3 Ling (*Molva Molva*)

3.1 Stock description and management units

WGDEEP 2006 indicated: 'There is currently no evidence of genetically distinct populations within the ICES area. However, ling at widely separated fishing grounds may still be sufficiently isolated to be considered management units, i.e. stocks, between which exchange of individuals is limited and has little effect on the structure and dynamics of each unit. It was suggested that Iceland (Division 5.a), the Norwegian Coast (Subarea 2), and the Faroes and Faroe Bank (Division 5.b) have separate stocks, but that the existence of distinguishable stocks along the continental shelf west and north of the British Isles and the northern North Sea (Subareas 4, 6, 7 and 8) is less probable. Ling is one of the species included in a recently initiated Norwegian population structure study using molecular genetics, and new data may thus be expected in the future'.

WGDEEP 2007 examined available evidence on stock discrimination and concluded that available information is not sufficient to suggest changes to current ICES interpretation of stock structure.

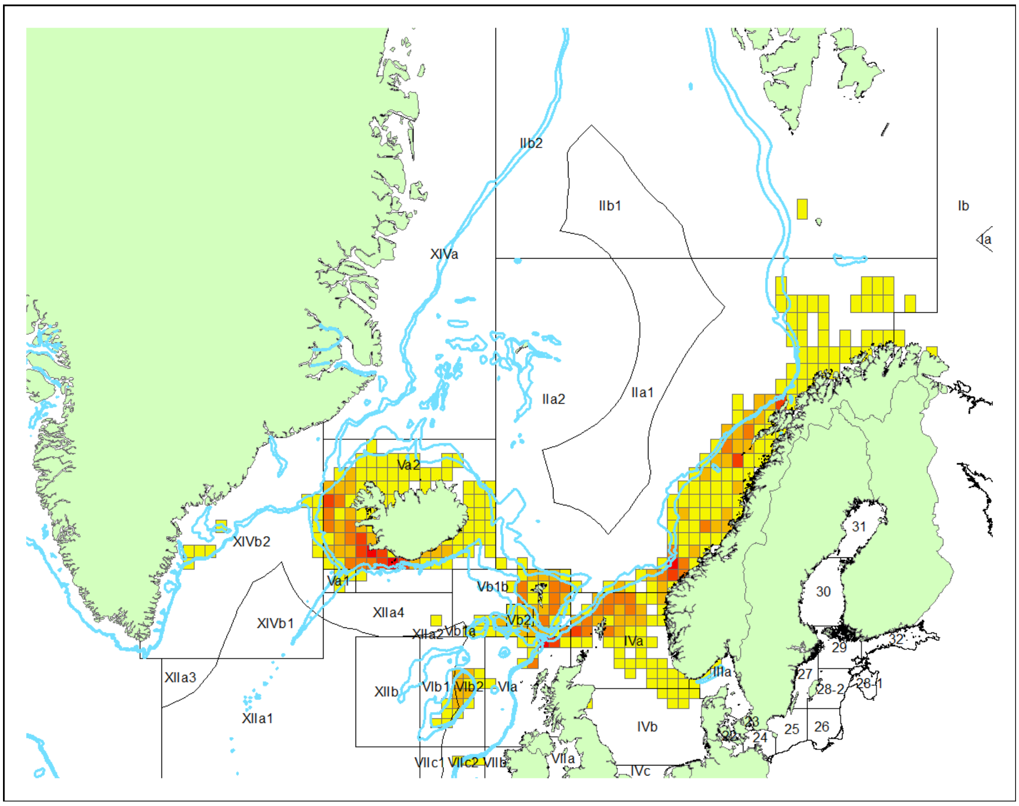

Figure 3.1. Map of fishery distribution (catches) in 2013 (data from Iceland, Faroes and Norway).

A study on population genetic structure of ling in the Northeast Atlantic rejected the hypothesis of a single ling stock in the Northeast Atlantic, and rather suggest the existence of two or more groups, with the main grouping represented by a western (Rockall and Iceland) and an eastern group (Faroe Bank, Norway) (Gonzales *et al*., 2015). Significant genetic differences coincide with an expanse of deep water that probably limits connectivity facilitated by migration. Retention in gyres and directional oceanic circulation may also prevent drift and admixture during planktonic life stages. On the other hand, the apparent absence of genetic differentiation within the eastern part of the distribution range indicates gene flow, perhaps by larval drift and migration, over considerable distances.

A small-scale exchange of 50 ling otolith images was done in 2013 (WKAMDEEP, 2013). The results of this exchange showed that the mean CV of all the 9 age readers of ling was 10.3% and the conclusion was that the precision is probably high enough to support age-structured analytical assessments (WGDEEP, 2013). The results from the annotations of this exchange highlighted that the problem (in most cases) was to do with edge growth. It is necessary to train an age reader and inform them when to count the first translucent zone (first year) (WKAMDEEP, 2013). Also earlier ling otolith exchanges concluded that there was some inconsistencies between age readers but the differences were not very substantial and could easily be adjusted (Bergstad *et al*., 1998; Øverbø Hansen, 2012). An analysis of edge growth of ling otoliths is recommended to help on this problem with edge growth.

3.1.1 References

Blanco Gonzalez, E., Knutsen, H., Jorde, P. E., Glover, K. A., and Bergstad, O. A. Genetic analyses of ling (*Molva molva*) in the Northeast Atlantic reveal patterns relevant to stock assessments and management advice. – ICES Journal of Marine Science, 72: 635–641.

3.2 Ling (*Molva Molva*) in Division 5.b

3.2.1 The fishery

General description of the fishery in Faroese waters is presented in the stock annex. In 2020, the longliners and trawlers who catch ling as bycatch in saithe fishery were mainly fishing on the slope on the Faroe Plateau and somewhat to the South East on the Faroe Bank and Wyville-Thomson Ridge (Figure 3.2.1). Recent years, foreign catches were mainly by the Norwegian longliners.

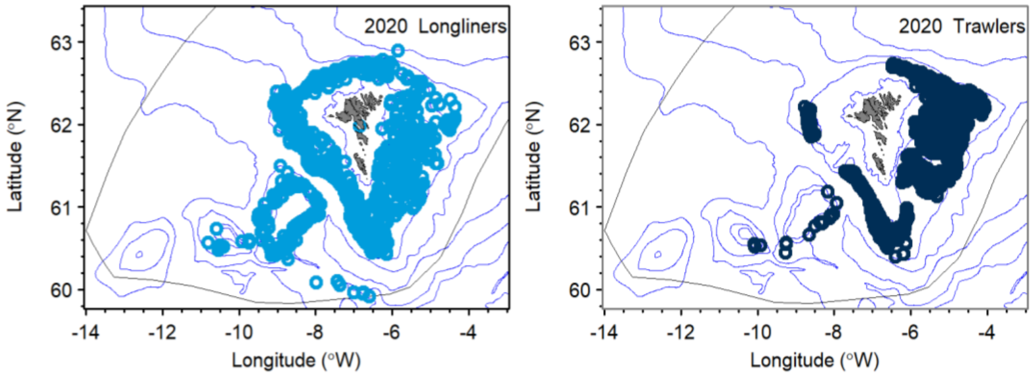

Figure 3.2.1. Ling in 5.b. Spatial distribution in 2020 of the Faroese longliner fishery (left) and pair trawler fishery (bycatch in saithe fishery, right).

3.2.2 Landings trends

Landing statistics for ling by nation for the period 1988–2020 are given in Tables 3.2.1–3.2.3 and total landings data from 1904 onwards are available and shown in Figure 3.2.2. The historic landing trends are described in the stock annex.

Total landings in Division 5.b have in general been very stable since the 1970s varying between around 4000 and 7000 tonnes. In the period from 1990–2005 around 20% of the catch was fished in area 5.b2, and in the period 2006–2020 this has decreased to around 10%. The preliminary landings of ling increased in 2020 to 9427 tons (the highest catch in the whole time series), of which the Faroes caught 67%. The reason for the low foreign catches in 2011–2013 was because of no bilateral agreement on fishing rights between the Faroes, Norway and EU.

Around 50–70% of the ling in 5.b was caught by longliners and the rest mainly by trawlers (30–40%). Only a minor part of the landings was by other gear (Table 3.2.4).

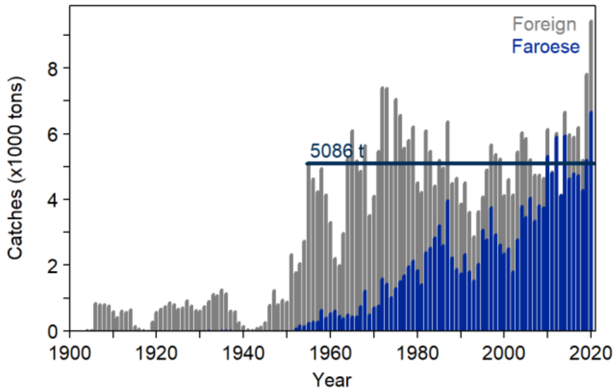

Figure 3.2.2. Ling in 5.b. Total international catches since 1904. The mean catches from 1955-present were around 5000 tons.

3.2.3 ICES Advice

ICES advices that when the precautionary approach is applied, catches should be no more than 4157 tonnes in each of the years 2020 and 2021. All catches are assumed to be landed. ICES is not in a position to advice on the corresponding level of fishing effort.

3.2.4 Management

For the Faroese fleets, there is no species-specific management of ling in 5.b although there is a licensing scheme and effort limitations. The main fleets targeting ling are each year allocated a total allowable number of fishing days to be used in the demersal fishery in the area. Other nations fishing ling in Division 5.b are regulated by TACs. The recommended minimum landing size for ling is 60 cm (total length) which is not enforced due to the discard ban. Regulation is set for juvenile catch and a maximum of 25% of the ling catch (per settings/hauls) can be juveniles e.g. smaller than 75 cm.

Since 1977 there has been a bilateral agreed quota between Norway and Faroe Islands except for 2011–2013. In 2021, Norway can catch 2500 tons ling/blue ling, 2000 tons tusk and 800 tons other species as by-catch in bottom fishery in Faroese waters (fiskiveiðiavtala-millum-føroyar-og-noreg-fyri-2021.pdf).

In 2021, the Faroese Party will allow five Russian fishing vessels to undertake experimental fishing in the Faroese Fishing Zone at depths deeper than 700 meters provided that a Russian scientific observer is onboard. No more than three of these vessels can be operating simultaneously. Two of these vessels can undertake experimental fishery in deep waters around Outer Bailey and Bill Baileys Banks at depth between 500 and 700 meters provided that catches in this area do not exceed 500 tonnes of deep-sea species (fiskiveiðiavtala-millum-føroyar-og-russland-fyri-2021.pdf).

There are no agreements about a TAC between EU and Faroe Islands at the time of this year's assessment.

3.2.5 Data available

Data on length, gutted weight and age are available for ling from the Faroese landings and Table 3.2.5 give an overview of the level of sampling since 1996.

There are also catch and effort data from logbooks for the Faroese longliners and trawlers. In addition, there are also data available on catch, effort and some mean lengths from Norwegian longliners fishing in Faroese waters.

From the two annual Faroese groundfish surveys on the Faroe Plateau targeting cod, haddock and saithe, biological data (mainly length and round weight, Table 3.2.6) as well as catch and effort data are available. Data of ling larvae from the annual 0-group survey on the Faroe Plateau has also been investigated.

3.2.5.1 Landings and discards

Landing data is available for all relevant fleets. No estimates of discards of ling are available. But since the Faroese fleets are not regulated by TACs and there is a ban on discarding in Faroese EEZ, incentives for illegal discarding are believed to be low. The landings statistics are therefore regarded as being adequate for assessment purposes.

3.2.5.2 Length compositions

Length composition data is available from the Faroese commercial longliners, the trawler fleet that captures ling as bycatch in saithe fishery and from the two groundfish surveys (Figures 3.2.3–3.2.5).

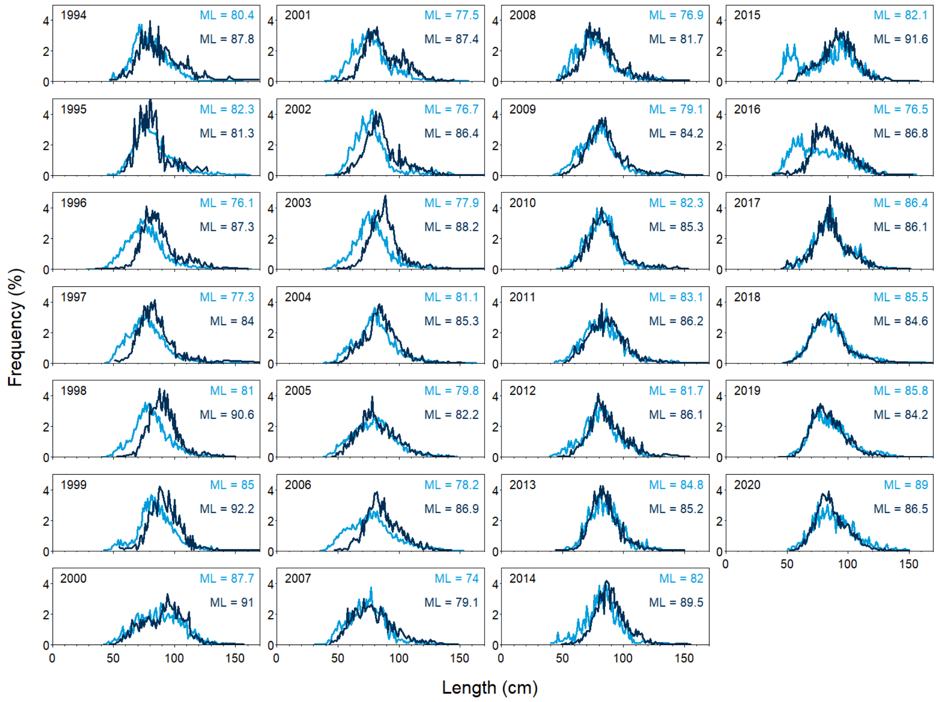

Figure 3.2.3. Ling in 5.b. Length frequencies from the landings of ling from Faroese longliners (>110 GRT, turquoise line) and Faroese trawlers (>1000 HP, dark blue line) from 1994-present. ML- mean length.

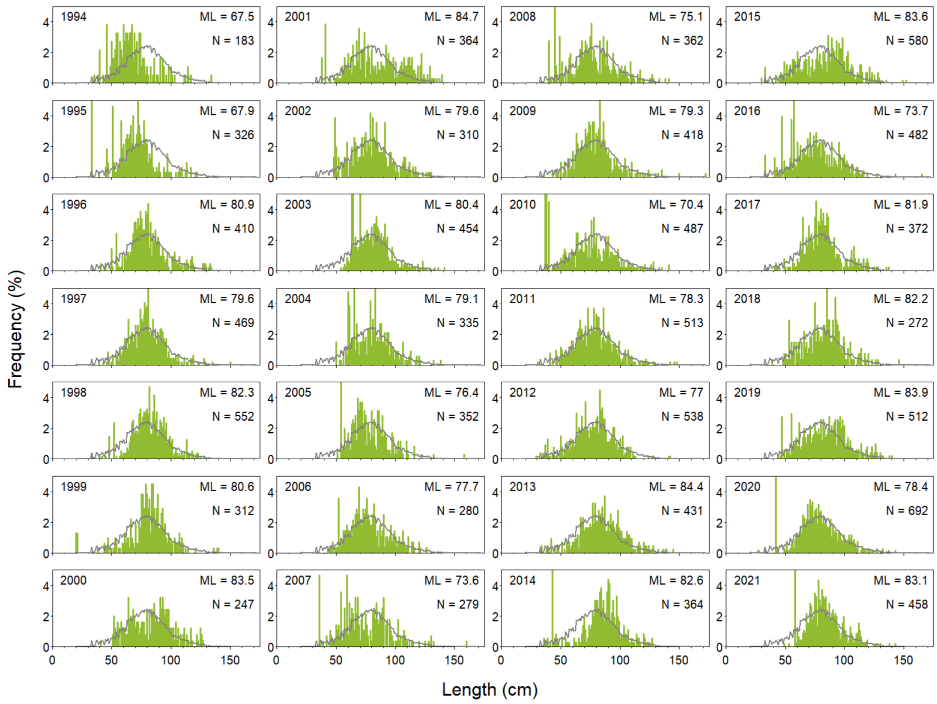

Figure 3.2.4. Ling in 5.b. Length frequencies from the groundfish spring survey. ML- mean length, N–number of calculated length measures, grey line- mean of all years. The small ling are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

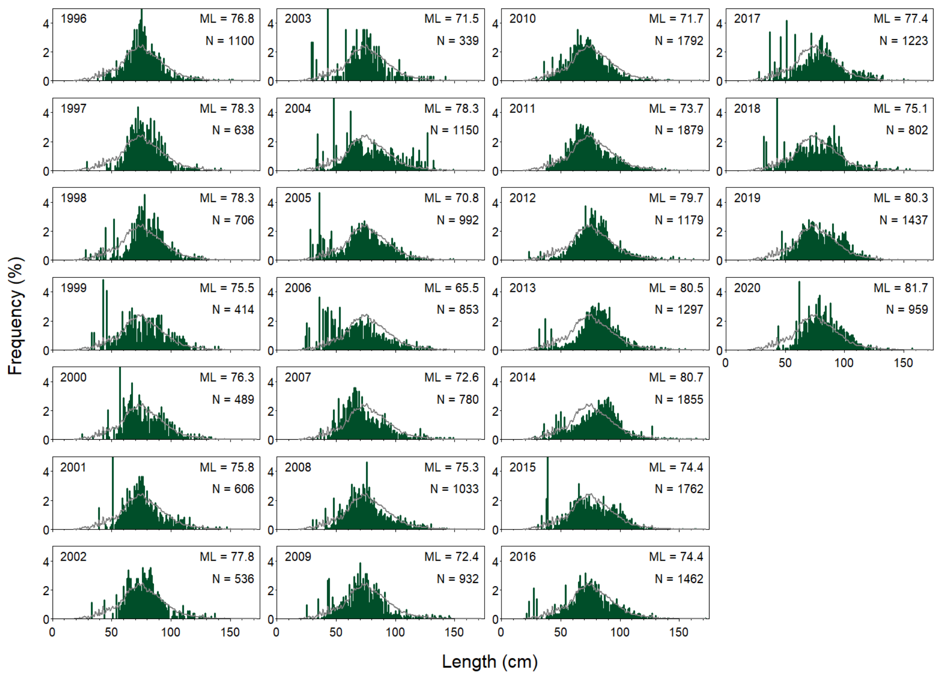

Figure 3.2.5. Ling in 5.b. Length frequencies from the groundfish summer survey. ML- mean length, N–number of calculated length measures, grey line- mean of all years. The small ling are often sampled from a subsample of the total catch, so the values are multiplied to total catch.

3.2.5.3 Catch-at-age

Catch-at-age data were provided for the Faroese fishery in 5.b for the period 1996 - present. In 2020, a new ALK- program was used to calculate the catch number at age from 1996 - present (see ICES, 2021, Stock annex). The most common ages in the landings are from five to nine years and the mean age is around 7–8 years (Figure 3.2.6 and Table 3.2.7). Consistency plot of the catch at age data is shown in Figure 3.2.7.

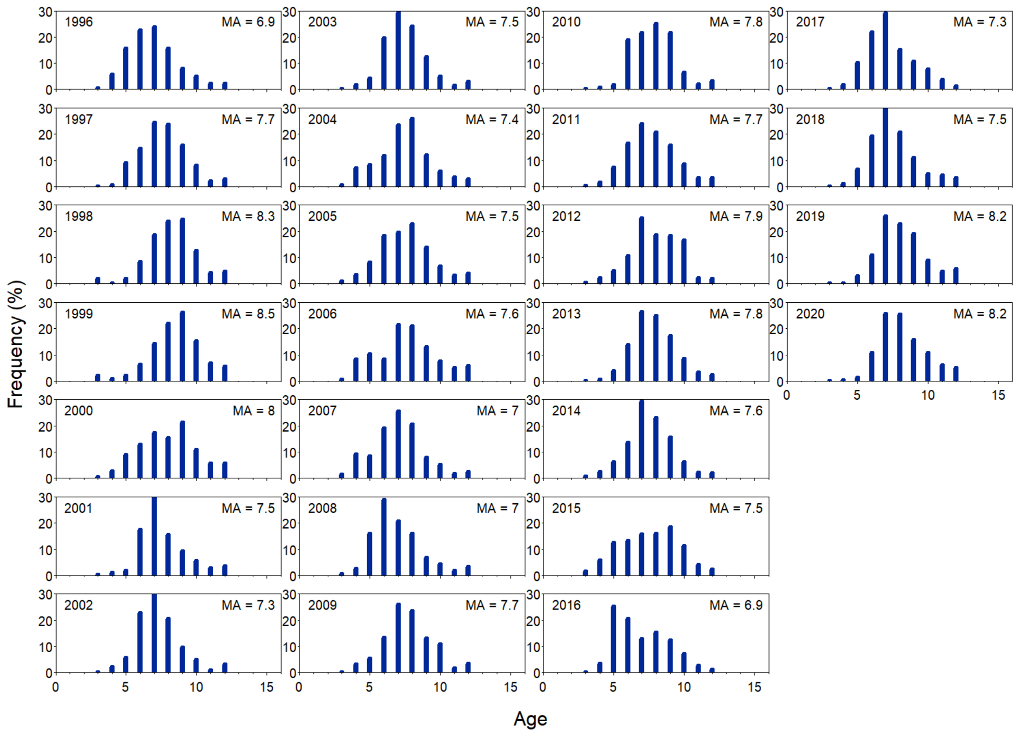

Figure 3.2.6. Ling 5.b. Catch-at-age from the commercial fleets in the assessment. MA- mean age.

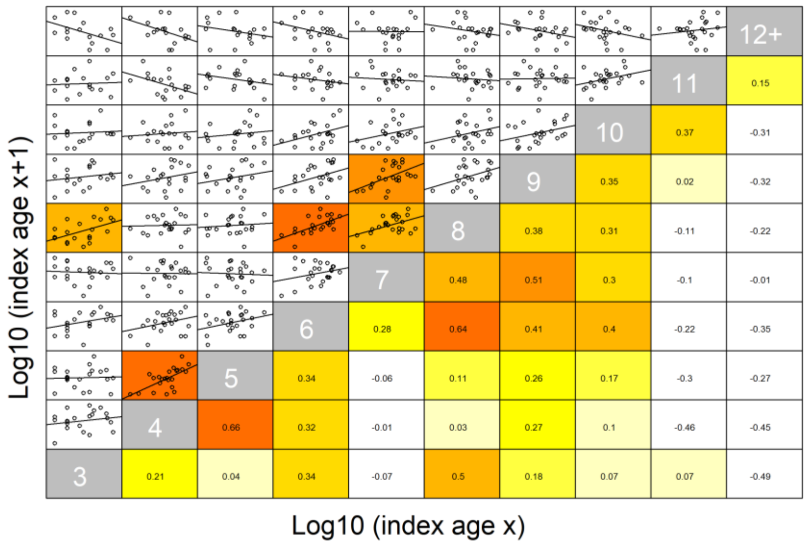

Figure 3.2.7. Ling 5.b. Consistency plot of catch-at-age used in the assessment.

3.2.5.4 Weight-at-age

Mean weight-at-age data from the landings in 5.b is modelled using the Faroese ALK-program (Stock annex, ICES, 2021). There are no particular trends in the mean weights over the period (Figure 3.2.8 and Table 3.2.8).

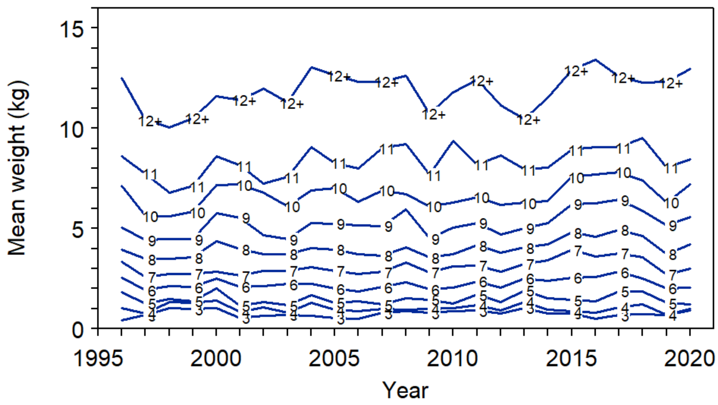

Figure 3.2.8. Ling in 5.b. Mean weight-at-age in the catches from 1996-present.

3.2.5.5 Maturity and natural mortality

The proportion mature at age used in the assessment is presented in the table below. The same maturity-at-age calculated from all data (2000-2019) for sexes combined was used for all years in the assessment. Maturity ogives of ling are presented in stock annex.

Age	3	4	5	6	7	8	9	10	11	12+
Proportion mature	0.00	0.04	0.19	0.50	0.79	0.93	0.98	1.00	1.00	1.00

No information is available on natural mortality of ling in 5.b. Natural mortality of 0.15 was assumed for all ages in the assessment. That is the same as used for ling in Division 5.a.

3.2.5.6 Catch, effort and research vessel data

Commercial cpue series

There are catch per unit of effort (cpue) data available from three commercial series; the Faroese longliners, the Faroese pair trawlers (bycatch in saithe fishery) and Norwegian longliners fishing in Division 5.b. Information on abundance trends can be derived from the CPUE data from these fleets. Even though there were no striking problems detected with the commercial tuning series (in terms of series trends or problems arising from aggregating fish or fishery targeting), the WKBARFAR benchmark decided not to use the commercial series in the tuning of the assessment model (ICES, 2021). The cpue series for Faroese fishery are described in stock annex for ling in 5b whilst the standardized cpue data from Norwegian longliners fishing in Division 5.b are described in the stock annex for ling in 2.a (Section ling in 1 and 2).

