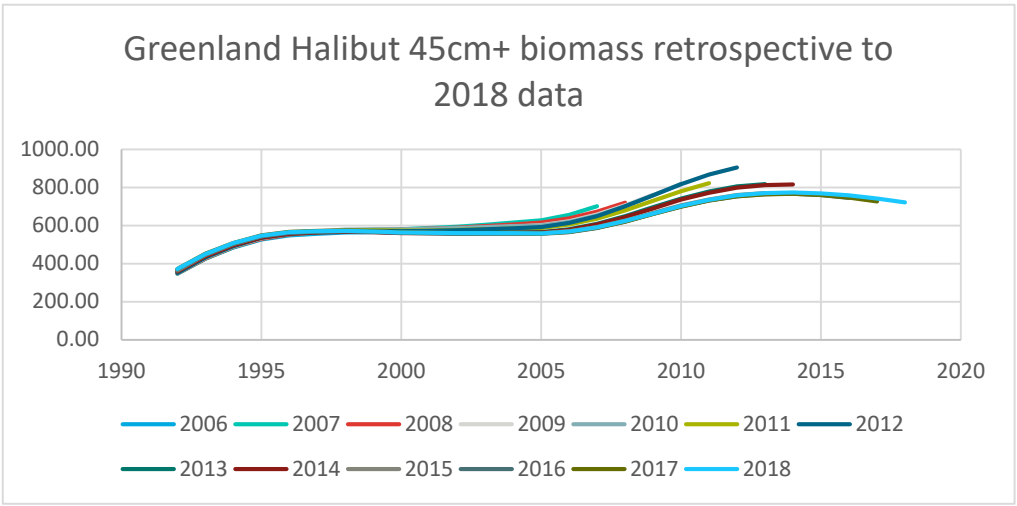


Figure 8.22. Retrospective patterns from the GADGET model run.

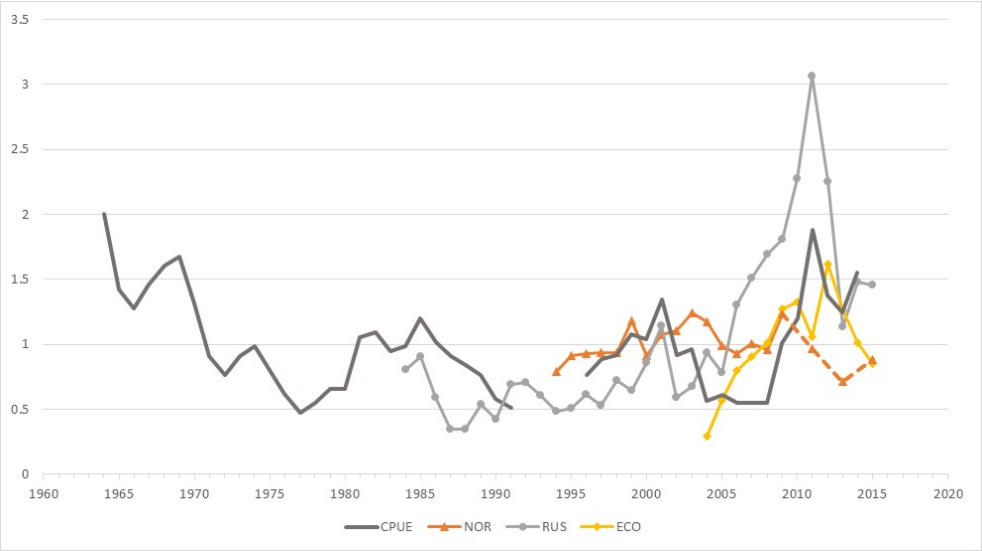


Figure 8.23. Dynamics of indices of the Barents Sea Greenland halibut stock in 1964–2015 (indices are taken divided by corresponding mean to put them in comparable scale; CPUE series divided by two: 1964–1991 and after 1996). In addition to the standardized CPUE three survey indices are shown; the Russian autumn survey (RUS), the Norwegian autumn survey (NOR) and the EcoSouth index (ECO).