Fisheries-independent cpue series

Survey biomass index (kg/h) for ling are available from two annual groundfish trawl surveys on the Faroe Plateau targeting cod, haddock and saithe. The annual survey on the Faroe Plateau covers the main fishing areas and a large part of the spatial distribution. Information on the surveys and standardization of the data are described in the stock annex. WKBARFAR benchmark decided to use these two survey series in the tuning of the assessment model (ICES, 2021).

A potential recruitment index for ling less than 40 cm has been calculated from the groundfish surveys. In addition, an index has been calculated from the annual 0-group survey on the Faroe Plateau.

3.2.6 Data analyses

Mean length in the length composition from commercial catches from Faroese longliners and trawlers showed an increase in mean length from 74–79 cm in 2007 to around 83–86 cm after 2010 (Figure 3.2.3). The mean length in 2003–2009 from the Norwegian longliners fishing in Faroese waters were around 87 cm. The Faroese trawlers and longliners have almost identical length compositions, only a few years where longliners have a lower mean length compared with the trawlers.

Length composition from the two groundfish surveys on the Faroe Plateau showed high inter-annual variation in mean length, from 65 to 85 cm which may partly be explained by occasional high abundance of individuals smaller than 60 cm (Figures 3.2.4–3.2.5).

3.2.6.1 Fluctuations in abundance

The Faroese longline CPUE series and the Faroese trawl bycatch CPUE series show an increasing trend since around 2001 (Figure 3.2.9). The Norwegian longline series show an increase after 2004, except in 2018 (Figure 3.2.9). It has to be noted that there are less than 100 fishing days from Norwegian longliners in Faroese waters in 2009–2014.

The two survey abundance series indicate a stable situation from the late 1990s and an increase to a higher level since 2010 (Figure 3.2.10).

A potential recruitment index was calculated from the two surveys with the number of ling smaller than 40 cm (Figure 3.2.13). The index indicates high recruitment in the period 2013-2018. There has been a decrease since 2019. In addition, a potential recruitment index was calculated of ling (2–3 cm in length) from the annual 0-group survey on the Faroe Plateau from 1983 - present. This also showed indications of high recruitment in some years (Figure 3.2.12). Together these recruitment indices support an indication of high recruitment in distinct years.

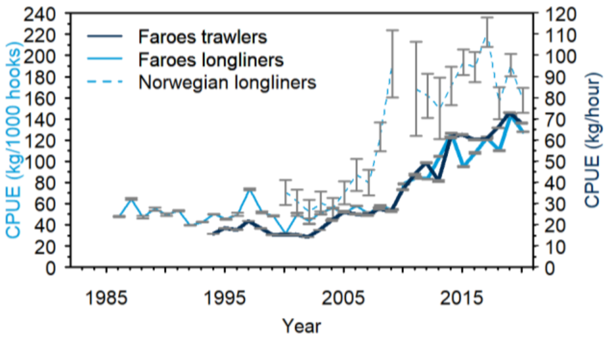

Figure 3.2.9. Ling in 5.b. Standardized CPUE from Faroese pair trawlers (bycatch, dark blue line), Faroese longliners (turquoise line) and Norwegian longliners (turquoise stippled line) fishing in Faroese waters. Data from Faroese trawlers are from hauls where ling was caught and saithe >60% of the total catch. Data from Faroese longliners (>110 GRT) are from

sets where ling >30% of the total catch. The error bars are SE. The bars denote the 95% confidence intervals in the Norwegian data (Helle and Pennington, WD 2021).

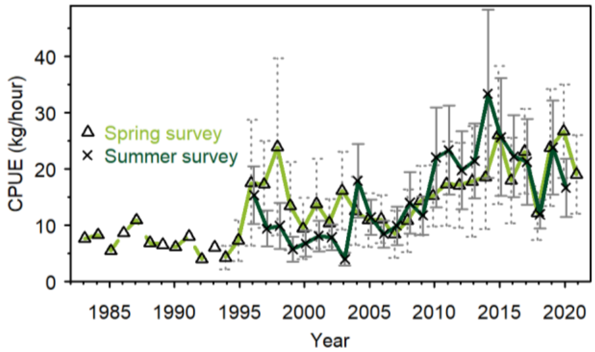

Figure 3.2.10. Ling in 5.b. Standardized CPUE (kg/hour) from the two annual Faroese groundfish surveys on the Faroe Plateau with standard errors. The data for 1983–1993 were not standardized.

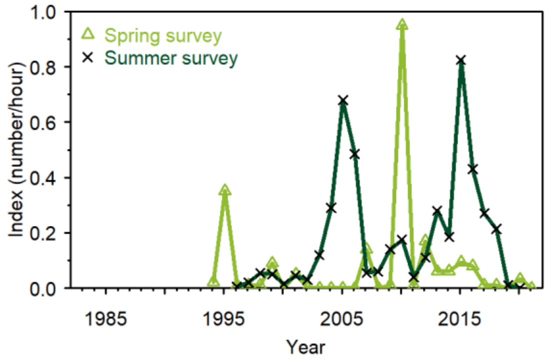

Figure 3.2.11. Ling in 5.b. Index (number/hour) of ling smaller than 40 cm from the spring- and summer survey on the Faroe Plateau.

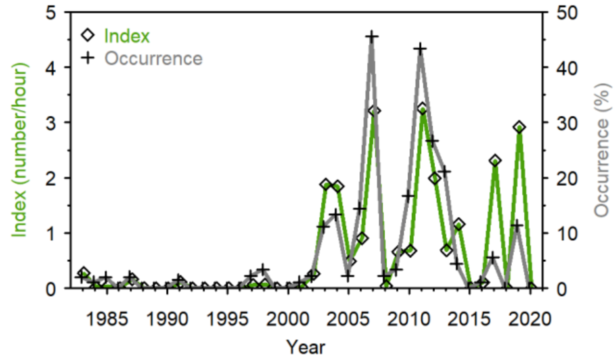

Figure 3.2.12. Ling in 5.b. Index (number/hour) and occurrence (%) of ling (2–3 cm in length) caught in the annual 0-group survey on the Faroe Plateau.

3.2.6.2 Stock assessment

Prior to the WKBARFAR benchmark in February 2021 this stock was under ICES 3.2 rule, where the advice was based on a survey trend-based assessment (ICES, 2019) using a survey biomass index (kg/h) from the Faroese summer groundfish survey. However, an exploratory age based assessment using SAM has been presented in the WGDEEP report since 2017 (ICES, 2020). At the WKBARFAR benchmark 2021 a Category 1 approach was adopted using the SAM model (ICES, 2021 and stock annex).

Analytical assessment using SAM

The input for the SAM model was catch at age for ages 3 to 12+ and for years back to 1996. Catch at age was derived from the Faroese sampling, and thereafter raised to the total catches. Maturity at age was from the Faroese survey data and used as time-invariant variable. Natural mortality was set to 0.15 for all ages and years. The age-disaggregated tuning series were the Faroese summer survey, ages 3 to 11 years (1996-2020) and the Faroese spring survey, ages 4 to 11 years (1998-2020). SAM model settings are described in detail in the stock annex.

The catches at age for the spring- and summer survey tuning series are presented in Table 3.2.9 and 3.2.10. They show periods of good year classes. An indication of good year classes was also seen in the 0-group survey (Figure 3.2.12). Stratified mean catch of ling in kg per hour shows an increased level since around 2010 in both surveys (Figure 3.2.10). The summer survey consistency plot shows good consistency between the cohorts (Figure 3.2.13), but in the spring survey the consistency in the cohorts is not as good (Figure 3.2.14). The fish seems to be fully recruited to the survey gear at around age 5.

The results and diagnostics of the final assessment **Ling5b_wgdeep2021** (stockassessment.org) are presented in Tables 3.2.11-3.2.14 and Figures 3.2.15-3.2.19.

The results from SAM shows that the spawning stock biomass (SSB) currently is at the highest level for the whole assessment period (since 1996) (Figure 3.2.15, Tables 3.2.11, 3.2.13). The fishing mortality ($F_{6\text{-}10}$) has generally been around 0.4; but F decreased to F_{MSY} in 2017 and 2018, and has since increased again to 0.3 in 2020 (Figure 3.2.15, Tables 3.2.11, 3.2.12). The increase in SSB and decrease in F is explained by good recruitments (Figure 3.2.15, Table 3.2.11).

The SAM results for 2020 showed that the spawning stock biomass was well above MSY $B_{trigger}$ and the fishing mortality above F_{MSY} but below F_{pa} and F_{lim}.

The diagnostics from SAM is shown as model fits to the data (Figure 3.2.16), residuals (Figure 3.2.17), leave-one-out analysis (Figure 3.2.18), retrospective analysis (Figure 3.2.19) and parameter estimates (Table 3.2.14). Overall, it seems that the model fits the data quite well. The residuals are randomly distributed. The leave one out analysis shows that the model is robust, only for recruitment it seems to give a bit different results. The retrospective pattern shows that F is overestimated and SSB subsequently underestimated. All the retrospective runs falls within the confidence intervals of the final assessment. Mohn’s rho parameters are estimated at -12%, 27% and 1% for the spawning stock biomass, F and recruitment, respectively.

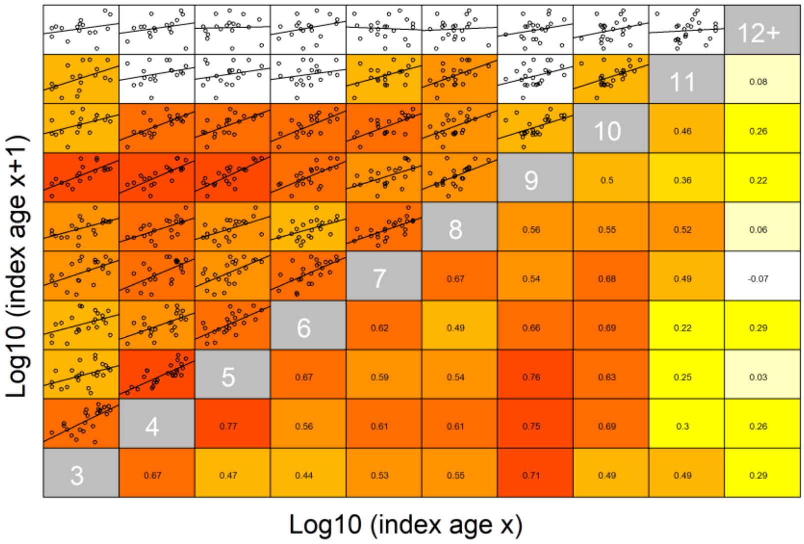

Figure 3.2.13. Ling in 5.b. Consistency plot of catch-at-age in the summer survey tuning series in the assessment.

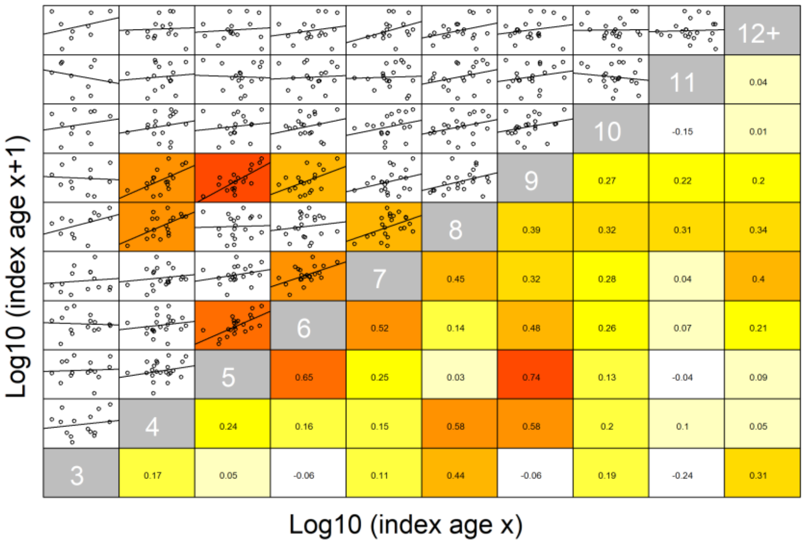

Figure 3.2.14. Ling in 5.b. Consistency plot of catch-at-age in the spring survey tuning series in the assessment.

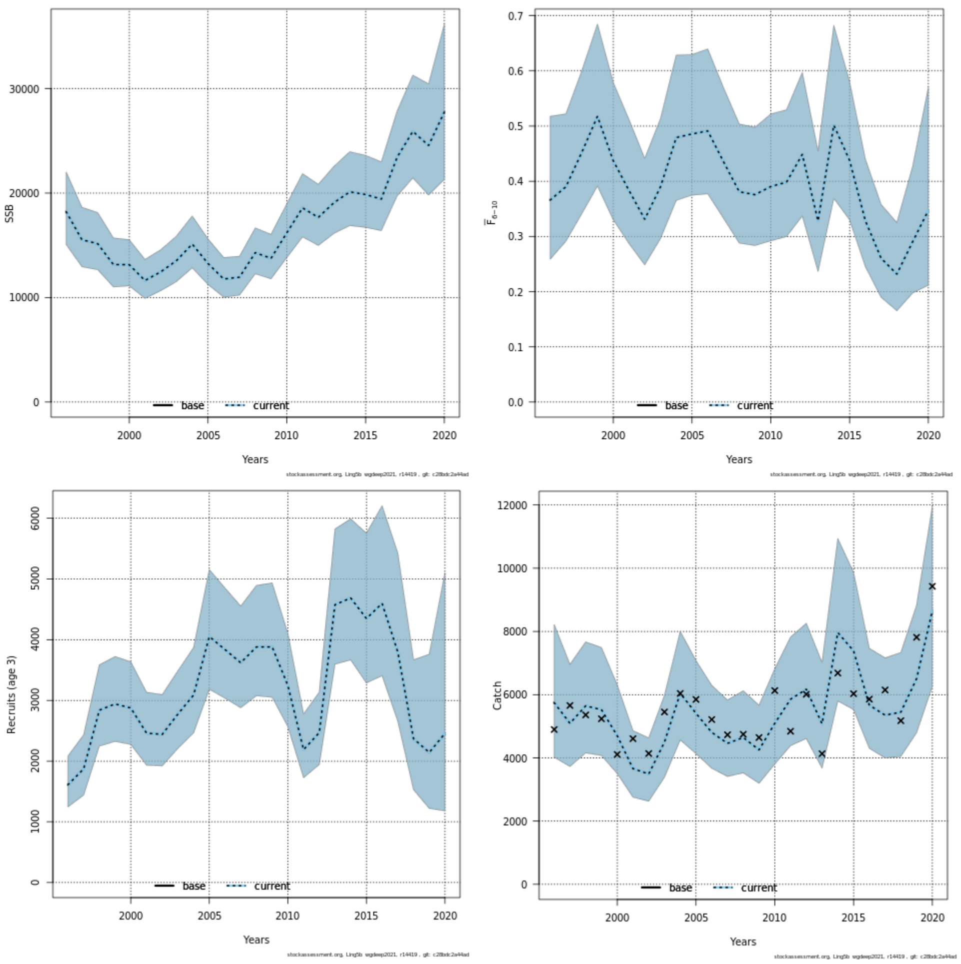

Figure 3.2.15. Ling in 5.b. Output from SAM. Results per year for spawning stock biomass (tonnes, upper left), fishing mortality ($F_{6\text{-}10}$, upper right), recruitment (age 3, thousands, lower left) and catch (tonnes, lower right). Stippled line is median, shaded area is 95% CI and x- is actual catch.

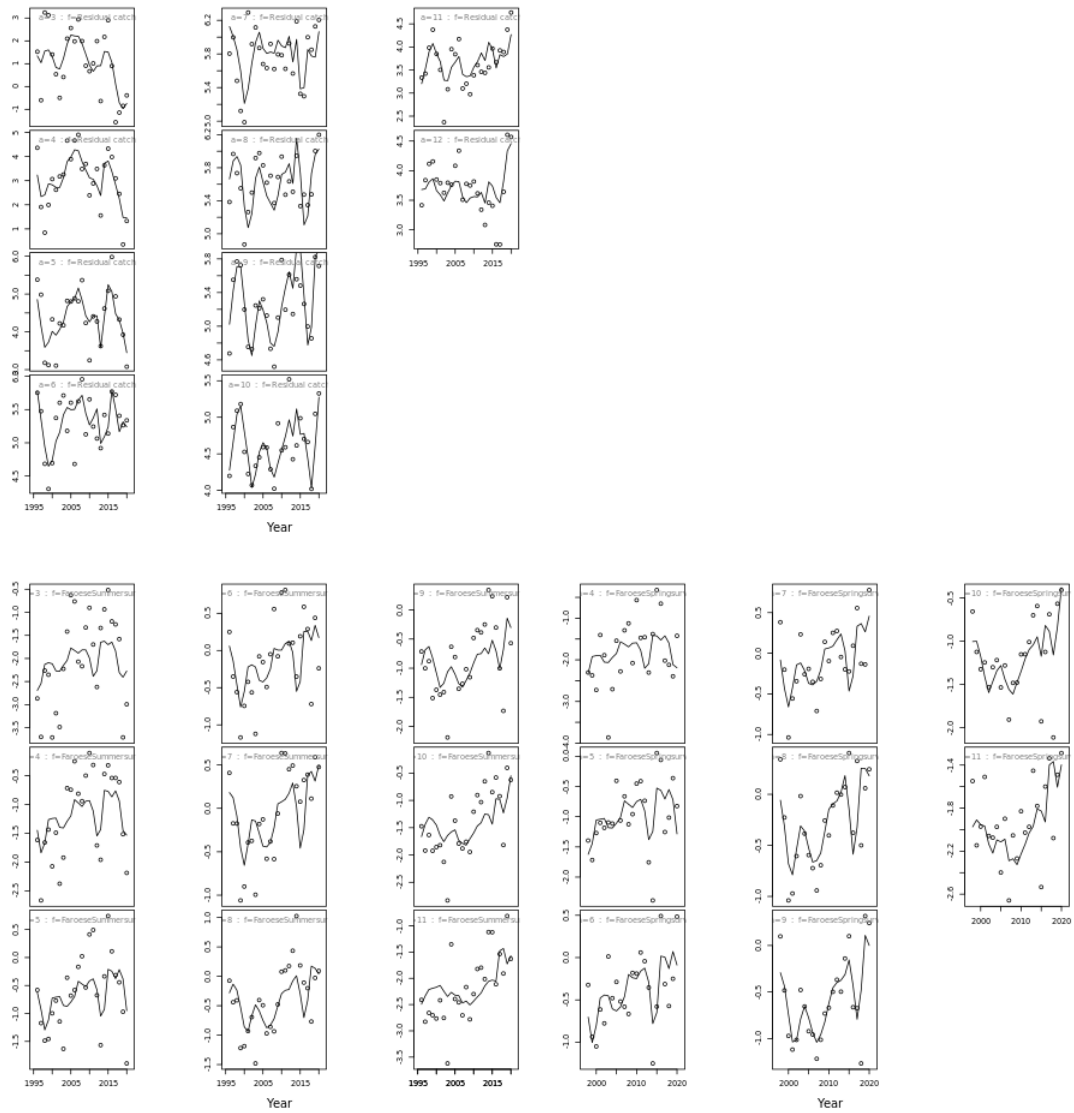

Figure 3.2.16. Ling in 5.b. Output from SAM. Model fit of data; catch (upper left), summer survey (lower left) and spring survey (lower right).

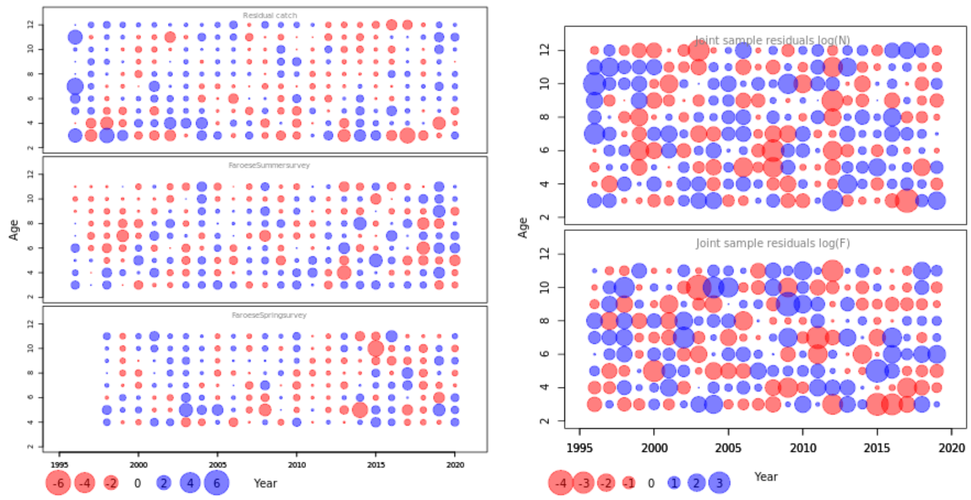

Figure 3.2.17. Ling in 5.b. Output from SAM. Estimated correlations and residuals.

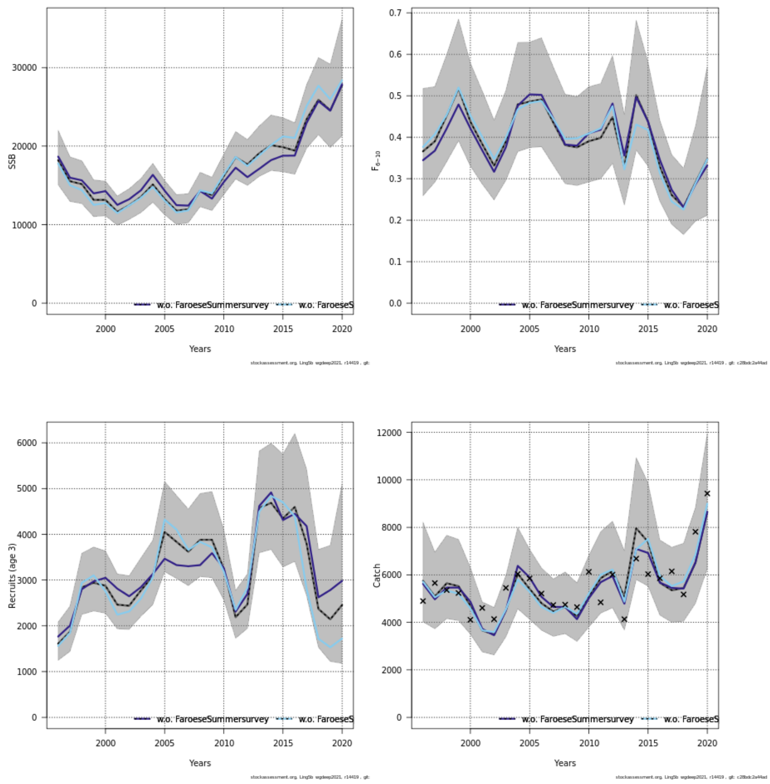

Figure 3.2.18. Ling in 5.b. Output from SAM. Leave-one-out analysis of SSB (upper left), fishing mortality (upper right), recruitment (lower left) and catch (lower right).

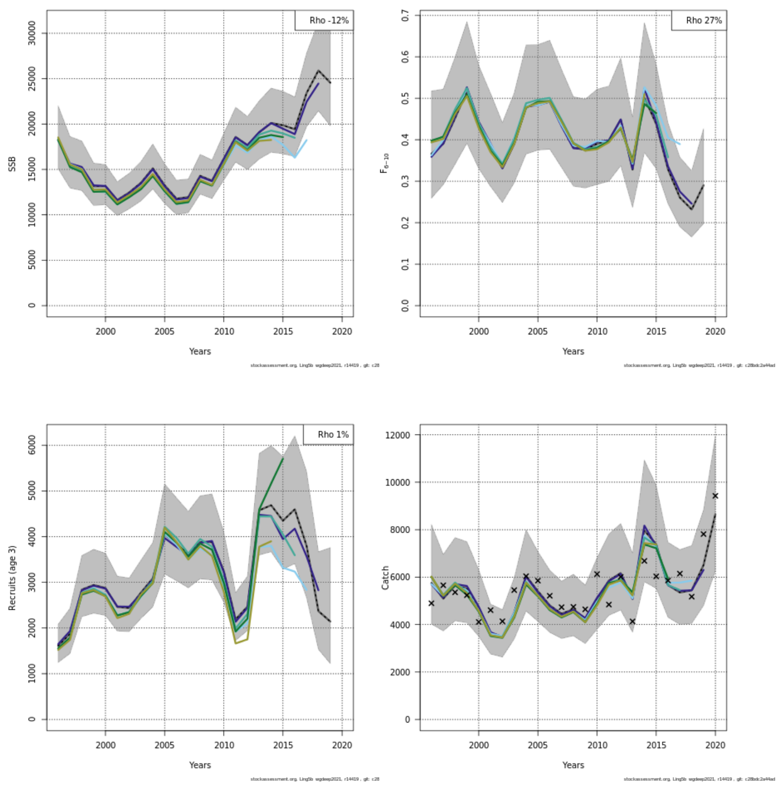

Figure 3.2.19. Ling in 5.b. Output from SAM. Retrospective analysis of SSB (upper left), fishing mortality (upper right), recruitment (lower left) and catch (lower right).

3.2.6.3 Quality of the assessment

Ling 5.b was benchmarked in 2021 (ICES, 2021), where the assessment was transformed from a trend-based assessment derived from the Faroese summer survey to a SAM state-space assessment using catch at age information and the Faroese spring- and summer surveys as tuning series. An exploratory assessment for ling in 5.b has been done for several years (with only summer survey as tuning series), and a comparison between the assessments of WGDEEP 2021 and the exploratory assessment WGDEEP 2020 indicates that the model results are comparable, although recruitment and F are estimated a bit higher at WGDEEP 2020 than in the 2021 assessment and SSB and TSB lower. Though, these values are still well inside the 95% CI.

3.2.7 Short term prediction

At the benchmark 2021 suggested settings for the short term prediction was approved (ICES, 2021), was performed in the final assessment **Ling5b_wgdeep2021** (stockassessment.org). The description of the model settings is found in the stock annex.

3.2.7.1 Input data

The assumptions made for the interim year and in the forecast are presented in the table below.

Variable	Value	Notes
$F_{ages\ 6\text{–}10}$ (2021)	0.357	$F_{sq} = F_{2020}$
SSB (2022)	25 070	Short-term forecast fishing at F_{sq}; Tonnes.
$R_{age\ 3}$ (2021/2022)	2 942	Median recruitment, resampled from the years 1996–2019; Thousands.
Total catch (2021)	8 744	Short-term forecast using F_{sq}; Tonnes.

3.2.7.2 Results

Results of short term forecast using F=F_{MSY} including confidence intervals (low and high columns) is presented in the Table below. According to the short term forecast with the F_{MSY} advised (F_{MSY} = 0.23), catches are projected to 5 636 tonnes in 2022, resulting in an SSB in 2022 of 25 070 tonnes, when assuming a recruitment of 2 942 thousands in 2021 and 2022. Under these conditions, SSB will be at the same level in 2023 as in 2022, at 25 018 tonnes.

Catch options for scenarios with F_{MSY}, F_{pa}, F_{lim}, F_{sq} and F = 0 is presented in Table 3.2.15.

Year	F_{6-10}			Recruitment (thousands)			SSB (tonnes)			Catch (tonnes)			TSB (tonnes)		
	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High	Median	Low	High
2021	0.357	0.222	0.572	2497	1182	5323	27949	21684	36598	8754	6347	11883	38581	29763	50605
2021	0.357	0.222	0.572	2942	1611	4687	27756	19317	38145	8744	6965	11072	37830	27217	51272
2022	**0.23**	0.143	0.368	**2942**	1611	4687	**25070**	15592	37169	**5636**	4388	7439	35165	24098	49968
2023	**0.23**	0.143	0.368	**2942**	1611	4687	**25018**	14821	39170	5660	4071	7686	35807	24113	51326

3.2.8 Reference points

The reference points for ling in 5.b are shown in the Table below. Description of the reference points calculation is given in the stock annex and in ICES, 2021.

$MSY_{Btrigger}$	$5thPerc\_SSB_{msy}$	B_{pa}	B_{lim}	F_{pa}	F_{lim}	F_{p05}	$F_{msy\_unconstr}$	F_{MSY}
11627	21707	11627	9340	0.62	0.85	0.6	0.23	0.23

3.2.9 Comments on assessment

All signals from the commercial catches and also surveys indicate that ling stock in Division 5.b at present is in good condition, and this is also confirmed in the assessment.

3.2.10 Management consideration

Stability in landings and abundance indices do suggest that ling stock in Division 5.b has been stable since middle of the 1980s, with an increasing trend in biomass in the last decade. The available data series does not cover the entire period of the fishery (back to the early 1900s; see Figure 3.2.3) and no information is available on stock levels prior to 1986. There is evidence of increased recruitments in last decade compared to earlier (Figure 3.2.15).

The only species-specific management in effect for Faroese fisheries of ling in Division 5.b is the recommended minimum landing size (60 cm). But this seems not to be enforced because of the general discard ban. Up to 25% of ling catches (per settings/hauls) can be juveniles e.g. smaller than 75 cm.

The exploitation of ling is influenced by regulations aimed at other groundfish species, e.g. cod, haddock, and saithe; such as closed areas. Fisheries by other nations are regulated by TACs.

The Faroese effort management system introduced in 1996 is in force for the demersal fleets operating on the Faroe Plateau. A preliminary management plan using a harvest control rule was adopted by the Faroese fisheries authorities in 2020, and applied for the first time for the calendar year 2021. The number of fishing days was decided according to the stock status of cod, haddock and saithe. Although the management plan opens up for the development of special bycatch rules, this has not yet been integrated. The management plan has not been evaluated by ICES, but will likely be sent to review in 2021.

3.2.11 Ecosystem considerations

Since on average 67% of the catches are taken by longlines, the remaining by trawls, the effects of the ling fishery on the bottom fauna and benthic ecosystem is moderate (Table 3.2.4).

3.2.12 Future research and data requirements

The aim is to collect a sufficient number of individual age and maturity samples to cover both the Faroese spring- and summer surveys, especially from the smallest and largest individuals.

3.2.13 References

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3.2.14 Tables

Table 3.2.1. Ling in 5.b1. Nominal landings (1988–present).

Year	Denmark(2)	Faroes	France	Germany	Norway	E&W(1)	Scotland (1)	Russia	Total
1988	42	1383	53	4	884	1	5		2372
1989		1498	44	2	1415		3		2962
1990		1575	36	1	1441		9		3062
1991		1828	37	2	1594		4		3465
1992		1218	3		1153	15	11		2400
1993		1242	5	1	921	62	11		2242
1994		1541	6	13	1047	30	20		2657
1995		2789	4	13	446	2	32		3286
1996		2672			1284	12	28		3996
1997		3224	7		1428	34	40		4733
1998		2422	6		1452	4	145		4029
1999		2446	17	3	2034	0	71		4571
2000		2103	7	1	1305	2	61		3479
2001		2069	14	3	1496	5	99		3686
2002		1638	6	2	1640	3	239		3528
2003		2139	12	2	1526	3	215		3897
2004		2733	15	1	1799	3	178	2	4731
2005		2886	3		1553	3	175		4620
2006	3	3563	6		850		136		4558
2007	2	3004	9		1071		6		4092
2008		3354	4		740	32	25	11	4166
2009	13	3471	2		419		270		4174
2010	28	4906	2		442		121		5500
2011	49	4270	2		0		0		4321
2012	117	5452	7		0		0		5576
2013	3	3734	7		0		0		3744
2014		5653	10		308		0	13	5983

Year	Denmark(2)	Faroes	France	Germany	Norway	E&W(1)	Scotland (1)	Russia	Total
2015		4375	16		993	1	0	6	5391
2016		4214	8		855	0	103		5180
2017		4371	4		864		54		5294
2018		3836	2		793		42		4673
2019		4862	25		1983		27		6895
2020*		5642	16		2537		83		8277

***Preliminary.**

(1) Includes 5.b2.

(2) Greenland 2006–2013.

Table 3.2.2. Ling in 5.b2. Nominal landings (1988–present).

Year	Faroes	France	Norway	Scotland	Total
1988	832		1284		2116
1989	362		1328		1690
1990	162		633		795
1991	492		555		1047
1992	577		637		1214
1993	282		332		614
1994	479		486		965
1995	281		503		784
1996	102		798		900
1997	526		398		924
1998	511		819		1330
1999	164	4	498		666
2000	229	1	399		629
2001	420	6	497		923
2002	150	4	457		611
2003	624	4	927		1555
2004	1058	3	247		1308
2005	575	7	647		1229
2006	472	6	177		655

2007	327	4	309		640
2008	458	3	120		580
2009	270	1	198		469
2010	393	1	236		630
2011	522	0	0		522
2012	434	1	0		435
2013	387	1	0		388
2014	276		389	7	672
2015	244	1	337	3	585
2016	569	4	126	11	710
2017	359		542		901
2018	428		78	6	512
2019	338		580	2	920
2020*	1015		128	6	1149

***Preliminary.**

Table 3.2.3. Ling in 5.b. Nominal landings (1988–present).

Year	5.b1	5.b2	5.b
1988	2372	2116	4488
1989	2962	1690	4652
1990	3062	795	3857
1991	3465	1047	4512
1992	2400	1214	3614
1993	2242	614	2856
1994	2657	965	3622
1995	3286	784	4070
1996	3996	900	4896
1997	4733	924	5657
1998	4029	1330	5359
1999	4571	666	5238
2000	3479	629	4109
2001	3686	923	4609

Year	5.b1	5.b2	5.b
2002	3528	611	4139
2003	3897	1555	5453
2004	4731	1308	6039
2005	4620	1229	5849
2006	4558	655	5213
2007	4092	640	4731
2008	4166	580	4747
2009	4174	469	4643
2010	5500	630	6129
2011	4321	522	4843
2012	5576	435	6011
2013	3744	388	4132
2014	5983	672	6655
2015	5391	585	5976
2016	5180	710	5890
2017	5294	901	6195
2018	4673	512	5185
2019	6895	920	7816
2020*	8277	1149	9427

***Preliminary.**

Table 3.2.4. Ling in 5.b. Catch distribution by fleet and total catch in 1996 to 2020. * preliminary catch.

Year	Trawl (%)	Longline (%)	Other (%)	Total catch (tonnes)
1996	31	68	1	4896
1997	37	62	1	5657
1998	39	61	0	5359
1999	37	62	1	5238
2000	42	57	1	4109
2001	37	61	1	4609
2002	41	57	1	4139

Year	Trawl (%)	Longline (%)	Other (%)	Total catch (tonnes)
2003	33	65	2	5453
2004	25	73	1	6039
2005	27	72	1	5849
2006	24	75	1	5213
2007	33	66	1	4731
2008	24	75	1	4747
2009	27	72	1	4643
2010	23	76	1	6129
2011	29	71	1	4843
2012	30	70	0	6011
2013	29	70	0	4132
2014	28	72	0	6684
2015	42	58	0	6031
2016	37	62	1	5857
2017	31	69	0	6148
2018	34	66	0	5185
2019	39	61	0	7816
2020	31	69	0	9427*
Average	32	67	1	5558

Table 3.2.5. Ling in 5.b. Overview of the sampling from commercial landings since 1996.

	Lengths			Gutted weights			Ages		
Year	Long-liners	Trawl-ers	Other	Long-liners	Trawl-ers	Other	Long-liners	Trawl-ers	Other
1996	5003	1426	48	290	120	0	709	375	0
1997	6493	1407	0	361	180	0	1195	331	0
1998	4163	1651	193	180	358	0	723	358	0
1999	3024	1067	445	180	120	60	240	180	60
2000	1719	1793	0	120	240	0	120	240	0
2001	2243	1562	0	180	240	0	180	240	0

2002	1845	2454	0	60	120	0	120	180	0
2003	4533	2052	0	120	240	0	421	240	0
2004	4350	2477	0	990	179	0	480	179	0
2005	4995	2172	0	3097	120	0	420	120	0
2006	4936	1291	0	3576	1082	0	157	119	0
2007	2077	1662	172	1034	447	172	60	60	0
2008	1432	1087	0	1215	730	0	60	0	0
2009	2127	2246	0	2102	2246	0	112	120	0
2010	1421	2502	422	1421	2436	422	60	120	0
2011	1438	1765	202	1438	1188	202	0	0	0
2012	1413	1397	0	1283	1164	0	50	0	0
2013	1040	1437	0	1040	1036	0	0	0	0
2014	827	1953	205	827	1242	205	0	20	0
2015	820	1724	0	820	1351	0	40	170	0
2016	1432	1329	0	1432	928	0	180	180	0
2017	1201	1776	0	1201	1225	0	239	241	0
2018	2717	4726	0	2717	4726	0	659	1013	0
2019	2890	3576	0	2890	3576	0	300	592	0
2020	1276	2698	0	705	1911	0	360	569	60

Table 3.2.6. Ling in 5.b. Overview of the sampling from spring-, summer and other surveys since 1996. * Have gender but not maturity.

	Lengths			Round weights			Ages			Gender and maturity		
Year	Spring	Summer	Other	Spring	Summer	Other	Spring	Summer	Other	Spring	Summer	Other
1996	398	1013	235	129	216	26	0	0	11	0	0	15
1997	460	631	274	0	247	79	0	0	0	0	0	0
1998	514	648	280	190	462	173	0	0	0	230*	20	5
1999	300	372	84	252	355	62	0	0	0	248*	3	7

	Lengths			Round weights			Ages			Gender and maturity		
2000	245	433	498	244	360	313	0	0	0	14	1	0
2001	347	553	600	265	503	472	0	0	0	28	0	2
2002	285	510	542	222	477	389	0	0	0	0	0	0
2003	389	284	660	345	284	582	0	0	0	0	0	0
2004	284	857	418	284	802	345	0	0	0	0	0	0
2005	321	821	172	264	719	161	0	0	0	0	0	0
2006	271	647	220	264	612	214	0	0	0	0	1	0
2007	268	729	99	247	662	99	0	0	0	0	0	0
2008	309	973	66	208	779	65	0	0	0	0	10	0
2009	413	859	152	371	608	152	0	0	0	0	0	0
2010	395	1637	125	281	1021	125	0	0	0	0	0	0
2011	507	1826	167	411	1400	165	0	0	0	3	0	0
2012	518	1160	145	518	1109	144	0	0	0	0	0	0
2013	427	1232	120	427	1105	120	100	78	96	100	78	114
2014	336	1725	674	330	1280	658	161	195	200	177	195	206
2015	562	1440	1077	496	1043	962	92	92	234	100	91	235
2016	409	1366	550	409	1265	550	131	191	110	131	193	110
2017	372	1004	306	308	914	247	124	201	112	126	203	115
2018	265	712	682	265	687	682	228	221	343	227	222	345
2019	490	1318	465	435	1089	465	144	147	155	144	147	162

Lengths			Round weights			Ages			Gender and maturity		
2020 665	900	249	594	884	249	181	140	99	186	140	99

Table 3.2.7. Ling in 5.b. Catch numbers at age (*1000) used in the assessment.

Year/Age	3	4	5	6	7	8	9	10	11	12+
1996	4.61	78.35	217.21	315.07	331.78	218.24	107.42	66.60	28.09	30.47
1997	0.55	6.75	146.07	238.84	402.52	390.43	257.69	129.96	30.65	46.49
1998	25.65	2.33	24.05	108.31	240.07	309.48	320.41	162.44	53.70	61.29
1999	22.75	7.35	22.63	74.23	167.75	257.56	306.70	178.02	79.40	63.87
2000	4.08	21.44	75.97	109.44	146.73	130.44	181.12	92.52	46.92	47.02
2001	1.72	13.75	22.35	215.75	540.89	193.18	116.06	68.42	33.26	44.27
2002	0.61	23.90	68.27	271.06	371.53	244.48	113.10	58.66	10.70	37.57
2003	1.52	25.89	64.96	302.49	453.02	371.62	189.99	76.46	21.85	44.53
2004	8.17	105.61	123.96	177.67	354.74	394.72	183.83	85.85	52.06	43.07
2005	13.02	48.96	121.94	271.20	293.16	340.27	204.43	98.64	46.65	59.31
2006	7.26	106.18	132.44	107.98	279.51	275.68	168.54	98.24	64.85	76.51
2007	18.96	134.46	122.59	276.73	372.36	299.89	113.57	72.91	22.21	33.42
2008	7.34	32.64	214.41	386.01	276.34	215.38	91.76	55.91	24.63	43.71
2009	2.49	40.18	69.00	168.71	328.79	295.46	164.51	136.75	19.61	42.54
2010	1.96	10.95	25.69	285.53	325.54	378.05	326.26	94.46	29.59	45.48
2011	2.76	17.90	82.28	189.47	276.87	238.35	180.57	98.56	36.85	37.23
2012	7.33	32.67	71.90	158.38	374.58	280.16	274.01	249.81	31.86	28.24
2013	0.53	4.75	37.42	137.06	261.82	246.96	171.52	83.66	31.18	21.83
2014	8.82	37.92	101.19	225.79	486.84	382.35	259.59	101.01	35.07	31.81
2015	18.28	75.68	161.86	170.67	205.68	207.57	240.45	146.60	52.78	30.18
2016	2.46	53.49	395.66	320.91	199.76	238.59	193.40	110.50	39.20	15.73
2017	0.21	22.12	139.53	305.36	403.18	210.10	147.90	105.84	50.66	15.70
2018	0.32	11.62	75.56	222.94	347.56	239.32	128.53	55.74	48.96	38.21
2019	0.43	1.43	50.59	193.19	458.31	405.07	337.82	155.72	79.56	100.16
2020	0.63	3.51	20.19	193.48	460.41	458.05	282.34	191.36	107.11	89.74

Table 3.2.8. Ling in 5.b. Weighted mean weights at age used in the assessment.

Year/Age	3	4	5	6	7	8	9	10	11	12+
1996	0.437	1.033	1.815	2.549	3.356	3.949	5.054	7.143	8.600	12.509
1997	0.689	0.772	1.271	1.932	2.602	3.487	4.427	5.643	7.740	10.415
1998	1.038	1.345	1.469	2.112	2.728	3.500	4.486	5.599	6.786	10.064
1999	0.987	1.299	1.377	2.092	2.739	3.552	4.462	5.843	7.122	10.506
2000	1.037	1.402	2.005	2.517	2.855	4.374	5.775	7.157	8.622	11.587
2001	0.549	0.858	1.154	2.093	2.651	3.983	5.555	7.207	8.136	11.429
2002	0.660	1.081	1.351	2.146	2.888	3.728	4.665	6.798	7.239	11.995
2003	0.701	0.818	1.181	2.225	2.890	3.732	4.463	6.123	7.585	11.290
2004	0.654	1.292	1.674	2.251	3.093	4.042	5.271	6.923	9.080	13.031
2005	0.528	0.964	1.300	2.006	2.890	3.950	5.241	7.034	8.270	12.661
2006	0.495	0.876	1.378	1.867	2.719	3.710	5.145	6.323	7.987	12.332
2007	0.788	1.010	1.216	2.092	2.841	3.651	5.138	6.915	9.019	12.339
2008	0.872	0.942	1.534	2.317	3.295	4.070	5.944	6.713	9.197	12.625
2009	0.796	1.006	1.462	1.965	2.830	3.556	4.514	6.124	7.682	10.750
2010	0.897	1.049	1.248	2.072	3.133	3.730	5.066	6.311	9.372	11.798
2011	0.901	1.173	1.705	2.358	3.165	4.159	5.277	6.564	8.211	12.429
2012	0.770	0.929	1.342	2.043	2.845	3.804	4.716	6.169	8.646	11.149
2013	1.036	1.352	1.912	2.519	3.238	4.048	5.013	6.282	7.947	10.466
2014	0.765	0.963	1.540	2.400	3.424	4.225	5.275	6.356	8.056	11.528
2015	0.775	0.864	1.438	2.565	3.940	4.812	6.233	7.580	8.947	12.918
2016	0.500	0.805	1.364	2.585	3.610	4.575	6.269	7.711	9.064	13.436
2017	0.672	1.085	1.867	2.846	3.763	4.952	6.445	7.821	9.049	12.586
2018	0.735	1.231	1.878	2.516	3.578	4.632	5.886	7.411	9.537	12.299
2019	0.702	0.707	1.294	2.030	2.703	3.738	5.176	6.298	8.056	12.321
2020	0.930	0.995	1.205	2.062	3.013	4.206	5.585	7.200	8.462	12.949

Table 3.2.9. Ling in 5.b. Spring survey input to the tuning series in the assessment.

Year	Effort/Age	4	5	6	7	8	9	10	11
1998	99	9.89	24.55	71.72	145.22	139.42	109.23	51.43	21.05
1999	100	9.32	17.96	39.25	81.76	79.70	61.73	32.54	11.70
2000	100	6.56	28.07	35.01	35.48	35.38	37.82	26.64	13.93
2001	100	24.58	33.24	54.15	57.28	37.88	32.66	28.81	22.10
2002	100	15.14	30.60	45.98	70.90	54.61	36.26	21.67	12.77
2003	100	2.10	33.42	101.31	126.24	98.29	61.98	27.26	12.56
2004	100	6.69	32.83	61.94	77.23	68.05	51.93	29.60	13.89
2005	100	21.42	66.62	75.03	82.55	55.15	39.79	21.59	9.09
2006	100	10.26	34.55	59.54	70.37	48.54	38.40	27.83	14.98
2007	100	27.50	51.54	55.93	49.14	39.00	29.58	14.88	7.01
2008	99	32.19	32.12	50.88	72.16	49.44	35.93	22.52	12.70
2009	100	12.53	38.37	83.48	115.08	77.42	48.14	22.83	10.35
2010	100	56.82	63.62	82.75	90.90	66.86	51.17	31.64	16.06
2011	102	23.41	67.54	108.40	131.17	91.45	62.01	32.31	13.43
2012	100	23.31	47.92	95.85	131.63	101.62	69.24	36.49	13.89
2013	100	9.97	17.30	70.18	95.52	99.77	60.88	49.70	23.41
2014	99	24.90	9.11	28.35	81.17	106.26	86.14	54.74	16.70
2015	96	69.48	101.31	53.80	76.77	143.87	106.13	14.00	7.62
2016	100	52.22	94.11	163.49	109.75	68.63	51.51	32.53	20.20
2017	90	11.96	25.69	65.83	157.08	124.76	45.87	45.23	23.65
2018	99	11.88	35.88	55.86	87.03	60.08	27.86	11.99	12.39
2019	100	9.12	69.58	77.89	87.17	106.18	137.35	56.81	22.55
2020	91	21.93	39.91	147.74	198.27	116.33	115.87	60.55	25.11

Table 3.2.10. Ling in 5.b. Summer survey input to tuning series in the assessment.

Year	Effort/Age	3	4	5	6	7	8	9	10	11
1996	200	11.38	39.70	111.95	256.77	300.86	185.77	98.00	45.83	17.95
1997	200	4.94	13.89	61.94	140.89	168.21	128.83	73.46	29.36	11.85
1998	201	20.92	38.21	45.48	114.95	168.79	133.77	83.41	39.23	14.09
1999	199	18.93	47.30	46.45	61.87	68.93	58.80	43.86	29.08	13.34
2000	200	4.89	25.12	73.80	95.02	81.32	61.06	50.79	31.30	12.60
2001	200	8.27	45.07	92.59	131.29	135.02	78.89	46.75	32.41	17.82
2002	199	6.10	18.48	63.43	113.29	136.87	99.41	48.59	23.73	12.67
2003	200	21.61	29.24	39.10	65.24	73.98	45.50	22.43	11.78	5.36
2004	200	48.54	97.79	139.48	184.82	167.07	133.66	106.36	79.13	51.71
2005	200	106.85	95.08	101.27	171.28	176.16	122.33	89.16	50.75	18.26
2006	200	93.25	155.98	111.89	122.50	111.92	75.77	51.65	33.39	17.12
2007	199	25.15	88.26	168.60	189.28	135.89	84.28	56.02	30.35	13.32
2008	200	22.87	78.03	204.72	349.54	111.51	78.49	72.37	34.51	22.90
2009	200	52.94	121.59	117.20	184.95	188.36	124.15	63.02	28.61	12.40
2010	200	81.20	179.96	302.53	436.20	378.24	216.37	123.76	59.79	20.05
2011	200	36.65	146.14	327.38	451.03	376.30	221.33	141.50	81.09	32.33
2012	202	14.74	36.49	102.95	221.93	316.95	240.56	137.37	71.99	33.48
2013	202	52.95	28.43	42.21	224.36	330.64	312.16	157.45	105.37	26.94
2014	200	78.55	125.02	142.89	140.83	258.05	557.88	281.63	175.20	65.24
2015	200	119.36	145.39	420.17	242.21	215.94	240.78	253.17	85.59	65.09
2016	199	60.14	116.01	222.53	358.31	275.61	178.93	147.10	111.26	24.05
2017	203	57.55	118.45	148.43	271.06	299.32	165.99	74.49	80.68	43.59
2018	202	41.65	109.80	129.74	98.40	226.02	93.65	35.76	32.80	29.95
2019	200	4.90	43.91	75.89	310.24	360.70	194.83	249.01	133.51	88.56
2020	199	9.98	22.31	29.98	156.65	320.24	218.20	112.55	106.64	39.00

Table 3.2.11. Ling in 5.b. Estimated recruitment, spawning stock biomass (SSB), and average fishing mortality.

Year	$R_{(age\ 3)}$	Low	High	SSB	Low	High	$Fbar_{(6-10)}$	Low	High	TSB	Low	High
1996	1609	1244	2081	18210	15068	22006	0.366	0.259	0.517	29077	24628	34330
1997	1870	1438	2431	15533	12952	18629	0.391	0.292	0.522	22734	19410	26627
1998	2837	2246	3584	15148	12668	18113	0.452	0.341	0.599	24196	20888	28029
1999	2939	2323	3719	13144	11013	15687	0.517	0.391	0.684	22580	19577	26045
2000	2872	2272	3631	13141	11124	15524	0.437	0.331	0.579	25131	21891	28850
2001	2459	1931	3131	11627	9913	13638	0.384	0.288	0.512	19554	17026	22457
2002	2436	1919	3091	12451	10649	14557	0.332	0.249	0.442	21536	18756	24727
2003	2772	2206	3483	13519	11519	15865	0.390	0.297	0.513	21971	19101	25271
2004	3086	2462	3868	15101	12828	17776	0.479	0.365	0.628	25448	22164	29220
2005	4049	3182	5151	13244	11247	15595	0.486	0.375	0.629	22337	19485	25607
2006	3833	3033	4846	11762	10021	13806	0.491	0.377	0.639	21336	18638	24426
2007	3616	2875	4547	11941	10229	13939	0.435	0.333	0.569	23562	20604	26945
2008	3874	3072	4885	14288	12263	16647	0.381	0.288	0.504	27599	24102	31604
2009	3873	3045	4924	13745	11785	16030	0.376	0.284	0.498	26473	23096	30343
2010	3239	2562	4095	16170	13807	18938	0.391	0.293	0.522	28970	25198	33306
2011	2183	1721	2769	18554	15780	21815	0.398	0.300	0.529	32022	27751	36952
2012	2462	1937	3128	17640	14963	20797	0.448	0.337	0.596	27754	23990	32110
2013	4557	3581	5799	19061	16126	22530	0.329	0.238	0.456	33037	28577	38195
2014	4664	3648	5962	20065	16849	23895	0.501	0.369	0.681	32716	28222	37926
2015	4324	3266	5724	19820	16680	23551	0.438	0.331	0.581	33727	29059	39144
2016	4567	3382	6167	19364	16363	22916	0.330	0.246	0.441	33003	28257	38548
2017	3770	2637	5392	23319	19623	27711	0.262	0.191	0.360	40377	34048	47882
2018	2353	1519	3647	25740	21307	31095	0.234	0.167	0.328	41814	34476	50714
2019	2124	1209	3732	24360	19632	30227	0.290	0.197	0.428	34812	27949	43361
2020	2424	1165	5045	27531	21094	35933	0.329	0.201	0.540	37741	28751	49543

Table 3.2.12. Ling in 5.b. Estimated fishing mortality at age.