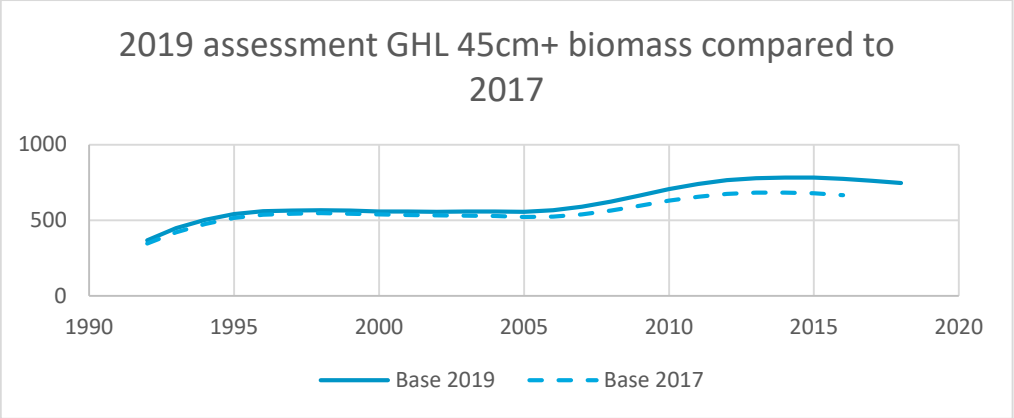


Figure 8.24. Change in Greenland halibut biomass since last assessment

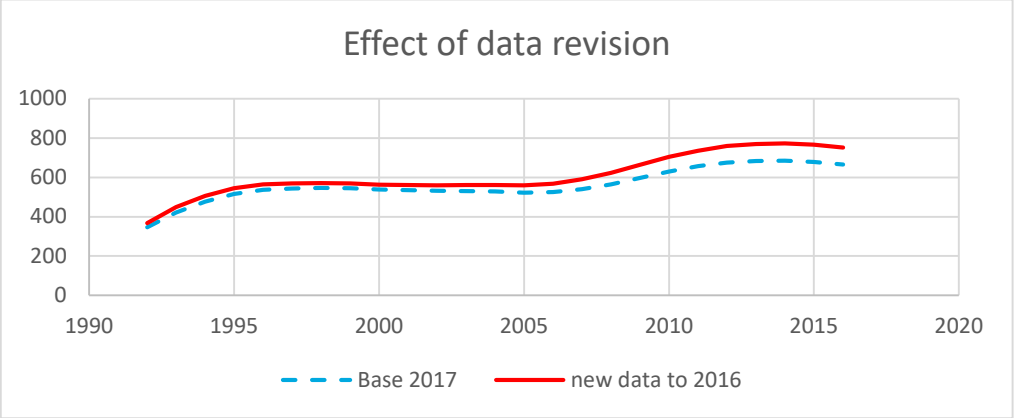


Figure 8.25. Effect of data revision on the estimated biomass of Greenland Halibut