Year /Age	3	4	5	6	7	8	9	10	11	12
1996	0.003	0.014	0.060	0.158	0.304	0.367	0.453	0.546	0.441	0.441
1997	0.002	0.008	0.041	0.127	0.289	0.391	0.517	0.629	0.511	0.511
1998	0.002	0.007	0.033	0.116	0.302	0.449	0.627	0.766	0.629	0.629
1999	0.002	0.008	0.032	0.117	0.334	0.529	0.736	0.871	0.715	0.715
2000	0.001	0.007	0.029	0.104	0.284	0.454	0.636	0.708	0.584	0.584
2001	0.001	0.007	0.026	0.100	0.266	0.389	0.543	0.620	0.490	0.490
2002	0.001	0.008	0.030	0.111	0.273	0.359	0.434	0.483	0.379	0.379
2003	0.001	0.012	0.042	0.147	0.347	0.445	0.499	0.513	0.412	0.412
2004	0.002	0.020	0.064	0.193	0.437	0.545	0.594	0.625	0.495	0.495
2005	0.003	0.022	0.067	0.192	0.421	0.536	0.604	0.674	0.570	0.570
2006	0.003	0.023	0.066	0.183	0.403	0.518	0.610	0.742	0.637	0.637
2007	0.003	0.023	0.067	0.186	0.391	0.462	0.523	0.614	0.516	0.516
2008	0.002	0.016	0.051	0.153	0.331	0.388	0.457	0.576	0.479	0.479
2009	0.001	0.010	0.035	0.121	0.297	0.374	0.475	0.614	0.518	0.518
2010	0.001	0.007	0.027	0.102	0.272	0.392	0.533	0.656	0.573	0.573
2011	0.001	0.008	0.031	0.103	0.260	0.381	0.565	0.683	0.594	0.594
2012	0.001	0.010	0.037	0.115	0.276	0.412	0.657	0.782	0.651	0.651
2013	0.001	0.006	0.026	0.080	0.186	0.292	0.515	0.573	0.508	0.508
2014	0.001	0.011	0.052	0.147	0.306	0.440	0.831	0.782	0.655	0.655
2015	0.001	0.012	0.059	0.149	0.278	0.399	0.684	0.680	0.569	0.569
2016	0.001	0.009	0.051	0.133	0.232	0.326	0.493	0.464	0.406	0.406
2017	0.000	0.005	0.033	0.101	0.198	0.277	0.390	0.345	0.313	0.313
2018	0.000	0.003	0.023	0.082	0.177	0.260	0.350	0.299	0.290	0.290
2019	0.000	0.002	0.019	0.077	0.192	0.331	0.455	0.397	0.395	0.395
2020	0.000	0.002	0.020	0.080	0.204	0.364	0.531	0.467	0.475	0.475

Table 3.2.13. Ling in 5.b. Estimated stock numbers at age.

Year /Age	3	4	5	6	7	8	9	10	11	12
1996	1609	2033	2368	2375	1868	1005	445	183	74	119
1997	1870	1367	1717	1903	1738	1188	602	244	91	107
1998	2837	1621	1185	1372	1422	1119	692	308	113	103
1999	2939	2436	1415	1015	1013	886	615	317	123	100
2000	2872	2486	2091	1238	794	601	443	256	114	94
2001	2459	2500	2118	1716	1002	531	322	198	110	100
2002	2436	2126	2146	1781	1329	675	319	159	90	111
2003	2772	2111	1848	1778	1387	868	407	182	84	119
2004	3086	2388	1849	1541	1291	846	477	212	97	116
2005	4049	2627	2002	1503	1099	715	424	228	97	112
2006	3833	3488	2206	1575	1073	620	362	198	101	103
2007	3616	3292	2902	1781	1119	622	319	171	80	93
2008	3874	3075	2729	2293	1269	657	341	160	81	89
2009	3873	3359	2576	2187	1627	808	392	185	77	91
2010	3239	3384	2835	2155	1636	1008	485	212	86	86
2011	2183	2824	2946	2354	1668	1059	578	247	95	84
2012	2462	1834	2438	2447	1809	1099	626	282	107	84
2013	4557	2043	1506	2053	1904	1160	620	282	110	85
2014	4664	4049	1736	1278	1593	1418	712	326	134	100
2015	4324	3978	3564	1457	962	1011	804	254	129	103
2016	4567	3598	3420	2824	1146	638	582	344	111	111
2017	3770	3982	2948	2764	2089	819	393	311	185	127
2018	2353	3343	3438	2400	2146	1451	532	234	189	196
2019	2124	1991	2903	2933	1944	1470	981	329	153	249
2020	2424	1838	1647	2503	2375	1386	902	533	193	233

Table 3.2.14. Ling 5.b. Output from SAM. Model parameters.

Parameter name	par	Sd(par)	Exp(par)	Low	High
logFpar_0	-9.964	0.187	0	0	0
logFpar_1	-8.944	0.127	0	0	0
logFpar_2	-8.236	0.113	0	0	0
logFpar_3	-7.483	0.113	0.001	0	0.001
logFpar_4	-7.009	0.113	0.001	0.001	0.001
logFpar_5	-6.806	0.116	0.001	0.001	0.001
logFpar_6	-6.585	0.12	0.001	0.001	0.002
logFpar_7	-6.353	0.127	0.002	0.001	0.002
logFpar_8	-9.68	0.168	0	0	0
logFpar_9	-8.657	0.089	0	0	0
logFpar_10	-7.862	0.087	0	0	0
logFpar_11	-7.231	0.087	0.001	0.001	0.001
logFpar_12	-6.929	0.088	0.001	0.001	0.001
logFpar_13	-6.638	0.091	0.001	0.001	0.002
logFpar_14	-6.505	0.098	0.001	0.001	0.002
logSdLogFsta_0	-1.047	0.201	0.351	0.235	0.525
logSdLogN_0	-1.352	0.191	0.259	0.177	0.379
logSdLogN_1	-2.876	0.479	0.056	0.022	0.147
logSdLogObs_0	-0.68	0.073	0.507	0.438	0.587
logSdLogObs_1	-0.139	0.138	0.87	0.66	1.146
logSdLogObs_2	-0.579	0.137	0.561	0.426	0.737
logSdLogObs_3	-0.7	0.111	0.496	0.398	0.62
logSdLogObs_4	-0.291	0.143	0.748	0.562	0.994
logSdLogObs_5	-1.102	0.085	0.332	0.28	0.394
transfIRARdist_0	-1.439	0.248	0.237	0.145	0.389
transfIRARdist_1	-0.463	0.212	0.629	0.412	0.961
itrans_rho_0	1.305	0.266	3.686	2.164	6.28

Table 3.2.15. Ling 5.b. Forecast of recruitment (thousands), SSB (tonnes), catch (tonnes) and TSB (tonnes) when $F=F_{sq}$ in 2020 and 2021 and different scenarios such as $F=F_{MSY}$, F=0, $F=F_{pa}$, $F=F_{lim}$, $F=F_{sq}$. Median values showed.

	Year	F_{6-10}	Recruitment	SSB	Catch	TSB
$F=F_{sq}$, then F_{MSY}	2020	0.357	2497	27949	8754	38581
	2021	0.357	2942	27756	8744	37830
	2022	0.23	2942	25070	5636	35165
	2023	0.23	2942	25018	5660	35807
$F=F_{sq}$, then 0	2020	0.357	2497	27949	8754	38581
	2021	0.357	2942	27756	8744	37830
	2022	0	2942	25070	0	35165
	2023	0	2942	31436	0	42315
$F=F_{sq}$, then $F_{pa}=F_{p0.5}$	2020	0.357	2497	27949	8754	38581
	2021	0.357	2942	27756	8744	37830
	2022	0.6	2942	25070	11838	35165
	2023	0.6	2942	17951	8212	28485
$F=F_{sq}$, then F_{lim}	2020	0.357	2497	27949	8754	38581
	2021	0.357	2942	27756	8744	37830
	2022	0.85	2942	25070	14816	35165
	2023	0.85	2942	14728	8263	25166
$F=F_{sq}$	2020	0.357	2497	27949	8754	38581
	2021	0.357	2942	27756	8744	37830
	2022	0.357	2942	25070	8083	35165
	2023	0.357	2942	22279	7101	32822

3.3 Ling (*Molva Molva*) in Subareas 1 and 2

3.3.1 The fishery

Ling has been fished in Subareas 1 and 2 for centuries, and the historical development is described in Bergstad and Hareide (1996). In particular, the post-World War II increase in catch caused by a series of technical advances, are well documented. Currently the major fisheries in Subareas 1 and 2 are the Norwegian longline and gillnet fisheries, and bycatches of ling are taken by other gears, such as trawls and handlines. Historically around 50% of the Norwegian landings were taken by longlines and 45% by gillnets, partly in directed ling fisheries and as bycatch in other fisheries. This distribution between the gear types seem to be changing and in 2020 the gillnet fishery was landing 59 % and longliners 37 % of the total catches. Other nations catch ling as bycatch in their trawl fisheries. Figure 3.3.1 shows the spatial distributions of the total catches for the Norwegian longline fishery in 2020. There was no fishery in the NEAFC regulatory area in 2020.

The Norwegian longline fleet (vessels larger than 21 m) increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number stabilized at 27 but increased to 30 in 2020. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that the longliners operated in ICES Subareas 1 and 2 has declined since its peak in 2011.. During the period 2000 to 2014 the main technological change in Subareas 1 and 2 was that the average number of hooks per day increased from 31 000 hooks to 35 000 hooks. During the period 1974 to 2014 the total number of hooks per year has varied considerably, but with a downward trend since 2002.(for more information see Helle and Pennington, WD 2021).

The cod stock in the Barents Sea has been very abundant for years, but now there is a downward trend in the cod stock which has resulted in lower quotas. Most likely the of lower quotas for cod has resulted in the observed increase in fishing pressure on ling.

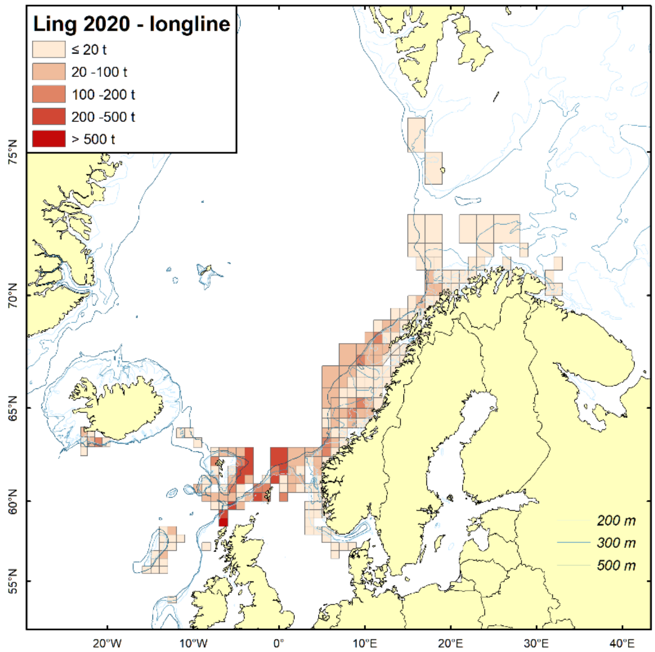

Figure 3.3.1. Distribution of the total catch of ling in Subareas 1 and 2 taken by the Norwegian longline fishery in 2020.

3.3.2 Landings trends

Landing statistics by nation in the period 1988–2020 are in Tables 3.3.1a–d. During 2000–2005, the landings varied between 5000 and 7000 t, which was slightly lower than the landings in the preceding decade. In 2007, 2008 and 2010 the landings increased to over 10 000 t. After this the landings declined to 8000 tons in 2017 followed by two years with high landings, above 11 000 tons. The preliminary landings for 2020 are 9 500 t, a significant decrease compared to the previous years. This decrease may be caused by lower fishing activities due to Covid 19. Total international landings in Areas 1 and 2 are given in Figure 3.3.2.

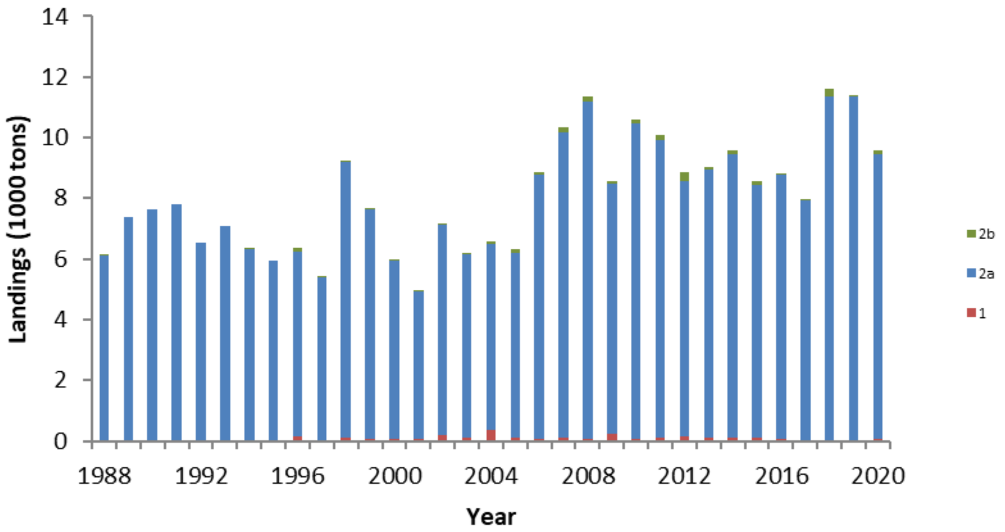

Figure 3.3.2. Total international landings of ling in Subareas 1 and 2.

3.3.3 ICES Advice

Advice for 2020 and 2021: ICES advises that when the precautionary approach is applied, catches should be no more than 15 593 tons in each of the years 2020 and 2021. All catches are assumed to be landed

3.3.4 Management

There is no quota for the Norwegian fishery for ling, but the vessels participating in the directed fishery for ling and tusk in Subareas 1 and 2 are required to have a specific license. There is no minimum landing size for the Norwegian EEZ.

There are ongoing negotiations between EU, UK and Norway and The TACs are therefore not available.

3.3.5 Data available

3.3.5.1 Landings and discards

Amounts landed were available for all relevant fleets. No discards were reported in 2020. But since the Norwegian fleets are not regulated by TACs, and there is a ban on discarding, the incentive for illegal discarding is believed to be low. The landings statistics are therefore regarded as being adequate for assessment purposes.

3.3.5.2 Length compositions

Length composition data are available for the longliners and gillnetters from the Norwegian Reference fleet. Figures 3.3.3 and 3.3.4 show the length distribution of ling in Areas 1 and 2 for the period 2001 to 2020. The mean length in Area 1 has varied slightly, while the mean length in Area 2a has been very stable. The weight–length graphs are in Figure 3.3.5.

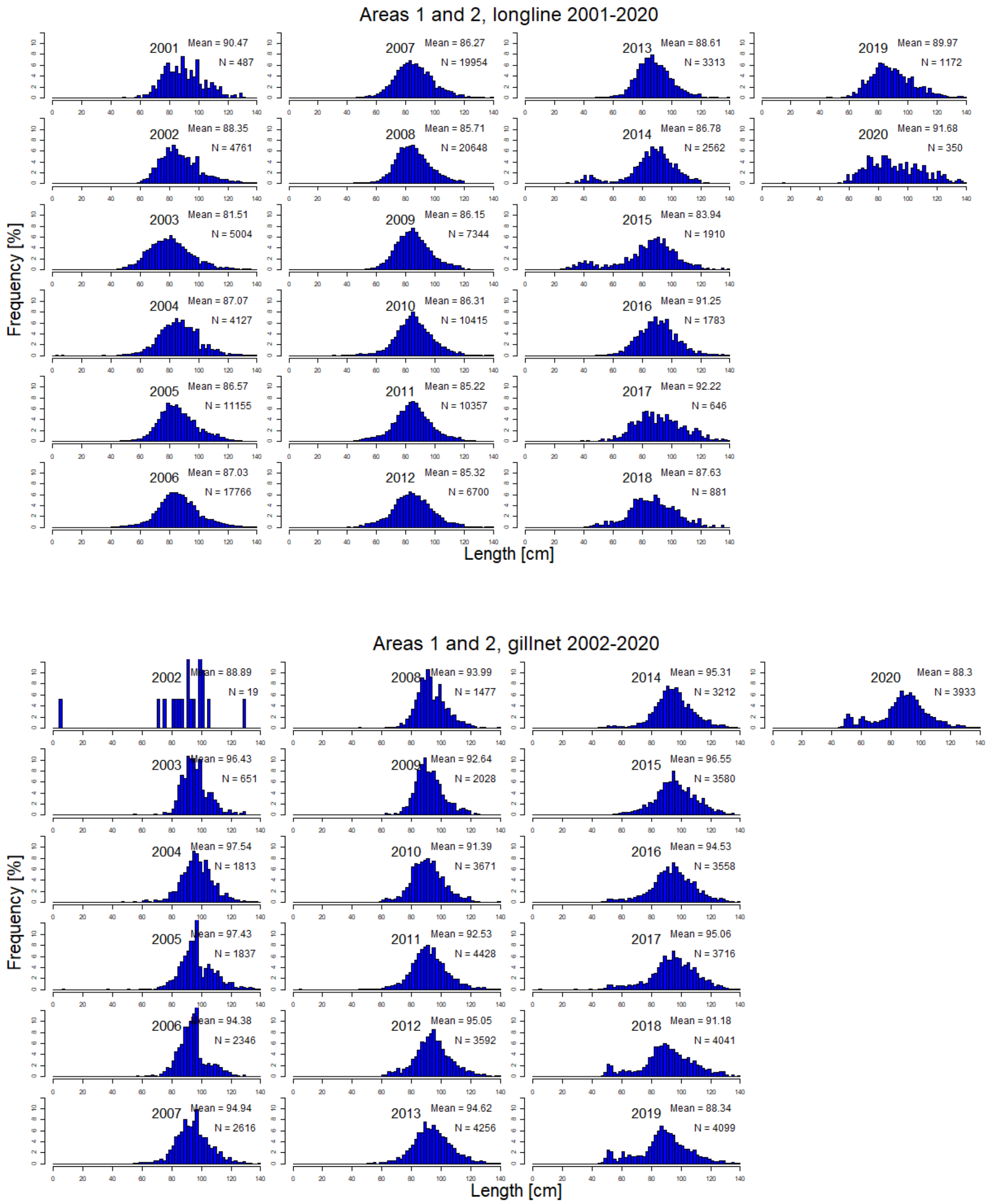

Figure 3.3.3. Plots of the length distributions of ling in Subareas 1 and 2 combined for the period 2001 to 2020 from the Norwegian Reference fleet.

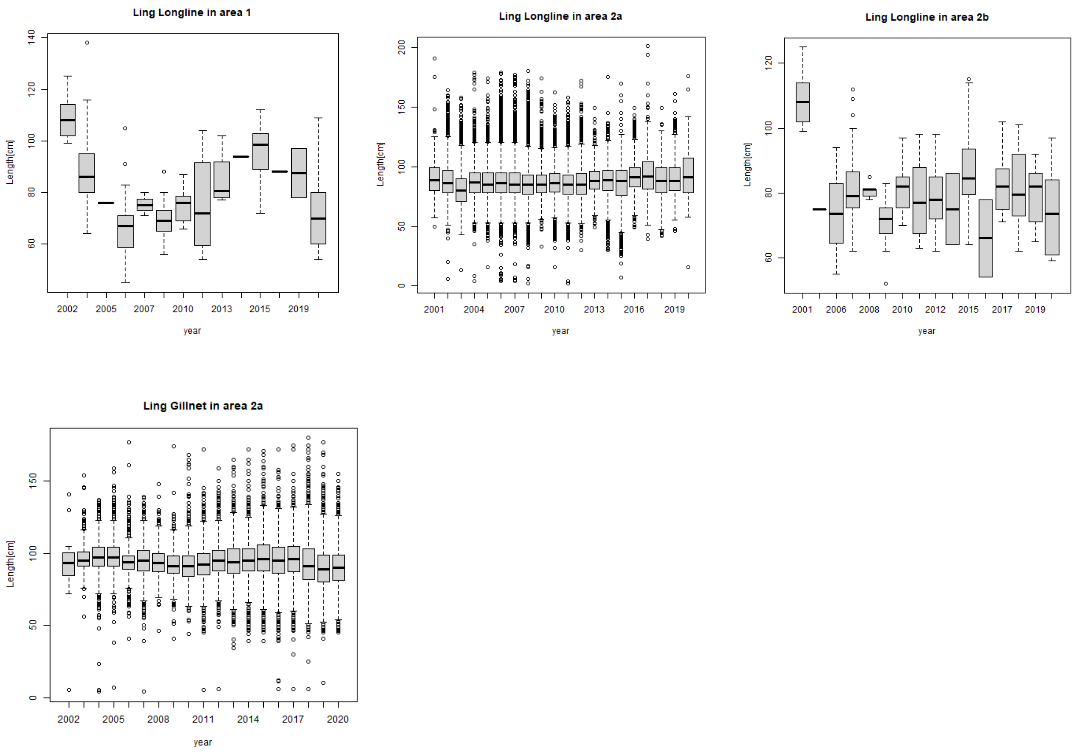

Figure 3.3.4. Box and whiskers plots for the length of ling in Areas 1, 2a and 2b for the period 2001 to 2020 from the Norwegian Reference fleet.

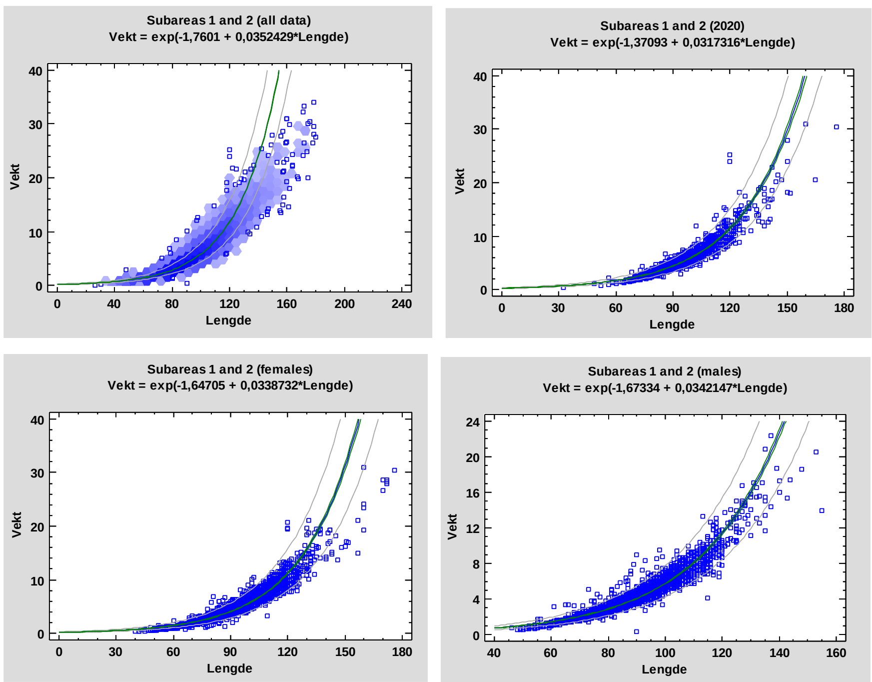

Figure 3.3.5. Weight–length relationship for the period 2008–2020, and only for 2020 (upper panel) and for females and for males, separately (lower panel). Data were collected by the Norwegian Reference Fleet.

3.3.5.3 Age compositions

The Catch-at-age composition for the longline fishery and for the gillnet fishery for 2010–2020 (Figure 3.3.6), and box and whiskers plots for the estimated age distribution of catch for each area are in Figure 3.3.7.

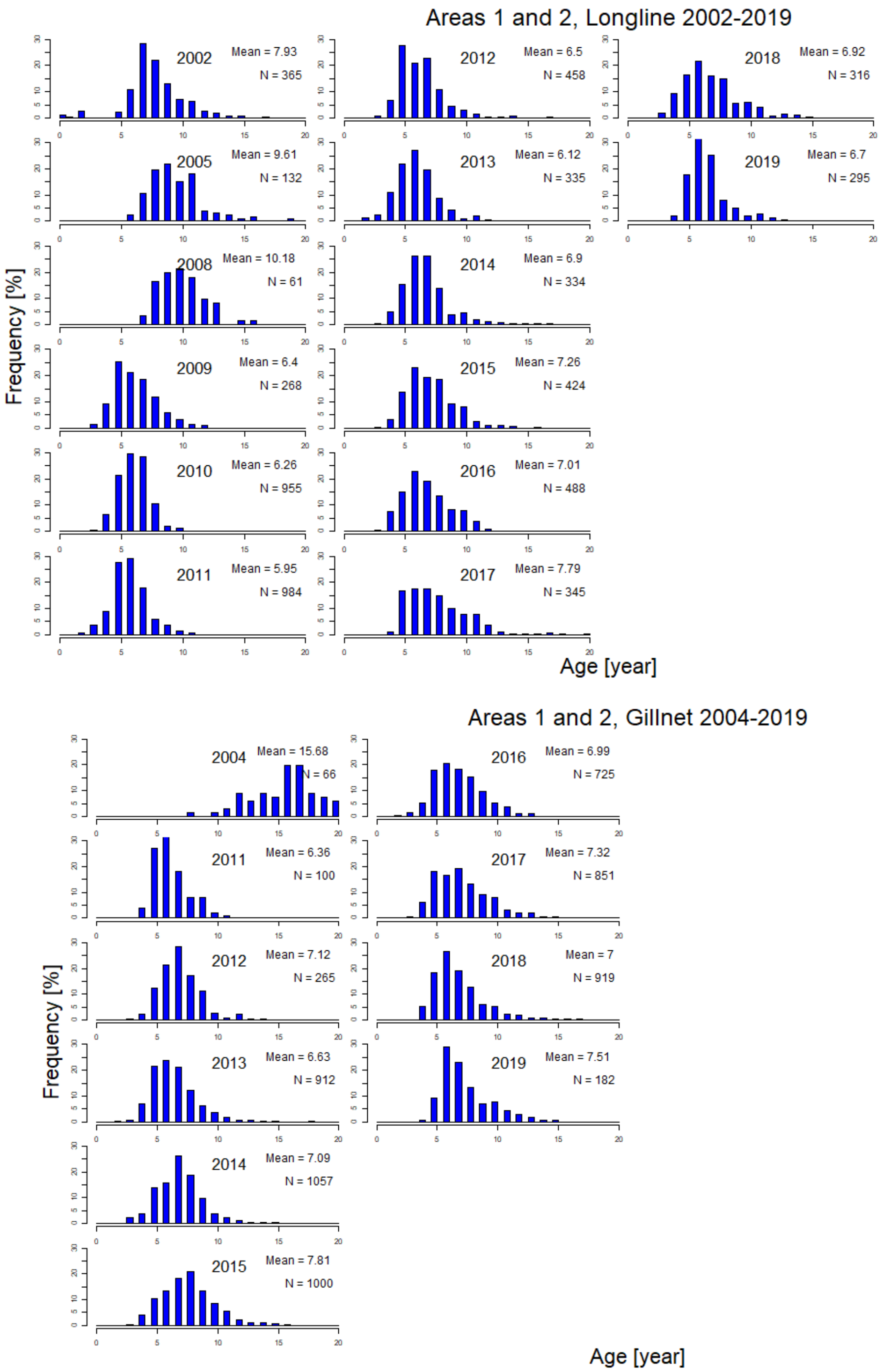

Figure 3.3.6. Ling in Areas 1 and 2, Catch-at-age compositions based on data from the Reference fleet, longliners and gillnetters...

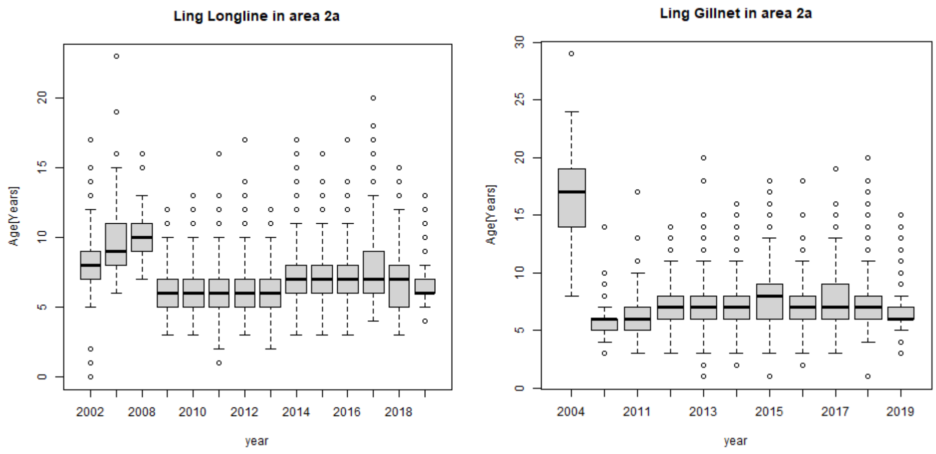

Figure 3.3.7. Age composition of the fish caught by longliners and gillnetters during the period 2002–2019.

3.3.5.4 Length and weight -at-age

Figure 3.3.8 shows the average mean length at age and mean weight at age for the years 2009–2020.

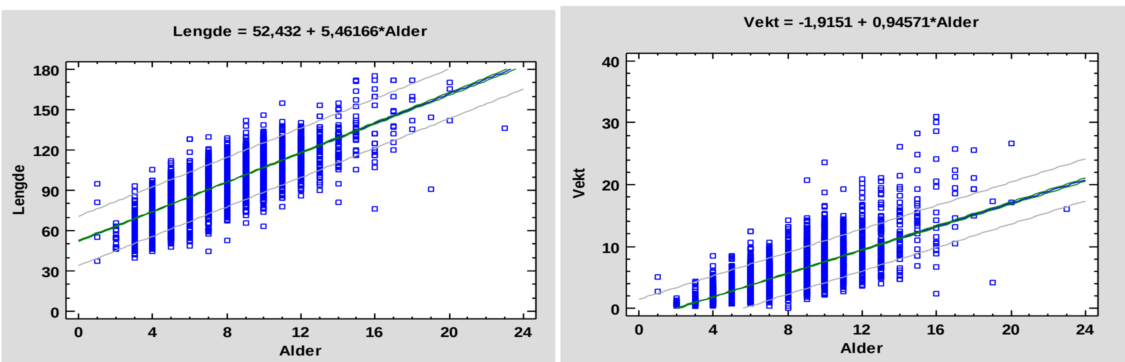

Figure. 3.3.8. Average mean length and mean weight versus age for the period 2010–2020.

3.3.5.5 Maturity and natural mortality

Maturity ogives for ling are in Figure 3.3.9 and in the following table. The results fit well with previous observations that ling reach maturity between ages 5–7 (60–75 cm) in most areas, while males reach maturity at a slightly younger age than females (Magnusson *et al.*, 1997).

Maturity parameters:

Stock	L50	N	A50	N	Source
Lin-arct	73.0	1540	7.0	769	Norwegian long liners (Reference fleet) and survey data

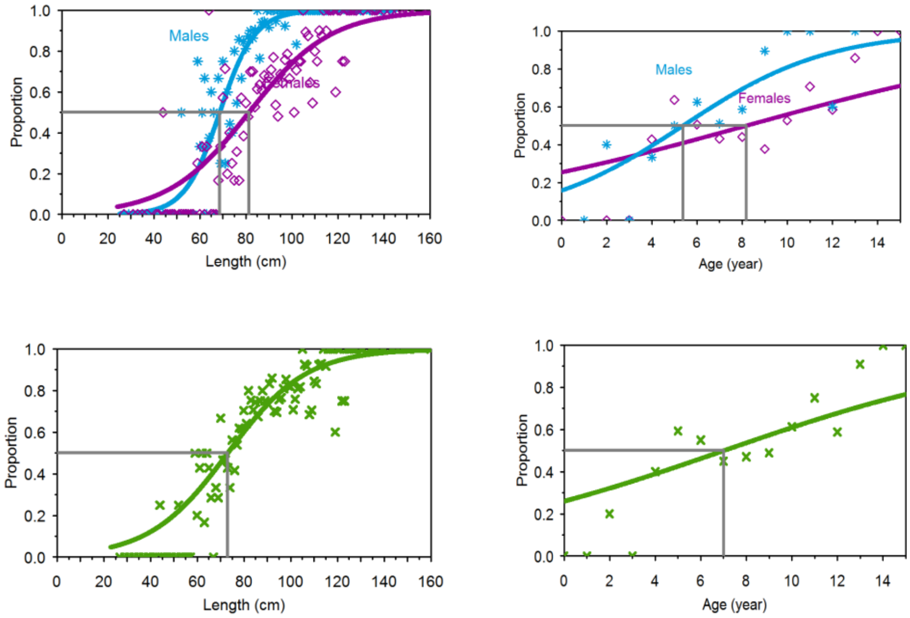

Figure 3.3.9. Maturity ogives for ling in Areas 1 and 2: males and females (upper panel) and for males and females combined (lower panel).

3.3.5.6 Catch and effort data

Two standardized cpue series for 2000–2020 for Norwegian longliners are in Figure 3.3.10. One series was based on all the catch data, and the other cpue series used only catches of ling that made up more than 30% of the total catch by weight, that is it is assumed that these were targeted catches. No research vessel data are available.

3.3.6 Data analyses

Length distribution

In Figures 3.3.3 and 3.3.4 are plots of the length distributions in Area 1 and 2 for 2001 to 2020. It appears that the mean length in Area 1 has varied slightly, while the mean length in Areas 2a and 2b has been very stable. The average length is slightly higher in the gillnet fishery than in the longline fishery.

Age distribution

In Figures 3.3.6 and 3.3.7 are plots of the age distributions in Area 1 and 2 for 2001 to 2020. It appears that the mean age in Area 2a has been very stable. The average age is slightly higher in the gillnet fishery than in the longline fishery.

Cpue

Graphs of two standardized GLM-based cpue series estimated based on all the data and based on data for which ling made up more than 30% of the catch are shown in Figure 3.3.10. Both cpue series indicate an upward trend for the period until 2017, after 2017 there was a declining trend. The method is described in Helle *et al*., 2015.

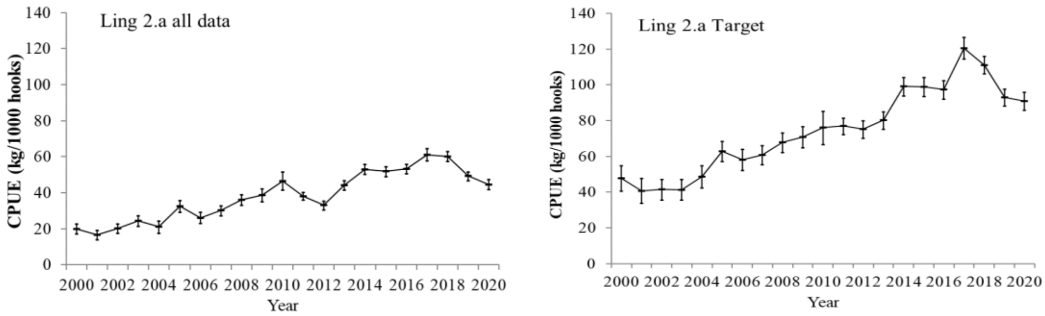

Figure 3.3.10. Estimate of cpue (kg/1000 hooks) for ling in Area 2a based; on all available data, and on catches when ling was considered the target species for 2000–2020. The bars denote the 95% confidence intervals. The data are from skipper's logbooks.

3.3.7 Comments on the assessment data analyses

The two cpue series, based on all data and when ling were targeted, show a stable and positive trend until the last three years.

3.3.8 Management considerations

The annual catch of ling since 2006 do not appear to have had a detrimental effect on the stock given that cpue continued to increase steadily, and even with the recent decline the current catch levels are considered appropriate.

However, the cod stock in the Barents Sea has been very abundant for several years but now there is a downward trend in the cod stock which results in lower quotas. There has also been an increase in the number longliners. Because of lower quotas for cod and the increased number of vessels, the fishing pressure on ling appear to have increased.

As always, it should be emphasized that commercial catch data are typically observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the ling cpue series tracks the population and/or how accurate the measures of uncertainty associated with the series are (see, for example, Rosenbaum, 2002). Consequently, one must usually hope that a cpue series, which is based only on commercial catch data, truly tracks abundance.

An infamous example of a misleading cpue series based on commercial data was a cpue series for Newfoundland cod that incorrectly indicated that the abundance of the cod stock was increasing greatly. Advice based on this cpue series ultimately caused the collapse of the stock (see, e.g., Pennington and Strømme, 1998).

In general, any assessment method based only on commercial catch data needs to be applied with caution. The reason that assessments using only commercial data are problematic is because the relation between the commercial catch and the actual population is normally unknown and probably varies from year to year.

3.3.9 Application of MSY proxy reference points

The Length-based indicator method (LBI) were applied for ling in Areas 1 and 2.

Length-based indicator method (LBI)
The input parameters and the length distributions of the catches for the period 2001–2020 are in Table 3.3.2 and Figure 3.3.11. The length data used in the LBI model are from the Norwegian gill netter and longline fleet.

Table 3.3.2. Ling in arctic waters (1, 2.a, 2.b). Input parameters for LBI.

Data type	Years/Value	Source	Notes
Length–frequency distribution	2001–2020	Norwegian gill netters (Reference fleet) fishing in divisions 1,2a,2b	
Length–weight relation	$0.0055 * length^{3.0175}$	Norwegian Reference fleet and survey data	
L_{MAT}	73 cm	Norwegian Reference fleet and survey data	Sexes combined
L_{inf}	172 cm (L_{max})	Norwegian Reference fleet and survey data	

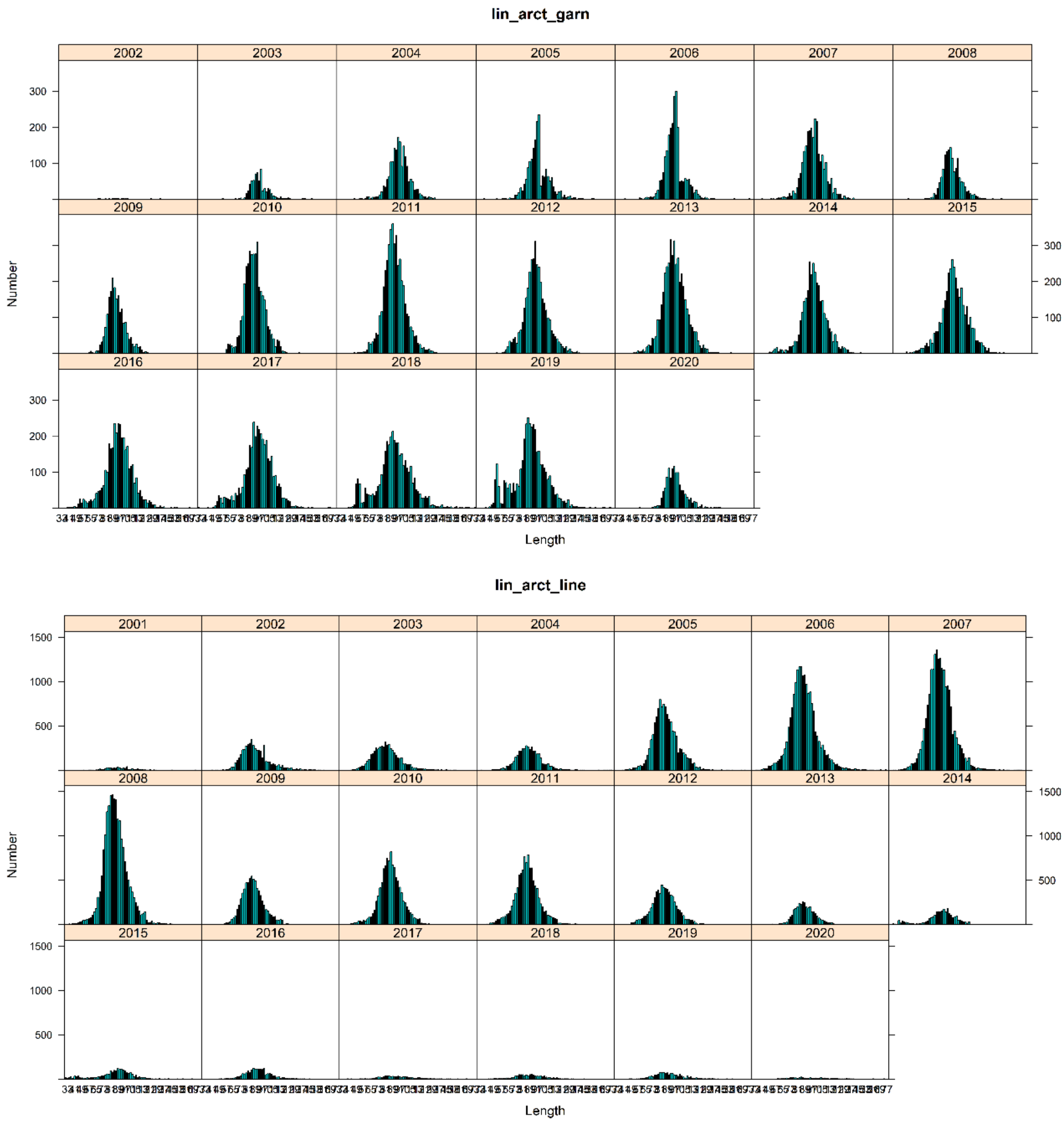

Figure 3.3.11. Ling in arctic waters (1, 2.a, 2.b), upper panel are length data from gillnetters, lower are from longliners. Catch length distributions, 2 cm length classes, for the period 2001–2020 (sex combined).

Outputs from the screening of length indicator ratios for combined sexes under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield, for ling from the gillnet and longline fishery are in Figures 3.3.12a and b.

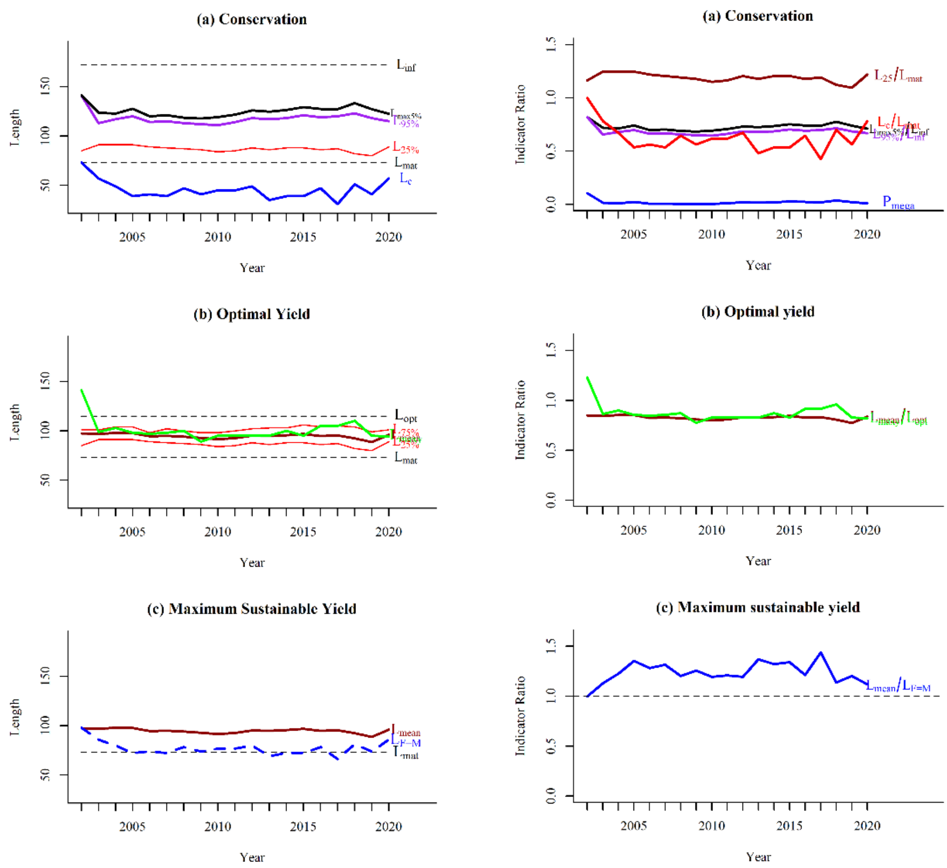

Figure 3.3.12a. Ling from gillnetters in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

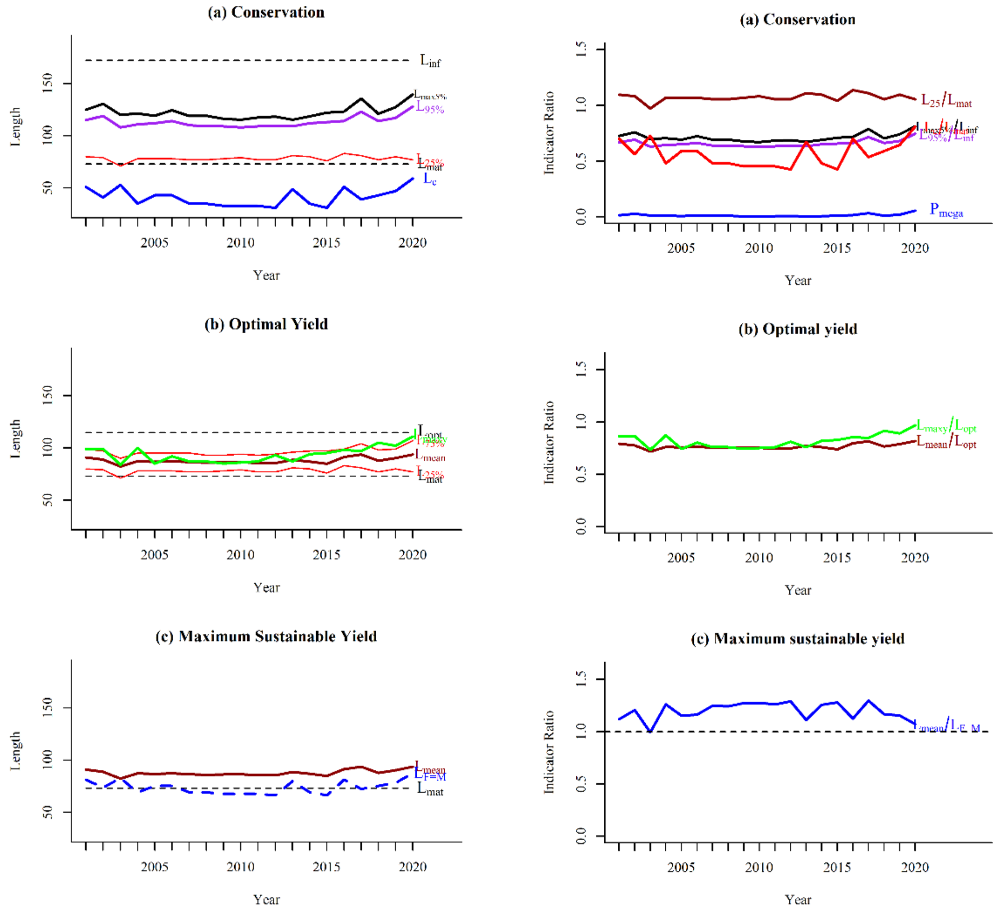

Figure 3.3.12b. Ling from longliners in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

Analysis of results

The results using length data from gillnet and longline fishery showed the same trend. The model for the conservation of immature ling shows that L_c/L_{mat} is usually less than one, but $L_{25\%}/L_{mat}$ is usually greater than 1 (Figure 3.3.12). In 2016–2020, $L_{25\%}/L_{mat}$ was also greater than 1 (Table 3.3.3), therefore there is no indication that immature ling are being overfished.

For the status for large ling, the model shows that the indicator ratio of $L_{max5\%}/L_{inf}$ is around 0.7 for the whole period (Figure 3.3.12) and between 0.74 and 0.78 in 2018–2020 (Table 3.3.3), which is less than the limit of 0.8 suggesting that there is a lack of mega-spawners in the catch, which indicates that there is a truncation point in the length distribution. The mean length of ling in the catch is lower than the mean length for optimizing yield.

The MSY indicator ($L_{mean}/L_{F=M}$) is greater than 1 for almost the whole period (Figure 3.3.12), which indicates that ling in arctic waters are fished sustainably. Regarding model sensitivity, the MSY value was always greater than 0.90.

Table 3.3.5. gives the outcomes of all estimates from the LBI, based on data from the gillnet and the longline fishery provided by the Norwegian reference fleet

Conclusion: The overall perception of the stock during the period 2018–2020 is that ling in arctic waters seems to be fished sustainably (Table 3.3.3a and b). However, the results are very sensitive to the assumed values of L_{mat} and L_{inf}.

Table 3.3.3a. Ling (gillnetters)in arctic waters (1, 2.a, 2.b). The results from the LBI method.

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2018	0,70	1,12	0,78	4 %	0,81	1,14
2019	0,56	1,10	0,74	2 %	0,77	1,20
2020	0,78	1,22	0,71	1 %	0,84	1,12

Table 3.3.3b. Ling (longliners) in arctic waters (1, 2.a, 2.b). The results from the LBI method.

	Conservation				Optimizing Yield	MSY
	Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Ref	**>1**	**>1**	**>0.8**	**>30%**	**~1 (>0.9)**	**≥1**
2018	0,59	1,05	0,70	1 %	0,77	1,17
2019	0,64	1,10	0,74	2 %	0,79	1,15
2020	0,81	1,05	0,81	5 %	0,82	1,07

Table 3.3.4 Ling in arctic waters (1, 2.a, 2.b). Stock status inferred from LBI for MSY. Green tick marks for MSY are provided because the $L_{mean}/L_{F=M}$ > 1 in each year. Stock size is unknown as this method only provides exploitation status.

	Fishing pressure			
	2018	2019	2020	
MSY (F/F_{MSY})	✔	✔	✔	Fished sustainably

	Stock size			
	2018	2019	2020	
MSY $B_{trigger}$.(B/B_{MSY})	?	?	?	Unknown

Table 3.3.5. Outcomes from the LBI, based on data from the gillnet and the longline fishery provided by the Norwegian reference fleet.

	Gillnet			Longline		
Year	2018	2019	2020	2018	2019	2020
L75	104	99	101	98	99	107
L25	82	80	89	77	80	77
Lmed	92	89	94	88	88	90
L90	115	110	110	107	111	122
L95	123	118	115	114	117	128
Lmean	92.45	88.61	95.88	87.75	90.23	93.58
Lc	51	41	57	43	47	59
LFeM	81.25	73.75	85.75	75.25	78.25	87.25
Lmaxy	110	95	94	105	102	111
Lmat	73	73	73	73	73	73
Lopt	114.67	114.67	114.67	114.67	114.67	114.67
Linf	172	172	172	172	172	172
Lmax5%	133.35	127.20	122.40	120.96	127.37	139.60
Lmean/LFeM	1.14	1.20	1.12	1.17	1.15	1.07
Lc/Lmat	0.70	0.56	0.78	0.59	0.64	0.81
L25/Lmat	1.12	1.10	1.22	1.05	1.10	1.05
Lmean/Lmat	1.27	1.21	1.31	1.20	1.24	1.28
Lmean/Lopt	0.81	0.77	0.84	0.77	0.79	0.82
L95/Linf	0.72	0.69	0.67	0.66	0.68	0.74
Lmaxy/Lopt	0.96	0.83	0.82	0.92	0.89	0.97
Lmax5%/Linf	0.78	0.74	0.71	0.70	0.74	0.81
Pmega	0.04	0.02	0.01	0.01	0.02	0.05
Pmegaref	0.3	0.3	0.3	0.3	0.3	0.3

3.3.10 References

Bergstad, O.A. and N.R. Hareide, 1996. Ling, blue ling and tusk of the northeast Atlantic. Fisken og Havet (Institute of Marine Research, Bergen) 15. 126 p.