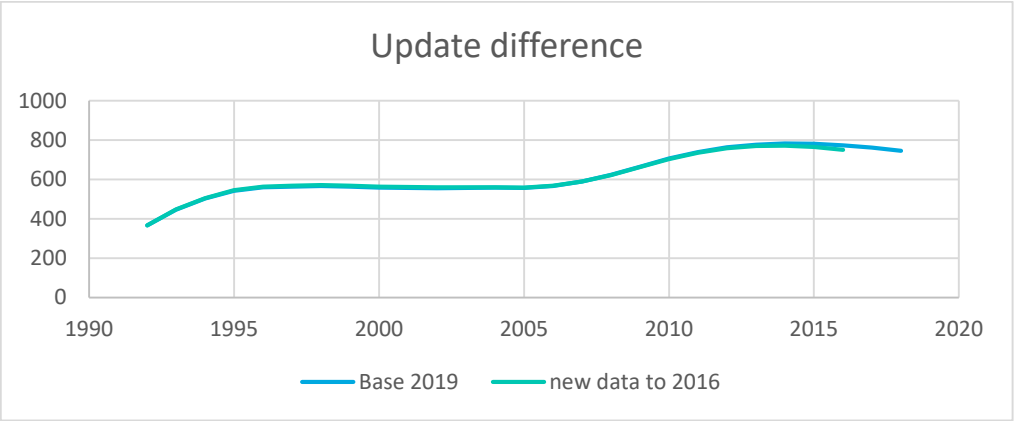


Figure 8.26. Effect of update year on estimated biomass of Greenland Halibut

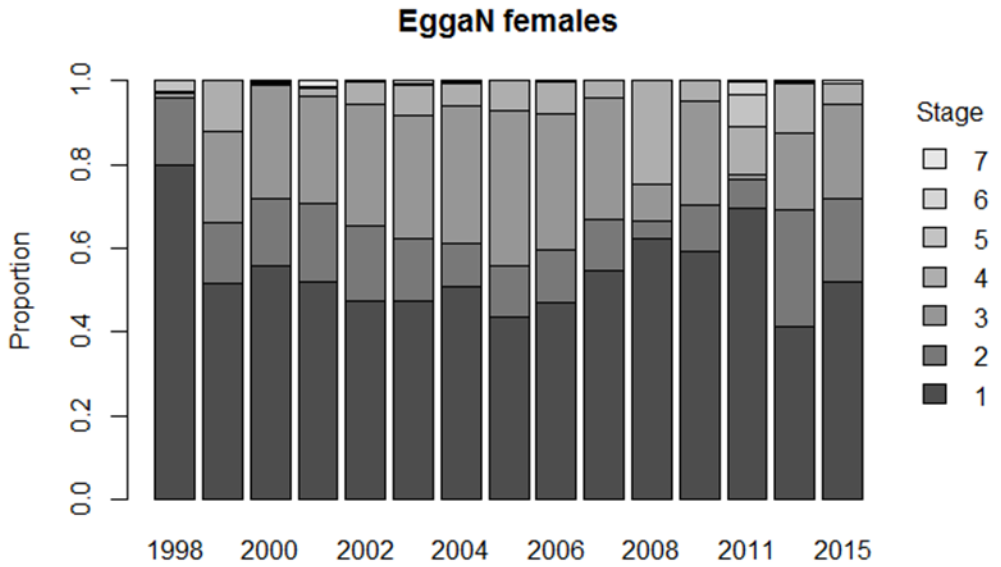


Figure 8.27. Proportion of numbers per maturity stage for Greenland halibut females in the Norwegian slope survey.