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Pennington, M., and Strømme, T. (1998). Surveys as a research tool for managing dynamic stocks. Fisheries Research 37, 97–106.Rosenbaum, P.R.2002. Observational Studies (second ed.), Springer-Verlag, New York, NY (2002) (377 pp.)

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3.3.11 Tables

Table 3.3.1a. Ling 1.a and b. WG estimates of landings.

Year	Norway	Iceland	Scotland	Faroes	France	Total
1996	136					136
1997	31					31
1998	123					123
1999	64					64
2000	68	1				69
2001	65	1				66
2002	182		24			206
2003	89					89
2004	323			22		345
2005	107					107
2006	58					58
2007	96					96
2008	55					55
2009	236					236
2010	57					57
2011	129					129
2012	158					158
2013	126					126
2014	122				1	123
2015	93					93
2016	65					65
2017	43					43
2018	34					34
2019	37					37
2020*	73					73

Preliminary. Table 3.3.1b. Ling 2a. WG estimates of landings.

Year	Faroes	France	Germany	Norway	E & W	Scotland	Russia	Ireland	Iceland	Spain	Greenland	Poland	Total
1988	3	29	10	6070	4	3							6119
1989	2	19	11	7326	10	-							7368
1990	14	20	17	7549	25	3							7628
1991	17	12	5	7755	4	+							7793
1992	3	9	6	6495	8	+							6521
1993	-	9	13	7032	39	-							7093
1994	101	n/a	9	6169	30	-							6309
1995	14	6	8	5921	3	2							5954
1996	0	2	17	6059	2	3							6083
1997	0	15	7	5343	6	2							5373
1998		13	6	9049	3	1							9072
1999		12	7	7557	2	4							7581
2000		9	39	5836	5	2							5891
2001	6	9	34	4805	1	3							4858
2002	1	4	21	6886	1	4							6917
2003	7	3	43	6001		8							6062
2004	15	0	3	6114		1	5						6138
2005	6	5	6	6085	2		2						6106
2006	9	8	6	8685	6	1	11						8726
2007	18	6	7	9970	1	0	55	1					10 058
2008	22	4	7	11 040	1	1	29	0					11 104
2009	1	2	7	8189	0	19	17						8244
2010	10	0	18	10 318	0	2	47						10 395
2011	4	6	6	9763			19						9798
2012	21	6	9	8334		7	45		3				8425
2013	7	9	7	8677		1	114		4				8819

Year	Faroes	France	Germany	Norway	E & W	Scotland	Russia	Ireland	Iceland	Spain	Greenland	Poland	Total
2014	3	13	3	9245			73						9337
2015	10	5	4	8220		3	115		5				8362
2016	18	6	11	8523	2	3	112		8	2	9	6	8700
2017	17	13	8	7684		3	150		15		4	6	7900
2018	13	9	16	11155			129		4		1	5	11332
2019	5	24	9	11216			60		1			1	11316
2020*	8	13	5	9323	1	1	42		2				9395

*** *Preliminary. Table 3.3.1c. Ling 2b. WG estimates of landings.**

Year	Norway	E & W	Faroes	France	Total
1988		7			7
1989		-			
1990		-			
1991		-			
1992		-			
1993		-			
1994		13			13
1995		-			
1996	127	-			127
1997	5	-			5
1998	5	+			5
1999	6				6
2000	4	-			4
2001	33	0			33
2002	9	0			9
2003	6	0			6
2004	77				77
2005	93				93
2006	64				64

Year	Norway	E & W	Faroes	France	Total
2007	180		0		180
2008	162	0	0		162
2009	84				84
2010	128				128
2011	164			7	171
2012	266				266
2013	76				76
2014	85	52			137
2015	95				95
2016	53				1
2017	28				28
2018	238				238
2019	55				55
2020	96				96

***Preliminary.**

Table 3.3.1d. Ling 1 and 2. Total landings by subarea or division.

Year	1	2.a	2.b	All areas
1988		6119	7	6126
1989		7368		7368
1990		7628		7628
1991		7793		7793
1992		6521		6521
1993		7093		7093
1994		6309	13	6322
1995		5954		5954
1996	136	6083	127	6346
1997	31	5373	5	5409
1998	123	9072	5	9200
1999	64	7581	6	7651

Year	1	2.a	2.b	All areas
2000	69	5891	4	5964
2001	66	4858	33	4957
2002	206	6917	9	7132
2003	89	6062	6	6157
2004	345	6138	77	6560
2005	107	6106	93	6306
2006	58	8726	64	8848
2007	96	10 058	180	10 334
2008	80	11 104	161	11 346
2009	236	8244	84	8564
2010	57	10395	128	10580
2011	129	9798	171	10098
2012	158	8425	266	8849
2013	126	8819	76	9021
2014	123	9337	137	9606
2015	93	8362	95	8550
2016	65	8700	54	8819
2017	43	7900	28	7971
2018	34	11332	238	11604
2019	37	11321	55	11413
2020*	73	9395	96	9564

***Preliminary.**

3.4 Ling in 5.a (*Molva molva*)

3.4.1 The fishery

The fishery for ling in Icelandic waters has not changed substantially in recent years. Around 130-160 longliners annually report catches of ling, around 20-50 gillnetters and around 60 trawlers. Most of ling is caught on longlines (Figure 3.4.1 and Table 3.4.1) which has increased since 2000 to around 67% in 2020. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2007 to around 2% in 2020. Catches in trawls have varied less and have been at around 20% of Icelandic catches. (Figure 3.4.1, Table 3.4.1). Most of the ling caught by Icelandic longliners is caught at depths less than 300 m, and by trawlers at less than 400 m (Figure 3.4.2). The main fishing grounds for ling as observed from logbooks are in the south, southwestern and western part of the Icelandic shelf (Figure 3.4.3 and Figure 3.4.4). The main trend in the spatial distribution of catches according to logbook entries is the decreased proportion of catches caught in the southeast and increased catches on the western part of the shelf two decades ago. Around 40% of ling catches are caught on the southwestern part of the shelf (Figure 3.4.3). In recent years, the main fishing pressure has shifted towards shallower waters (Figure 3.4.2).

Table 3.4.1: Ling in 5.a and 14. Number of Icelandic boats and catches by fleet segment participating in the ling fishery from logbooks.

Year	Bottom trawl	Gill nets	Longlines	Bottom trawl	Gill nets	Longlines	Other	Total catch
2000	125	184	289	726	704	1540	244	3214
2001	108	232	254	493	1061	1101	225	2880
2002	100	203	235	664	648	1283	250	2845
2003	96	172	244	583	454	2215	337	3589
2004	97	165	234	656	545	2017	508	3726
2005	99	127	260	989	501	2046	779	4315
2006	91	99	259	1246	629	3734	676	6285
2007	91	86	251	1395	633	4042	529	6599
2008	82	68	209	1509	477	5007	748	7741
2009	77	78	208	1540	723	6232	1121	9616
2010	75	69	197	1538	363	6532	1436	9869
2011	67	61	201	1676	222	5595	1297	8790
2012	68	62	206	1396	245	7479	1575	10695
2013	71	62	209	1610	345	6836	1465	10256
2014	64	57	220	1707	673	10624	1242	14246
2015	64	55	207	1911	650	9249	1225	13035
2016	65	55	186	1825	681	6545	834	9885

2017	67	48	171	1527	556	5975	708	8766
2018	63	47	151	1606	387	5366	702	8061
2019	61	32	149	1667	115	5964	523	8269
2020	68	36	124	1985	138	4765	162	7061

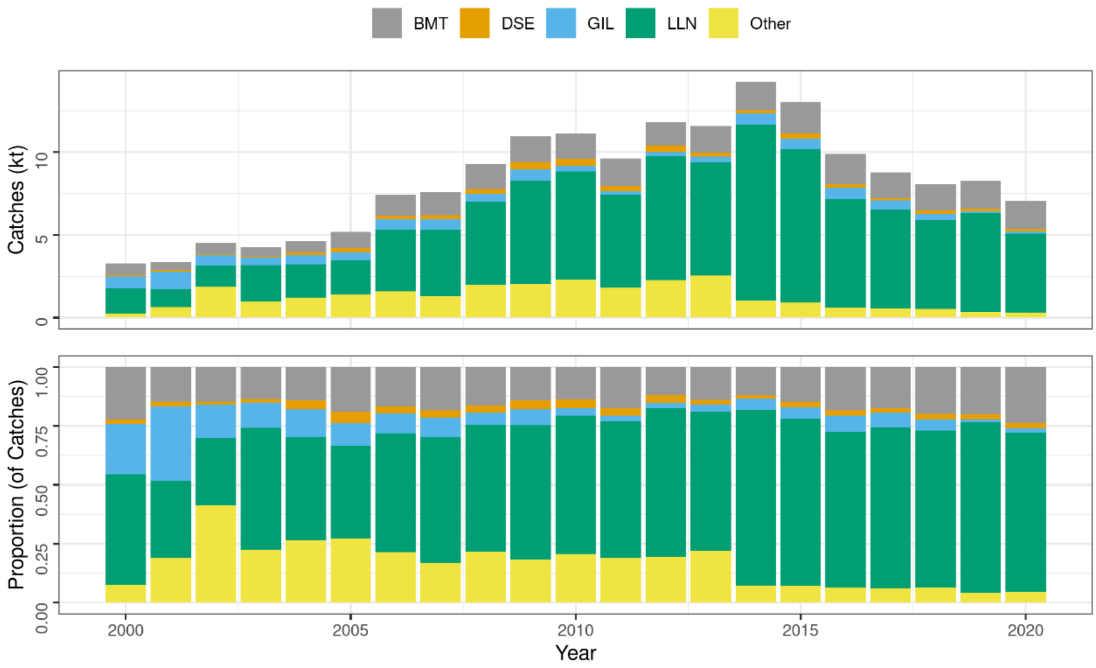

Figure 3.4.1: Ling in 5.a and 14. Commercial catches by gear as registered in Icelandic logbooks.

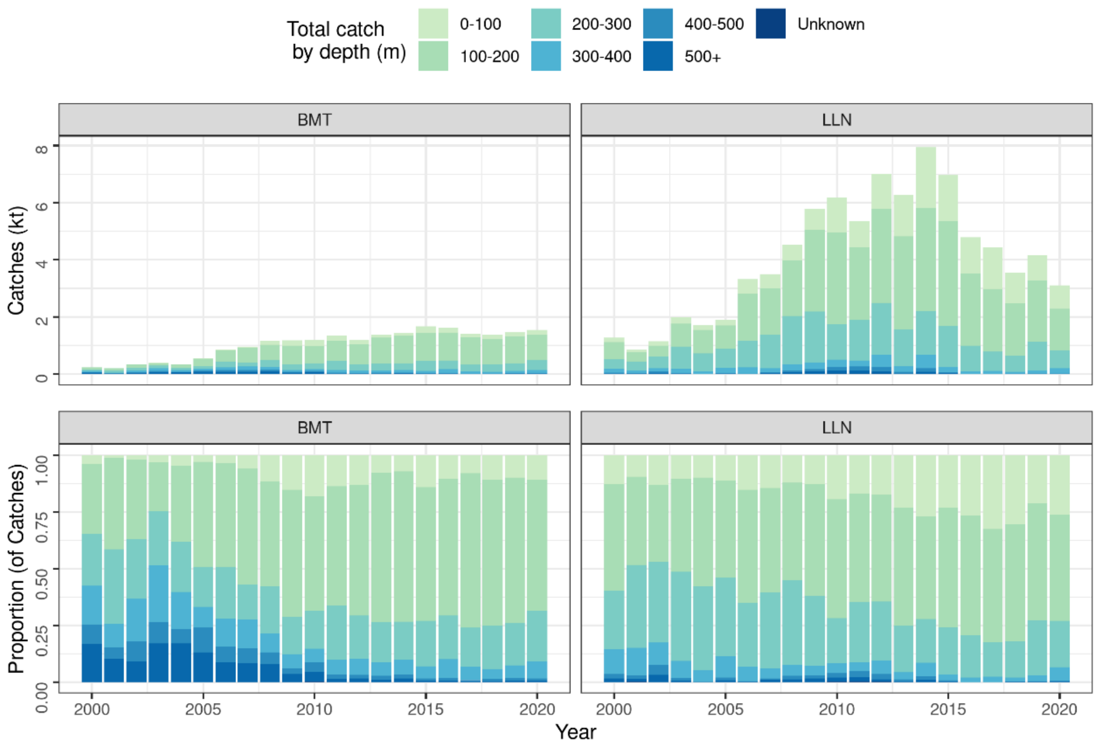

Figure 3.4.2: Ling in 5.a and 14. Depth distribution of catches in 5.a according to logbooks. All gears combined.

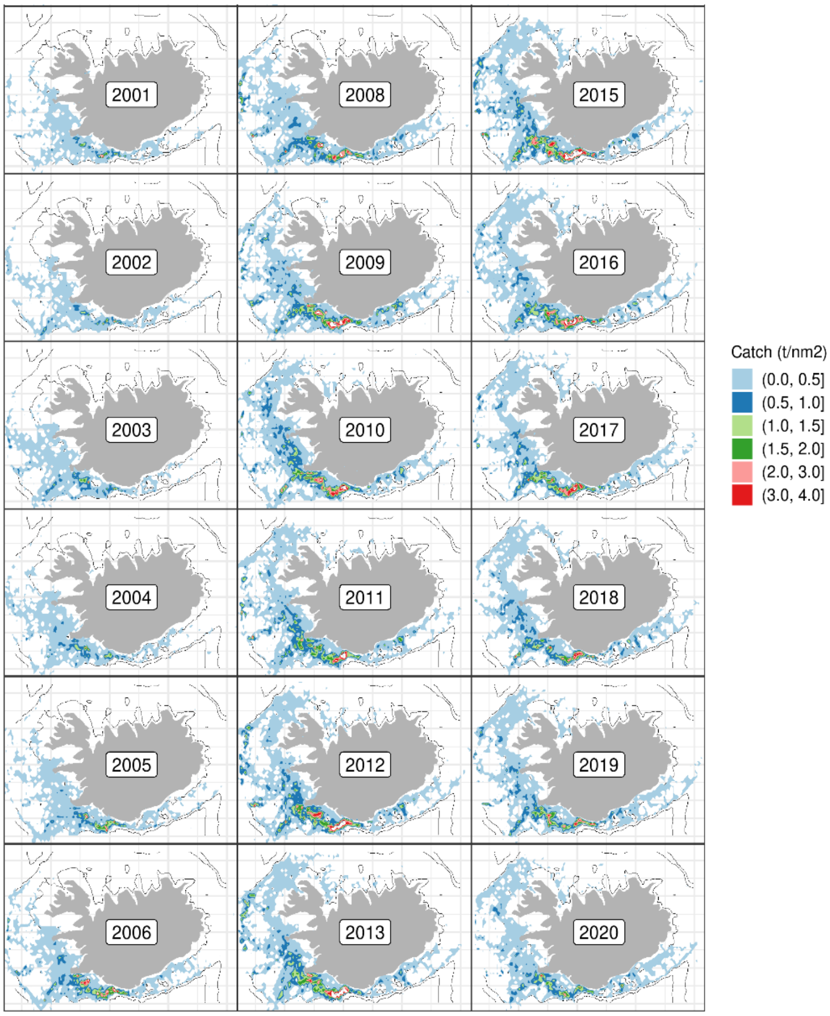

Figure 3.4.3: Ling in 5.a and 14. Spatial distribution of the Icelandic fishery catches as reported in logbooks. All gears combined.

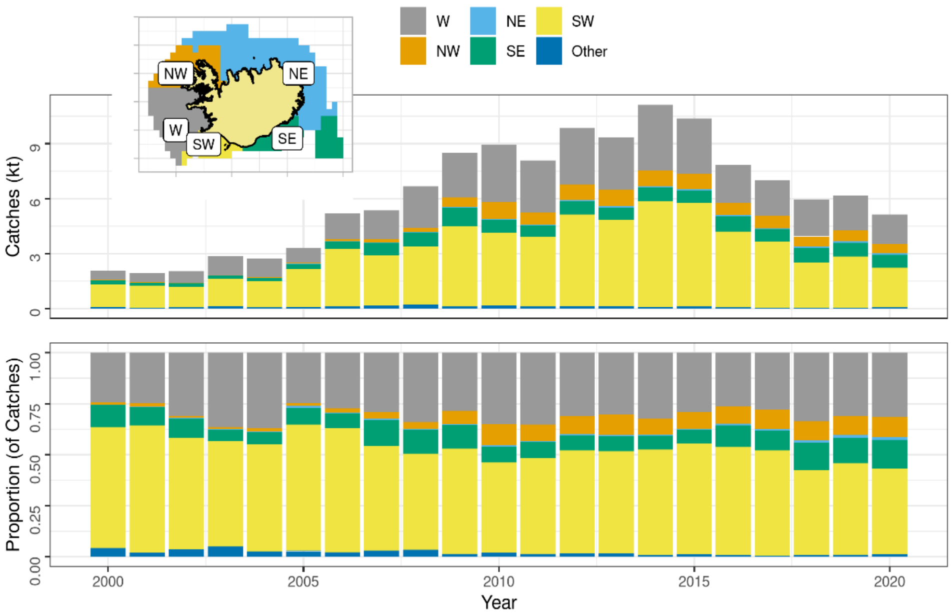

Figure 3.4.4: Ling in 5.a and 14. Changes in spatial distribution of the Icelandic fishery as reported in logbooks. All gears combined.

3.4.2 Landing trends

In 1950 to 1971, landings of ling in Icelandic waters ranged between 7000 to more than 15000 tonnes. Landings decreased between 1972 and 2000 to as little as 3000 tonnes as a result of most foreign vessels being excluded from the Icelandic EEZ. In 2001-2010, catches increased constantly and reached 11000 tonnes in 2010 and remained at that level for the most part until 2014, when the catches increased to 14000 tonnes. Since 2014, ling catches have reduced and were around 7061 tonnes in 2020 (Table 3.4.2 and Figure 3.4.5).

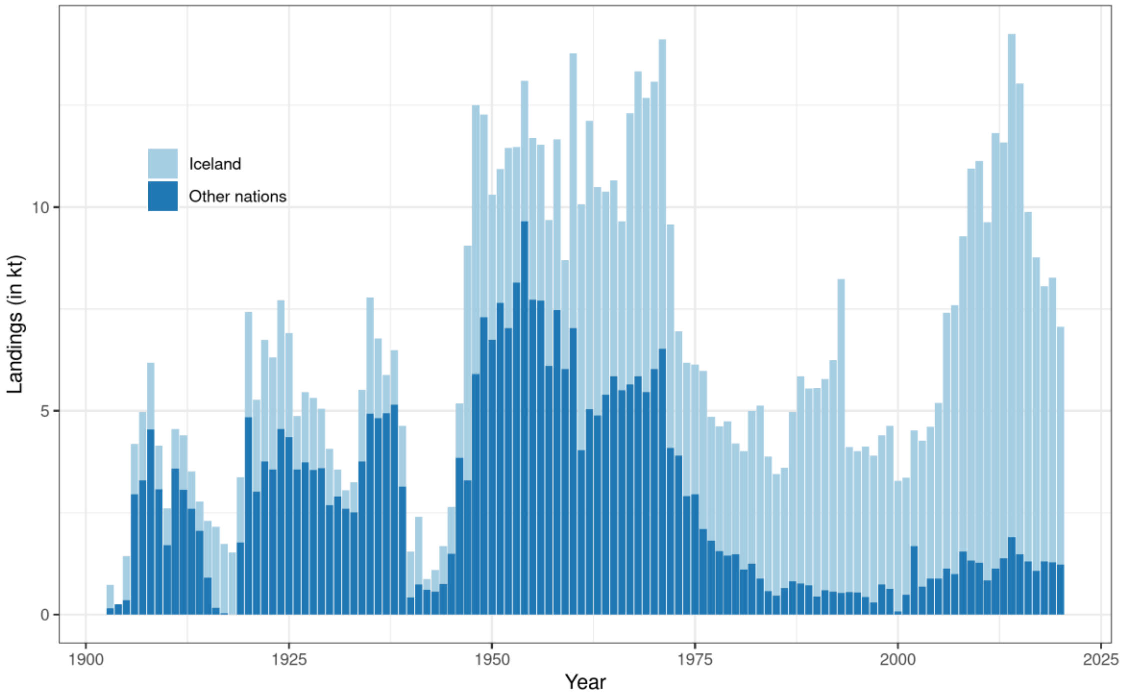

Figure 3.4.5: Ling in 5.a and 14. Landings in 5.a

Table 3.4.2: Ling in 5.a and 14. Percentage of landed catch by gear as reported from logbooks in 5.a.

Year	Bottom trawl	Gill nets	Longlines	Other	Total
1992	24	13	57	7	1158
1993	27	39	25	10	3525
1994	24	36	27	13	3563
1995	25	23	38	14	3552
1996	26	20	39	14	3747
1997	25	17	46	12	3607
1998	23	19	47	11	3695
1999	20	17	54	9	4003
2000	23	22	48	8	3214
2001	17	37	38	8	2881
2002	23	23	45	9	2845

Year	Bottom trawl	Gill nets	Longlines	Other	Total
2003	16	13	62	9	3590
2004	18	15	54	14	3727
2005	23	12	47	18	4315
2006	20	10	59	11	6285
2007	21	10	61	8	6599
2008	19	6	65	10	7741
2009	16	8	65	12	9616
2010	16	4	66	15	9868
2011	19	3	64	15	8789
2012	13	2	70	15	10695
2013	16	3	67	14	10257
2014	12	5	75	9	14246
2015	15	5	71	9	13035
2016	18	7	66	8	9884
2017	17	6	68	8	8766
2018	20	5	67	9	8062
2019	20	1	72	6	8269
2020	24	2	67	8	7061

3.4.3 Data available

In general sampling is considered good from commercial catches from the main gears (longlines and trawls). 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 (Figure 3.4.6, ICES (2012)).

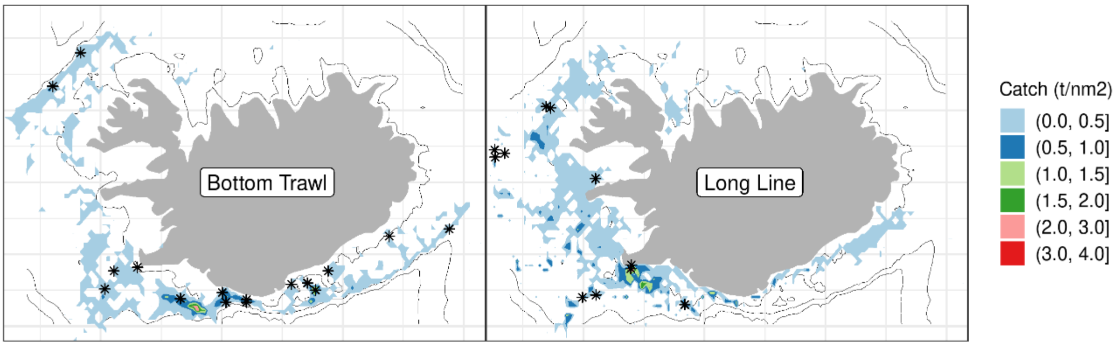

Figure 3.4.6: Ling in 5.a and 14. Fishing grounds in 2020 as reported by catch in logbooks (tiles) and positions of samples taken from landings (asterisks) by longliners and trawlers.

3.4.4 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 long-line fishery for ling are estimated very low (<1% in either numbers or weight) (ICES (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 discarding in mixed fisheries. A description of the management system is given in the stock annex and Iceland fisheries overview (ICES (2017b) and ICES (2019) .

3.4.5 Length composition

An overview of available length measurements is given in Table 3.4.3. Most of the measurements are from longlines. The number of available length measurements has been increasing in recent years in line with increased landings. Length distributions from the Icelandic longline and trawl-ing fleet are presented in Figure 3.4.7. Sampling from commercial catches of ling is considered good; both in terms of spatial and temporal distribution of samples (Figure 3.4.6). Mean length as observed in length samples from catches decreased from 2005-2008 from around 86 to 80 cm (Figure 3.4.7). This may be the result of increased recruitment in recent years rather than in-creased fishing effort. Mean length has gradually increased since 2015 and the mean length in 2020 is the highest recorded. It is premature to draw conclusions from the limited age-structured data. It can only be stated that most of the ling caught in the Icelandic spring survey is between age 5 and 10; but from longlines the age is between 6 to 11.

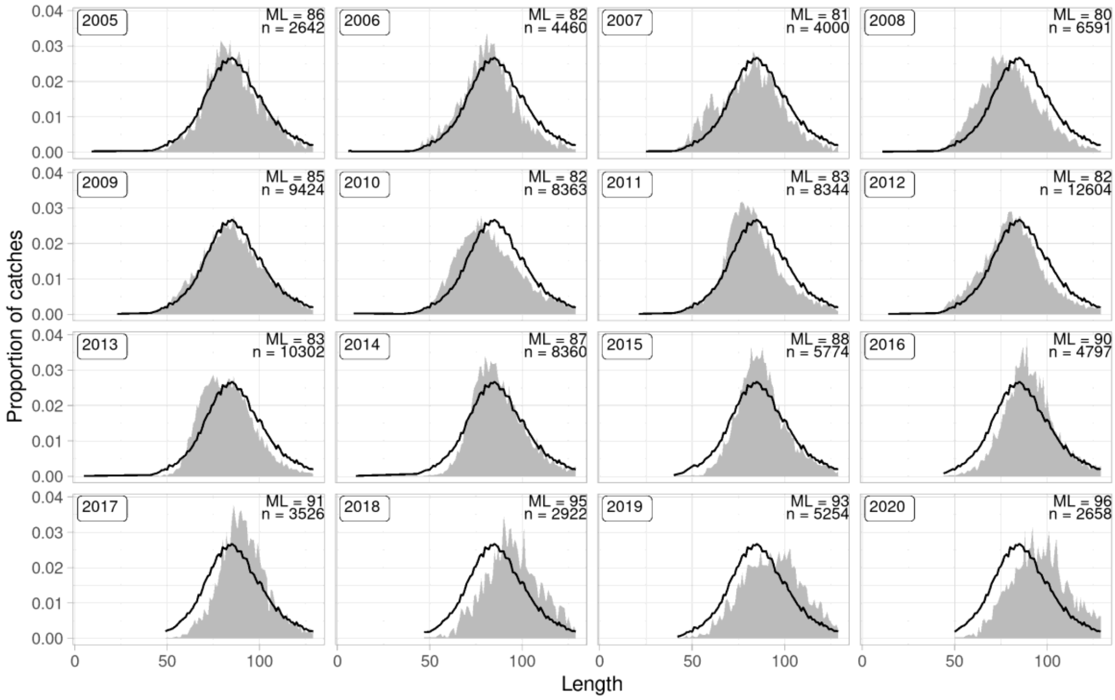

Figure 3.4.7: Ling in 5.a and 14. Length distribution from the Icelandic fleet (grey area) from 2005-2020. Black line is the average mean of the period.

Table 3.4.3: Ling in 5.a and 14. Number of available length and age measurements from Icelandic commercial catches.

Year	Length measurements					Age measurements					
	BMT	DSE	GLN	LLN	Other	LLN	GIL	DSE	BMT	Other	Total
2000	377	0	566	1624	6	650	200	0	150	0	1000
2001	37	0	493	1661	0	550	193	0	37	0	780
2002	221	0	366	1504	0	519	166	0	150	0	835
2003	137	0	300	2404	143	900	100	0	100	50	1150
2004	141	46	198	2640	150	750	50	46	100	50	996
2005	349	101	1	2323	180	750	0	0	181	50	981
2006	1157	0	641	3354	405	1138	289	0	450	100	1977
2007	400	76	0	3661	0	1300	0	50	100	0	1450
2008	819	15	357	5847	150	1950	150	0	315	50	2465
2009	516	0	410	9014	450	2550	150	0	250	150	3100
2010	1146	0	56	7322	1200	2498	50	0	450	400	3398
2011	1245	150	0	7248	750	2546	0	50	450	250	3296
2012	1411	150	85	11356	1337	3526	50	50	541	400	4567

Year	Length measurements					Age measurements					
2013	993	122	267	9405	1344	2590	100	50	350	450	3540
2014	2089	120	1286	6448	2964	665	225	20	399	514	1823
2015	2615	0	1563	3315	3052	595	300	0	484	520	1899
2016	2460	0	2039	2483	1212	440	345	0	460	220	1465
2017	1963	0	485	1637	1226	310	85	0	370	225	990
2018	1603	0	559	1424	712	245	100	0	310	120	775
2019	1830	0	0	3598	819	385	0	0	340	140	865
2020	1718	0	4	1099	0	225	40	0	355	0	620

3.4.6 Age composition

A limited number of otoliths collected in 2010 were aged and a considerable difference in growth rates was observed between the older data and the 2010 data (ICES (2011) :WD07). Substantial progress has been made since 2010. Now aged otoliths are available from the 2000 onwards (Table 3.4.3). Most of the ling caught in the Icelandic spring survey is between age 5 and 8 but from longlines the age is between 6 and 9.

3.4.7 Catch, effort and research vessel data

3.4.7.1 CPUE and effort

The CPUE estimates of ling in Icelandic waters have not been considered representative of stock abundance.

3.4.7.2 Survey data

Indices: The Icelandic spring groundfish survey, which has been conducted annually in March since 1985, covers the most important distribution area of the ling fishery. 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 3.4.8 shows both a recruitment index and the trends in biomass from both surveys. Length distributions from the spring survey are shown in Figure 3.4.9 (abundance) and changes in spatial distribution in the spring survey are presented in Figure 3.4.10.

Ling in both in the spring and autumn surveys are mainly found in the deeper waters south and west off Iceland. Both the total biomass index and the index of the fishable biomass (>40 cm) in the March survey gradually decreased until 1995 (Figure 3.4.8). In the years 1995 to 2003 these indices were half of the mean from 1985–1989. In 2003 to 2007, the indices gradually increased until 2017. Since then, indices have decreased. The index of the large ling (80 cm and larger) shows similar trend as the total biomass index (Figure 3.4.8). The recruitment index of ling, defined here as ling smaller than 40 cm, also showed a similar increase in 2003 to 2007 and but then decreased by around 25% and remained at that level until 2010. Then the juvenile index fell to a very low level in 2014 and has fluctuated at a low level since. (Figure 3.4.8). However, the juvenile index is very uncertain as it is simply some variation in the length distribution of the survey but not a distinct peak (Figure 3.4.8).

The shorter autumn survey shows that biomass indices were low from 1996 to 2000 but have increased since then (Figure 3.4.8). There is a consistency between the two survey series; the autumn survey biomass indices are however derived from substantially fewer ling caught. Also, there is an inconsistency in the recruitment indices (<40 cm), where the autumn survey shows much lower recruitment, in absolute terms compared with the spring survey (Figure 3.4.8). This discrepancy is likely a result of much lower catchability of small ling (due to different gears) in the autumn survey, where ling less than 40 cm has rarely been caught.

Changes in spatial distribution as observed in surveys: According to the spring survey, most of the increase since 2010 in ling abundance is in the western area, but an increase can be seen in most areas. However, most of the index in terms of biomass comes from the southwestern area, or around 40% compared to around 30% between 2003 and 2011. A similar pattern is observed in the autumn survey.

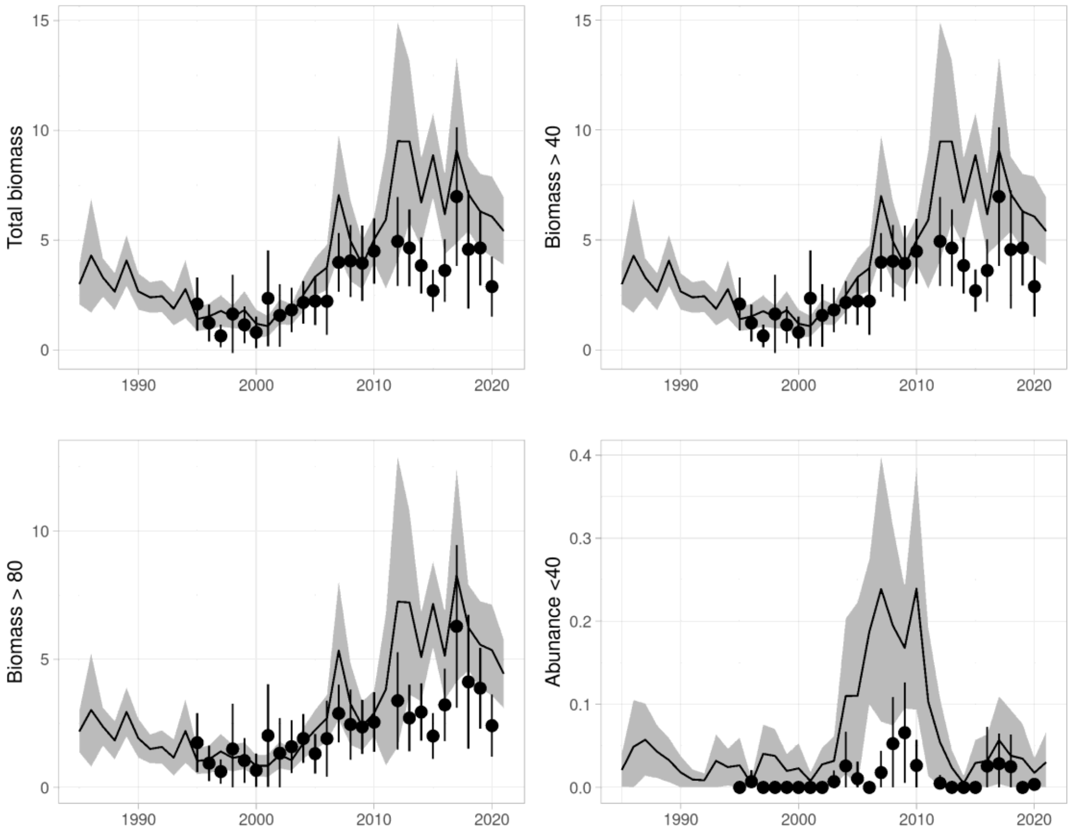

Figure 3.4.8: Ling in 5.a. and 14. Total biomass indices, biomass indices larger than 40 cm, biomass indices larger than 80 cm and abundance indices <40 cm. The lines with shaded area show the spring survey index from 1985 and the points with the vertical lines show the autumn survey from 1997. The shaded areas and vertical lines indicate +/- standard error.

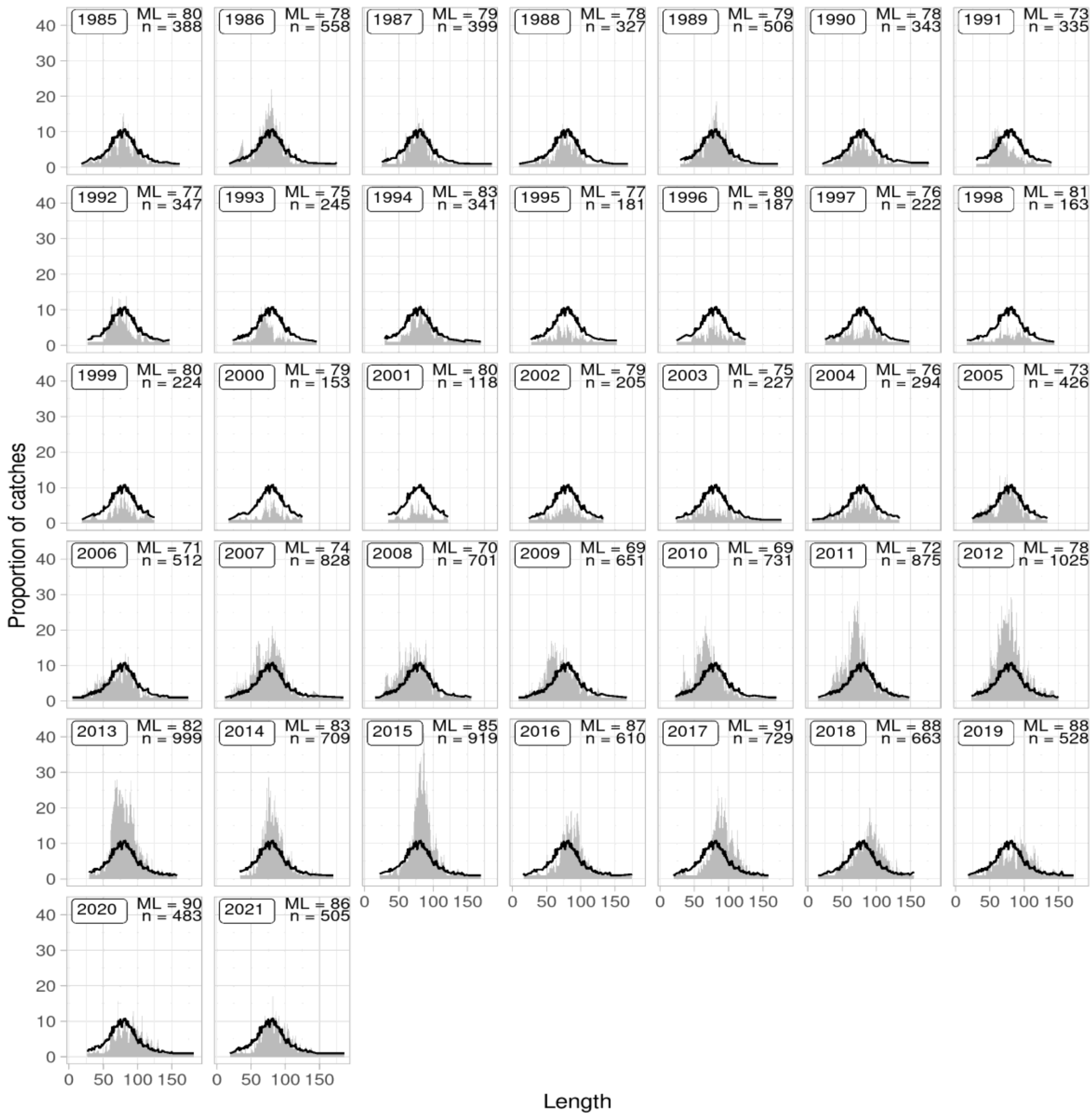

Figure 3.4.9: Ling in 5.a. and 14. Length distribution (grey area) from the spring survey. Black lines are the average mean of the period.

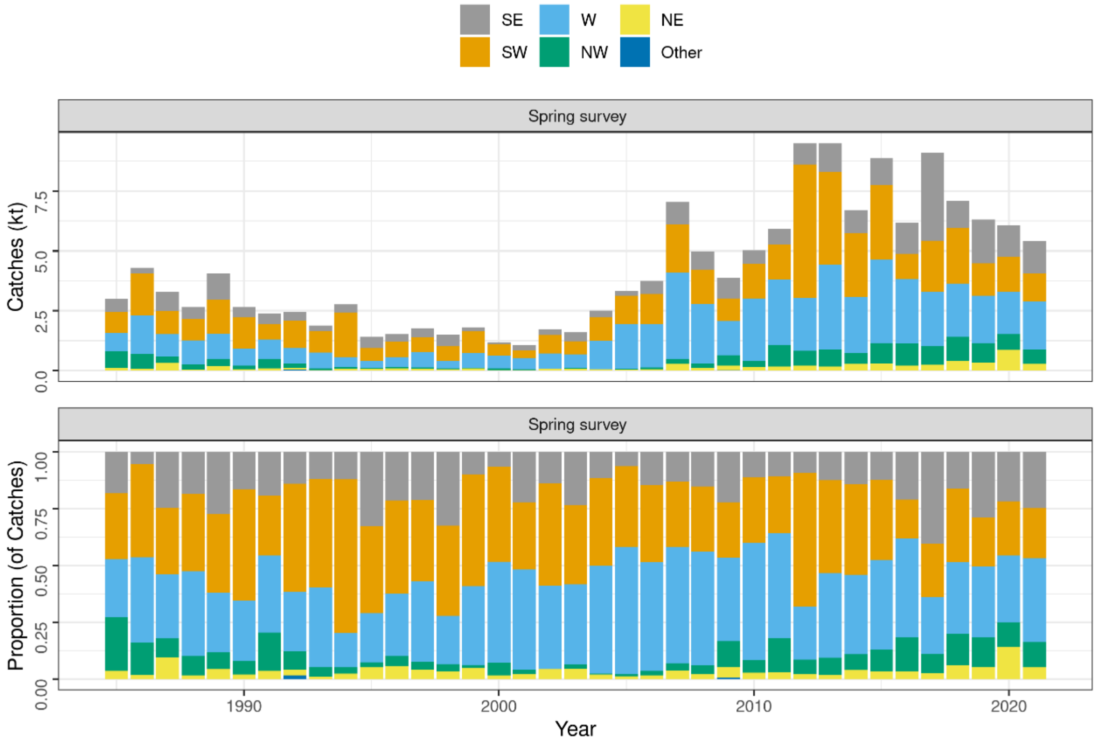

Figure 3.4.10: Ling in 5.a and 14. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

3.4.8 Data analyses

3.4.8.1 Analytical assessment using Gadget

In 2014 a model of Ling in Icelandic waters developed in the Gadget framework (see http://www.hafro.is/gadget for further details) and was benchmarked for the use in assessment. As part of a Harvest Control Evaluation requested by Iceland this stock was benchmarked in 2017 (ICES (2017a)). Several changes were made to the model setup and settings which are described in the Stock Annex.

3.4.8.2 Data used and model settings

Data used for tuning are given in the stock annex. Model settings used in the Gadget model are described in more detail in the stock annex.

3.4.9 Diagnostics

3.4.9.1 Observed and predicted proportions by fleet

Overall fit to the predicted proportional length and age–length distributions was close to the observed distributions. (Figure 3.4.11, Figure 3.4.12 Figure 3.4.13, Figure 3.4.14). In the initial years of the spring the observed length proportions appear to have greater noise, however as the number of samples caught increases, the noise level decreases. Similarly, for gears where only a small portion of the ling catch is caught, such as the gillnet, the overall noise is greater than for those gears with greater numbers of samples.

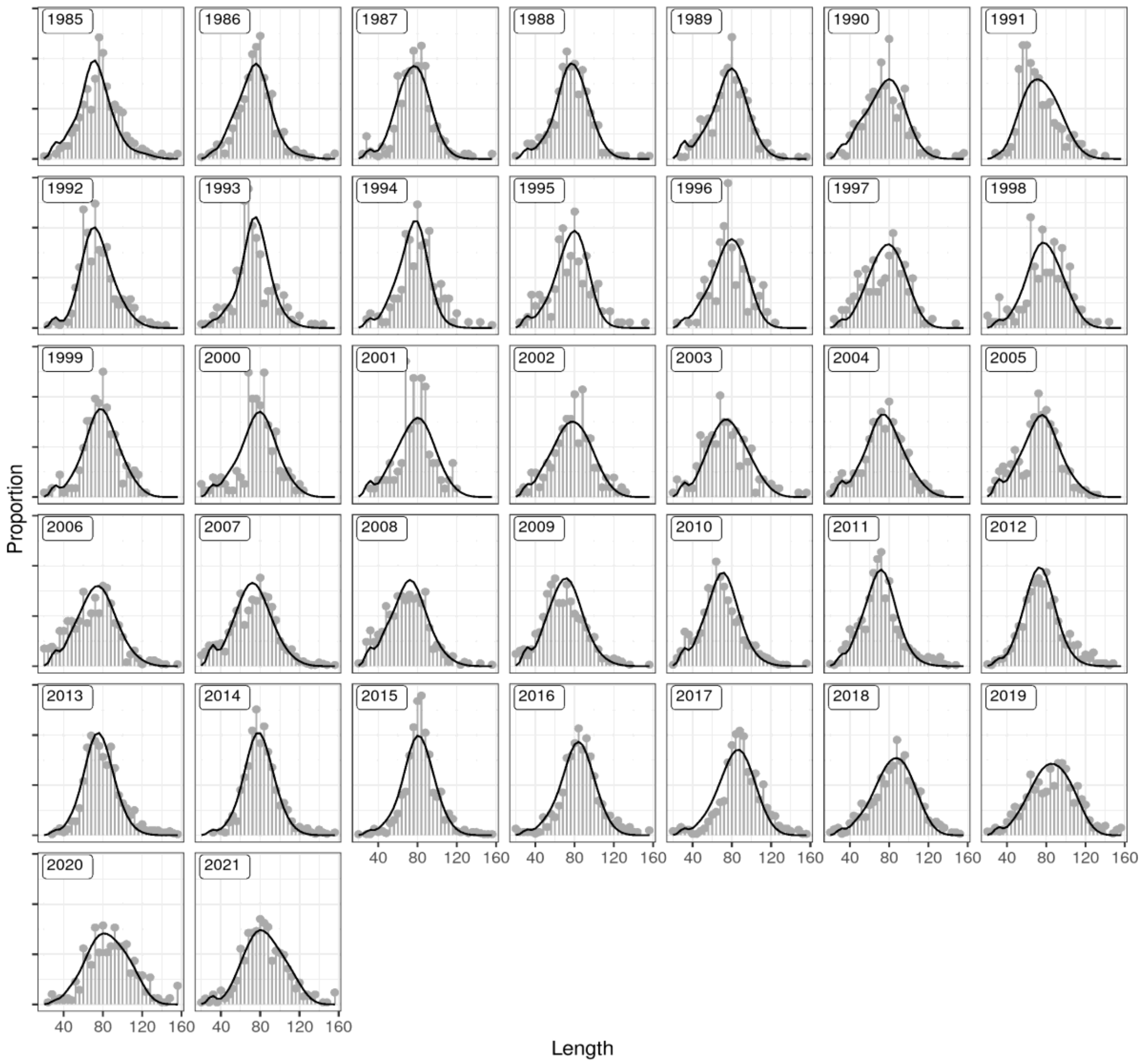

Figure 3.4.11: Ling in 5.a and 14. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions in the spring survey (grey lines and points)

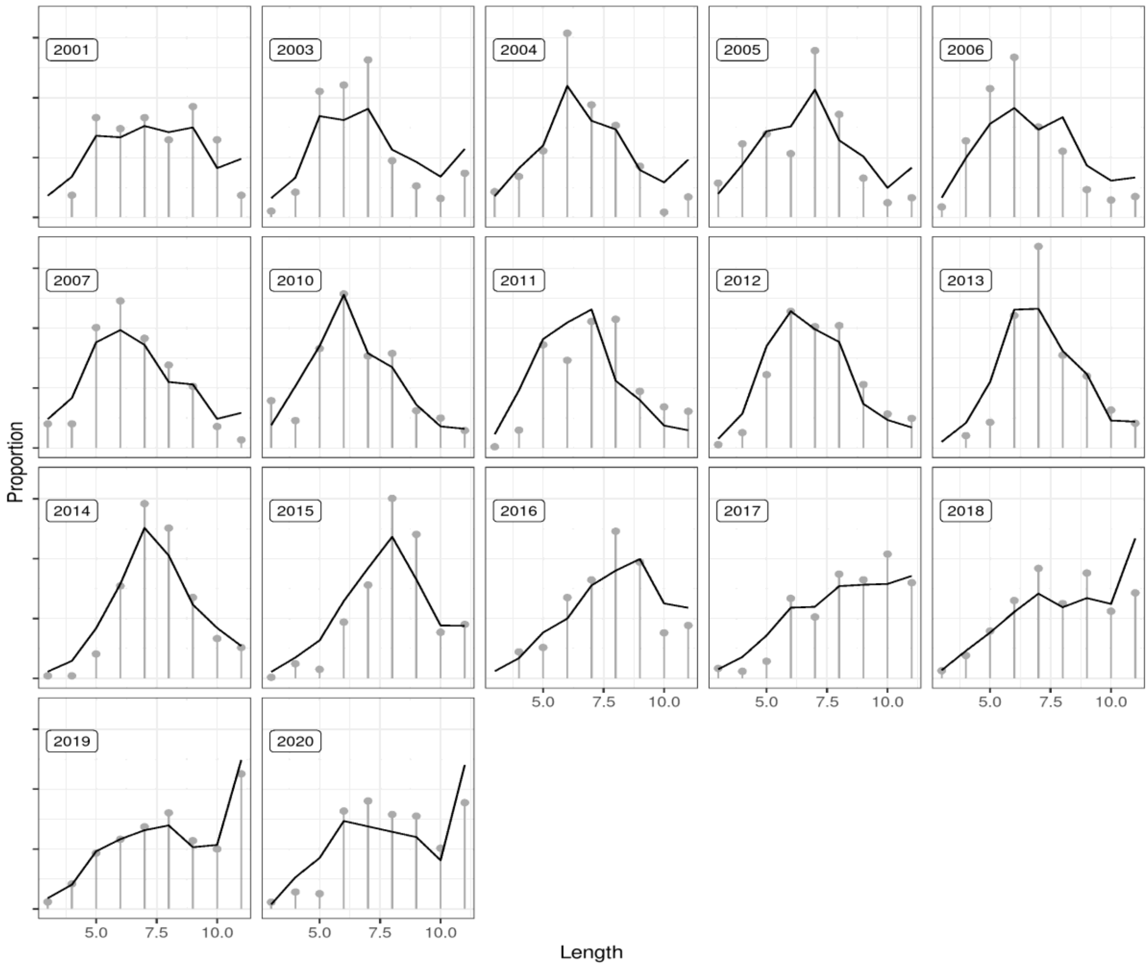

Figure 3.4.12: Ling in 5.a and 14. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in the spring survey catches (grey lines and points).

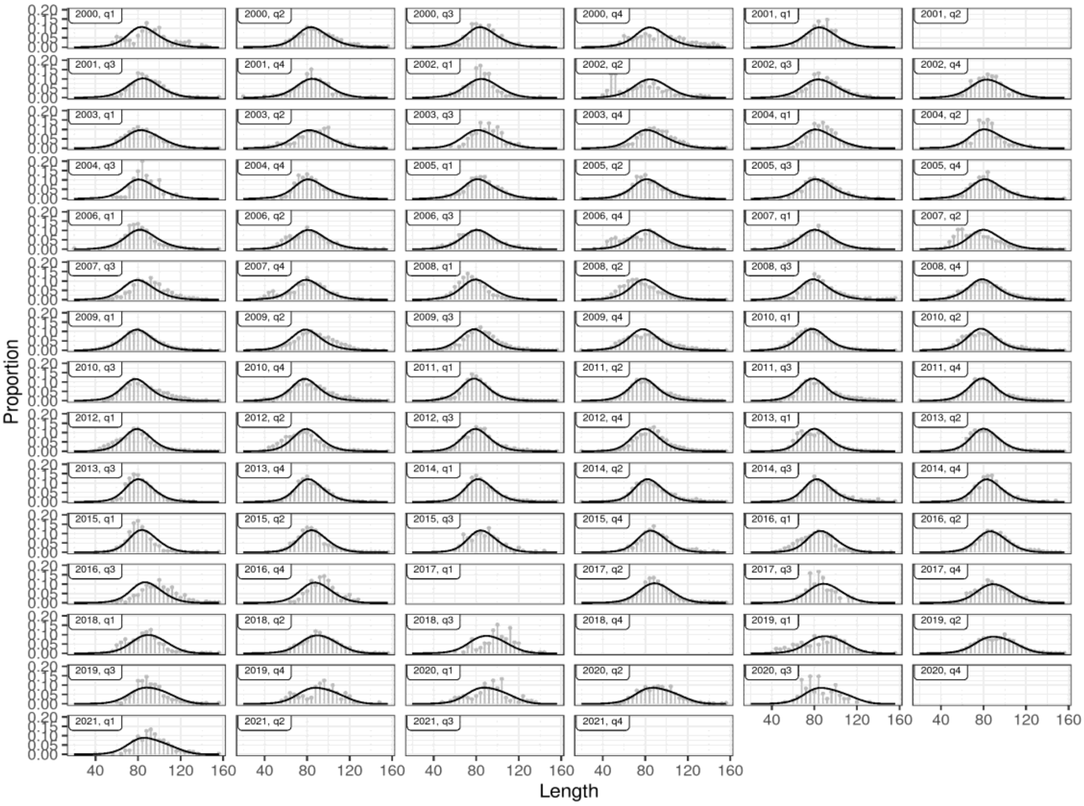

Figure 3.4.13: Ling in 5.a and 14. Fitted proportions-at-length from the Gadget model (black lines) compared to observed proportions from longline catches (grey lines and points).