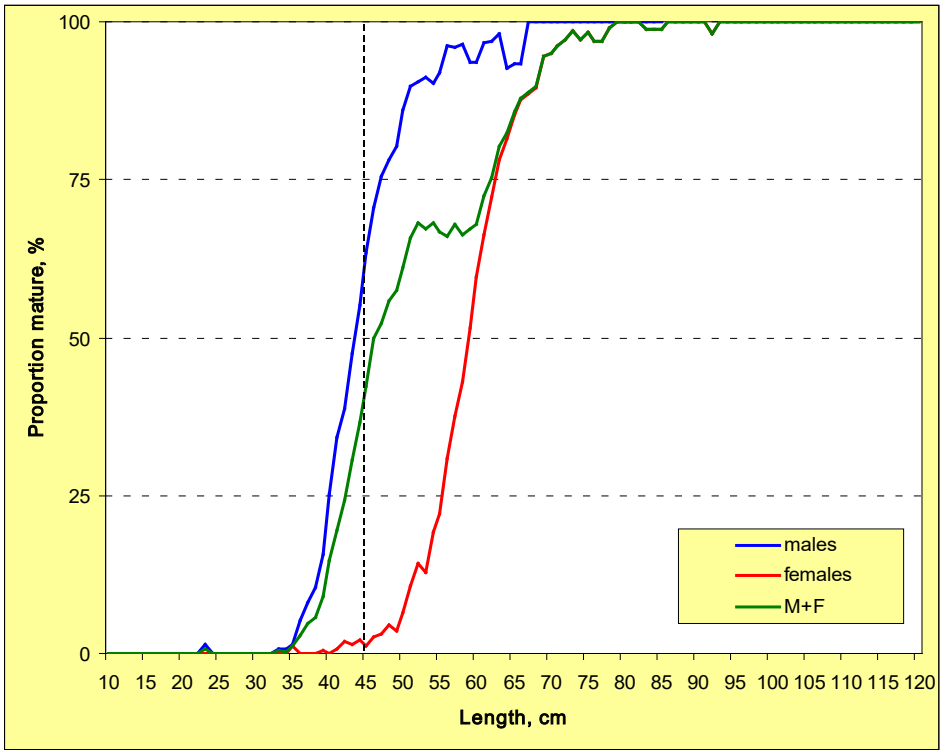


Figure 8.28. Greenland halibut maturity at length (Russian actual data, 2000–2009 combined). L_{50} for males ~43 cm, L_{50} for females ~57 cm (from Smirnov, 2011, WD21 ICES AFWG 2011)

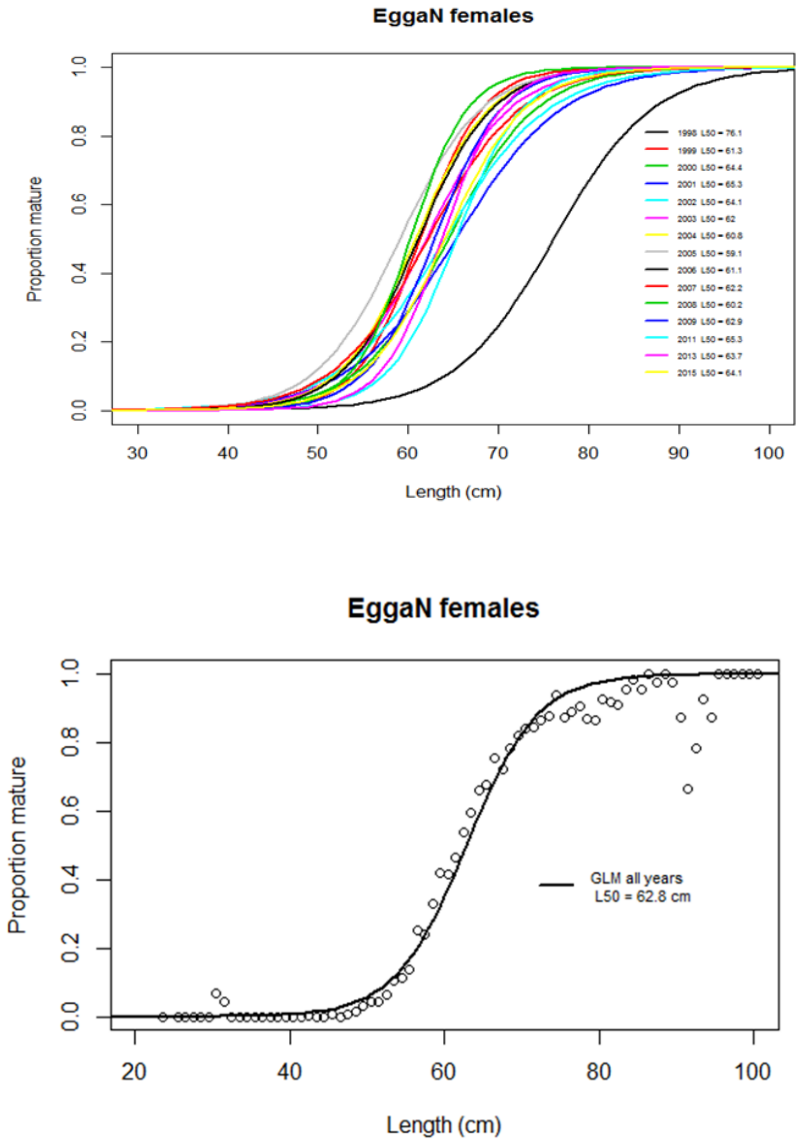


Figure 8.29. Maturity ogives for female Greenland halibut based on data from the Norwegian Slope survey, by year in upper panel and all years together (year 1998 omitted) in lower panel. Stage 1 and 2 on special maturity scale for females are taken as immatures; see Kennedy *et al.,* 2009, 2011, 2014, and Nunez *et al.,* 2015.

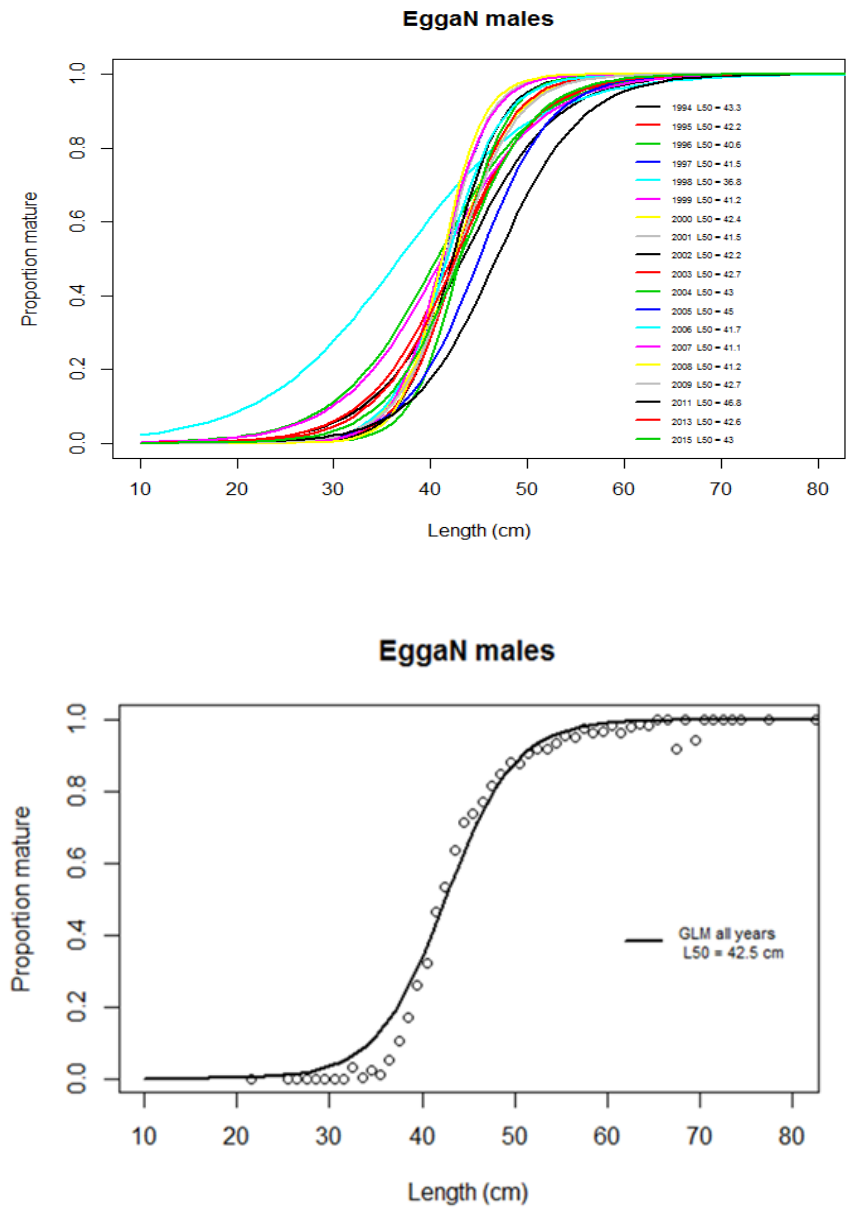


Figure 8.30. Maturity ogives for male Greenland halibut based on data from the Norwegian Slope survey, by year in upper panel and all years together (year 1998 and 2010 omitted) in lower panel.