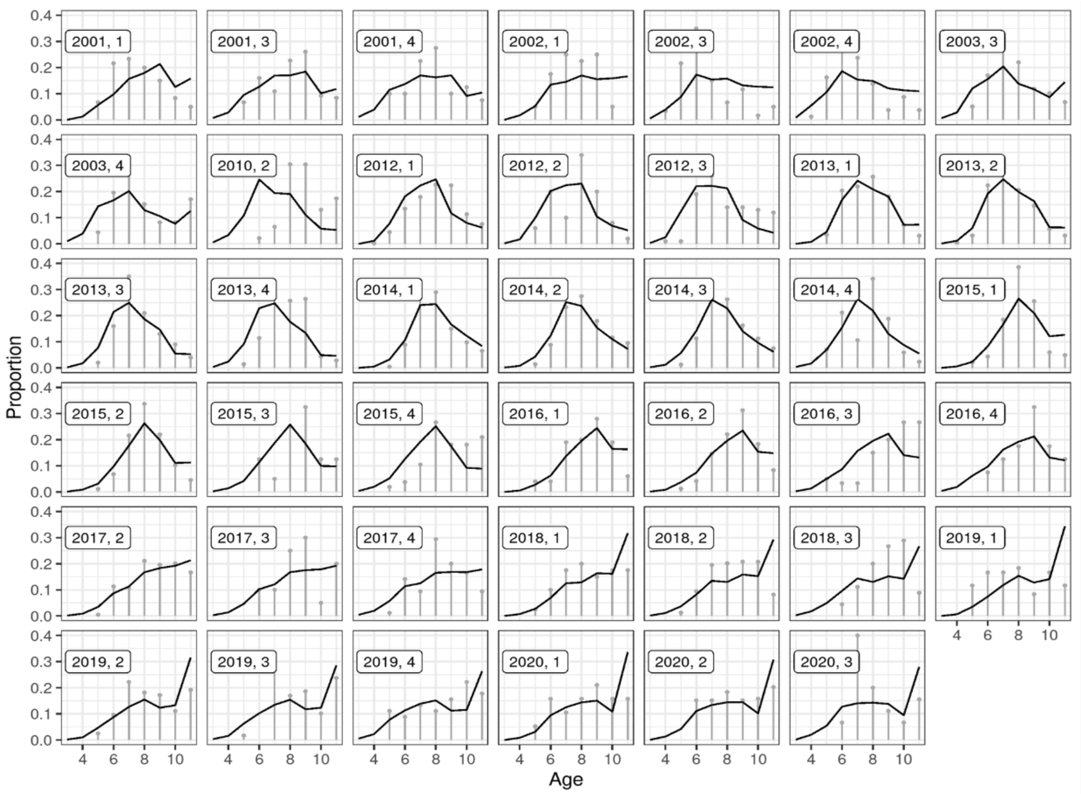

Figure 3.4.14: Ling in 5.a and 14. Fitted proportions-at-age from the Gadget model (black lines) compared to observed proportions in longline catches (grey lines and points).

3.4.9.2 Model fit

Figure 3.4.15 shows the overall fit to the survey indices described in the stock annex. In general, the model appears to follow the stock trends historically. Furthermore, the terminal estimate is not seen to deviate substantially from the observed value for most length groups, with model overestimating the abundance in the two largest length group. Summed up over survey biomass the model overestimates the biomass in the terminal years.

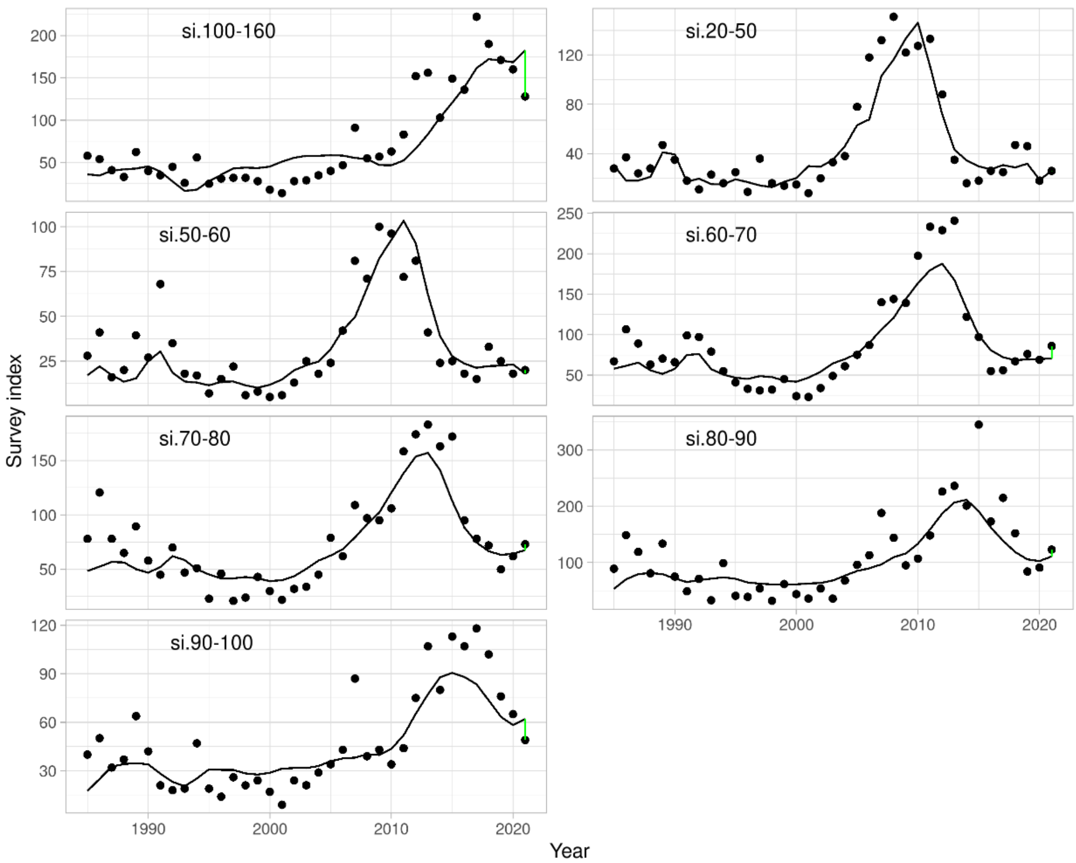

Figure 3.4.15: Ling in 5.a and 14. Fitted spring survey index by length group from the Gadget model (black line) and the observed number of ling caught in the survey (points). The green line indicates the difference between the terminal fit and the observations.

3.4.10 Results

The results are presented in Table 3.4.6 and Figure 3.4.16. The results are presented in Table 6 and Figure 16. Recruitment peaked in 2007 to 2010 but has decreased and is estimated in 2013 to 2015 to be at a level similar to that observed before the peak. The 2021 recruitment estimate is high compared to last year. Spawning–stock biomass has increased since 2000 and was estimated to be at its highest during 2014–2019 but has decreased this year and is expected to continue to decrease. Similarly, harvestable biomass was estimated at its highest level in 2015 but shows a slow and steady decrease. Fishing mortality for fully selected ling (age 14–19) has decreased from 0.66 in 2009 to 0.29 in 2020.

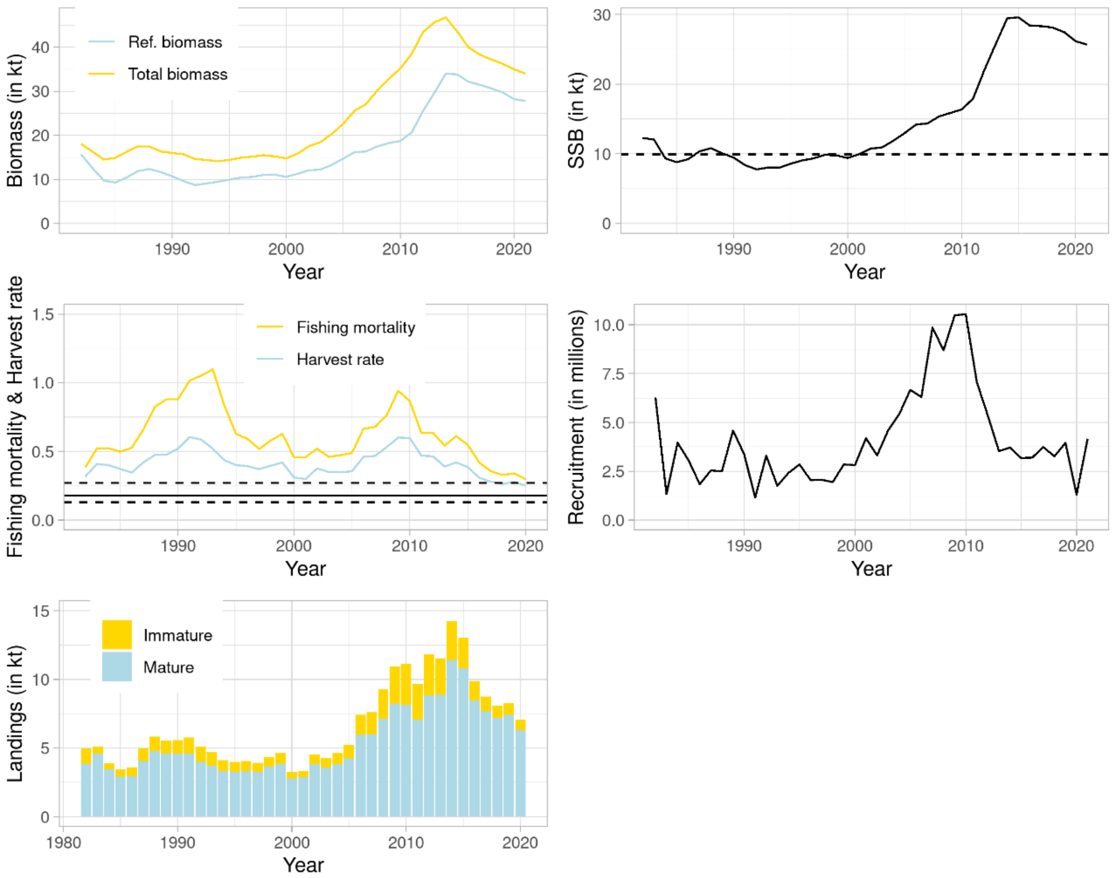

Figure 3.4.16: Ling in 5.a and 14. Estimated total biomass and reference biomass (>70+ cm), spawning stock biomass (SSB), fishing mortality for fully selected fishes and harvest rate, recruitment, and total catches. The dashed line in the SSB plot represents Bpa. The solid line in the harvest rate plot indicates the target harvest rate used in the harvest control rule, whereas the dashed lines indicate the bounds of the realized harvest rates resulting from the harvest control rule given the uncertainty in the assessment.

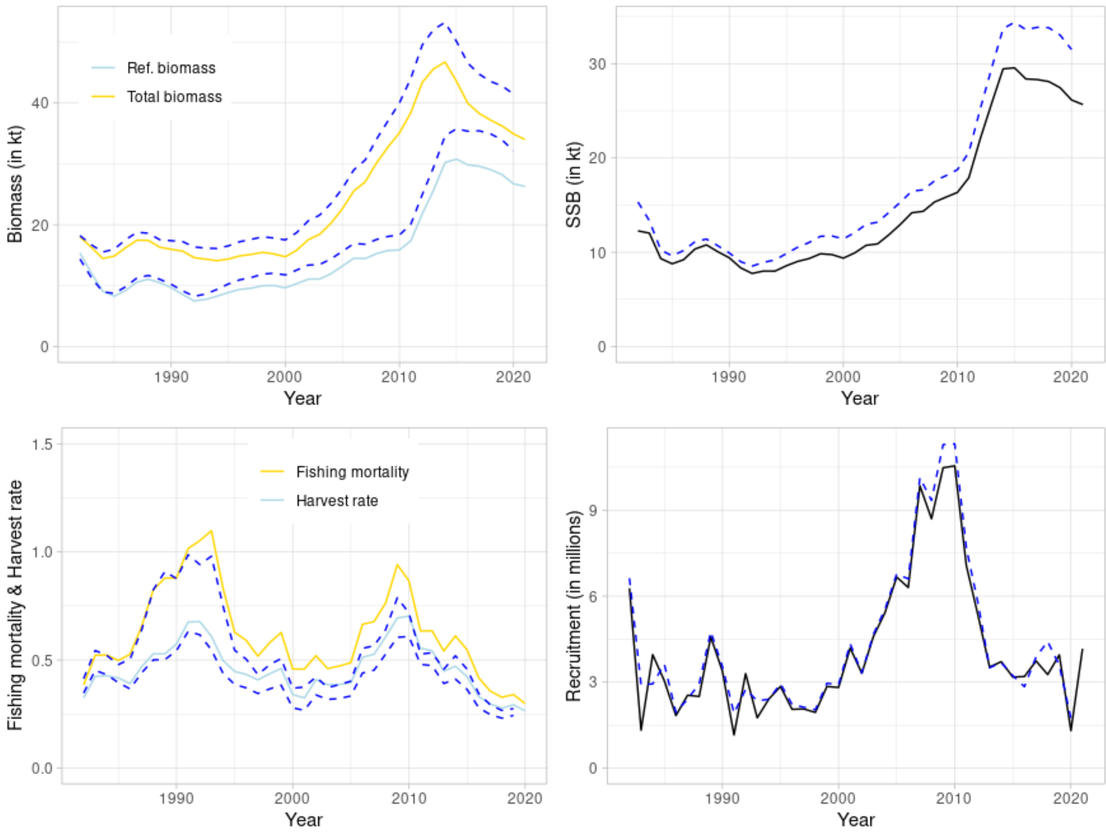

Figure 3.4.17: Ling in 5.a and 14. This year's assessment (blue and yellow lines) compared with the previous year's assessment (dashed lines). Estimated biomass, spawning stock biomass (SSB), fishing mortality for fully selected fishes and harvest rate and recruitment.

3.4.10.1 Retrospective analysis

The results of an analytical retrospective analysis are presented. The analysis indicates that there was an upward revision of biomass from the 5th to the 4th peel, followed by a downward revision of biomass that was more stably estimated over the last 3 years. As a result, there was a downward then upward revision of F. Estimates of recruitment are decently stable except for the apparent peak in 2017 - 2018. As explained in reference to the survey indices, this is likely the influence of highly variable survey indices that, for the smallest sizes in the most recent years, have no repeated observations at larger sizes with which this influence can be tempered. Therefore, it is expected that these recruitment peaks may simply be the result of uncertainty in survey indices and are likely to disappear in the coming assessment years. In addition, the downward revision observed between peels 4 and 3 is the result of the population reaching its peak in biomass and now decreasing. As the steep decrease in age 3 recruitment observed in 2010 - 2013 is expected to now be observed as decreased spawning stock size, it is likely that more downward revisions will be observed over the next 3 - 5 annual assessment cycles.

Mohn's rho was estimated to be 0.0778 for SSB, 0.306 for F, and 0.134 for recruitment.

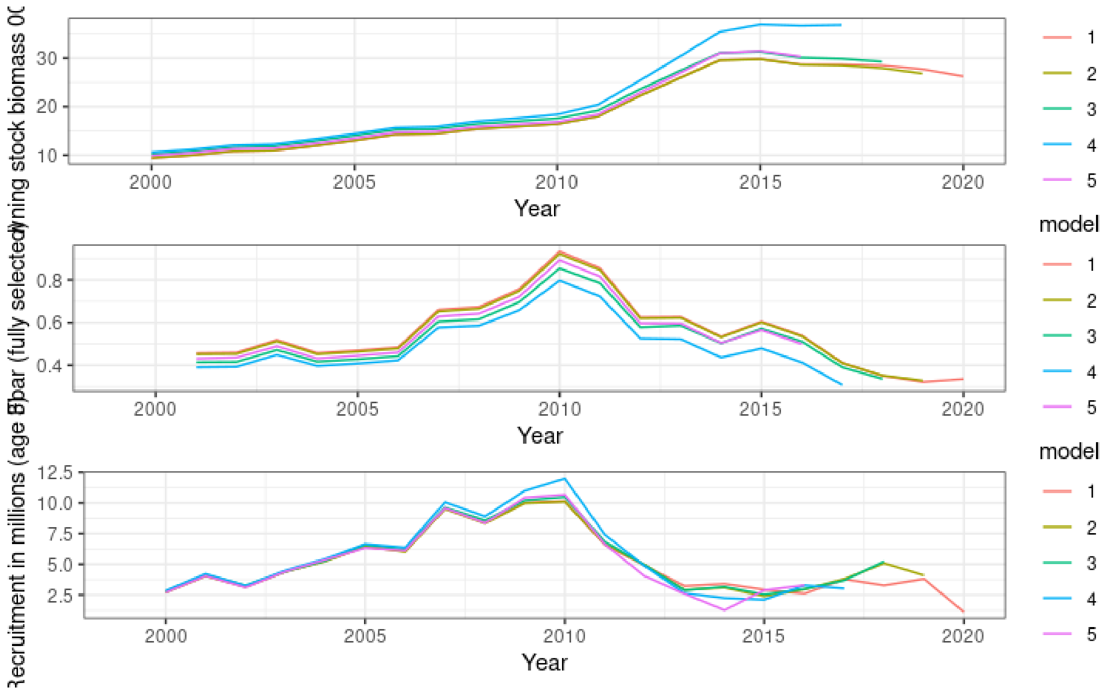

Figure 3.4.18: Ling in 5.a and 14. Retrospective plots illustrating stability in model estimates over a 5-year 'peel' in data. Results of spawning stock biomass, fishing mortality F, and recruitment (age 3) are shown.

3.4.11 ICES advice

In 2021, ICES advised that when the Iceland management plan was applied, catches in the fishing year 2021/2022 should be no more than 4 735 tonnes.

3.4.12 Management

The Icelandic Ministry of Industries and Innovation is responsible for management of the Icelandic fisheries and implementation of legislation. The Ministry issues regulations for commercial fishing for each fishing year (1 September–31 August), including an allocation of the TAC for each stock subject to such limitations. Ling in 5.a has been managed by TAC since the 2001/2002 fishing year.

Landings have exceeded both the advice given by MFRI and the set TAC from 2002/2003 to 2013/2014 but amounted to less than two thirds in 2015/2016 (Table 3.4.4). Overshoot in landings in relation to advice/TAC has been decreasing steadily since the 2009/2010 fishing year, with an overshoot of 53% to 35% in 2010/2011, 24% in 2011/2012 and 4% in 2012/2013. The reasons for the implementation errors are transfers of quota share between fishing years, conversion of TAC from one species to another (Figure 3.4.19) and additional catches by Norway and the Faroe Islands, taken in accordance with bilateral agreement. The level of those catches is known in advance but has until recently not been taken into consideration by the Ministry when allocating TAC to Icelandic vessels. There is no minimum landing size for ling.

There are 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 (ICES (2017b)).

Table 3.4.4: Ling in 5.a and 14. TAC recommended for ling in 5.a by the Marine and Fisheries Research Institute, national TAC and total landings.

Fishing Year	MFRI Advice	National TAC	Landings
1999/00			3 961
2000/01			3 451
2001/02	3 000	3 000	2 968
2002/03	3 000	3 000	3 715
2003/04	3 000	3 000	4 608
2004/05	4 000	4 000	5 238
2005/06	4 500	5 000	6 961
2006/07	5 000	5 000	7 617
2007/08	6 000	7 000	8 560
2008/09	6 000	7 000	10 489
2009/10	6 000	7 000	10 713
2010/11	7 500	7 500	10 095
2011/12	8 800	9 000	11 133
2012/13	12 000	11 500	12 445
2013/14	14 000	13 500	14 983
2014/15	14 300	13 800	13 166
2015/16	16 200	15 000	11 229
2016/17	9 343	8 143	8 426
2017/18	8 598	7 598	8 573
2018/19	6 255	5 200	6 927
2019/20	6 599	5299	7155
2020/21	5700		

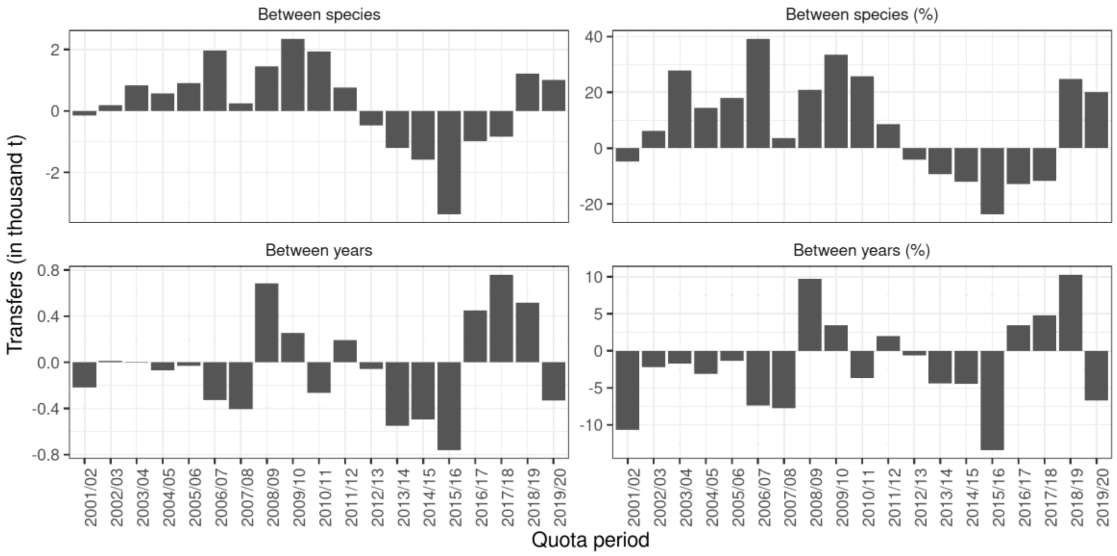

Figure 3.4.19: Ling in 5.a and 14. Net transfer of quota in the Icelandic ITQ system by fishing year. Between species (upper): Positive values indicate a transfer of other species to ling, but negative values indicate a transfer of ling quota to other species. Between years (lower): Net transfer of quota for a given fishing year (may include unused quota).

3.4.13 Current management plan

As part of the WKICESMSE 2017 HCR evaluations (ICES 2017a), the following reference points were defined for the stock:

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	9.93 kt	B_{pa}
	H_{msy}	0.24	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_{loss} as defined below.
	F_{msy}	0.284	The median fishing mortality when an harvest rate of H_{msy} is applied.
Precautionary approach	B_{lim}	7.09 kt	$B_{pa}/e^{1.645\sigma}$ where $\sigma = 0.2$
	B_{pa}	9.93 kt	SSB(1992), corresponding to B_{loss}
	H_{lim}	0.56	H corresponding to 50% long-term probability of SSB $> B_{lim}$
	F_{lim}	0.70	F corresponding to H_{lim}
	F_{pa}	0.41	$F_{lim}/e^{1.645\sigma}$ where $\sigma = 0.33$
	H_{pa}	0.35	H corresponding to F_{pa}
Management plan	H_{mp}	0.18	H such that $P(SSB < B_{pa}|\text{for any given year}) < 0.05$.

Figure 3.4.20: Ling in 5.a and 14. Reference points

The management plan accepted was: The spawning–stock biomass trigger (MGT Btrigger) is defined as 9.93 kilotonnes, the reference biomass is defined as the biomass of ling 70+ cm and the target harvest rate (HRMGT) is set to 0.18. 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 SSBY is equal or above MGT Btrigger: TACY/y+1 = HRMGT*BRef,y When SSBY is below MGT Btrigger: TACY/y+1 = HRMGT* (SSBy/MGT Btrigger) * Bref,y WKICEMSE 2017 concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

3.4.14 Management considerations

All the signs from commercial catch data and surveys indicate that ling is at present in a good state, even though the survey indices show downward trend in most recent years. This is confirmed in the Gadget assessment. However, the drop in recruitment since 2010 will result in decrease in sustainable catches in the near future. Currently the longline and trawl fishery represent 95% of the total fishery, while the remainder is assigned to gillnets. Should those proportions change dramatically, so will the total catches as the selectivity of the gillnet fleet is substantially different from other fleets.

Table 3.4.5: Ling in 5.a and 14. Landings (tonnes) by country in 5.a.

Year	Faroe Islands	Germany	Iceland	Norway	UK
2002	1631	0	2843	45	0
2003	570	2	3585	108	5
2004	739	1	3727	139	0
2005	682	3	4313	180	20
2006	962	1	6283	158	0
2007	807	0	6599	185	0
2008	1366	0	7738	179	0
2009	1157	0	9616	172	0
2010	1095	1	9868	168	0
2011	588	0	8789	249	0
2012	875	0	10695	248	0
2013	1030	0	10198	294	0
2014	1738	0	12350	158	0
2015	1233	0	11552	250	0
2016	1072	0	8583	230	0
2017	829	0	7692	244	0
2018	1103	0	6756	203	0
2019	1093	0	6992	184	0
2020	989	0	5836	237	0

Table 3.4.6. Tusk in 5.a and 14. Estimates of biomass, biomass 75+ cm, spawning–stock biomass (SSB) in thousands of tonnes and recruitment at age 1 (millions), harvest rate (HR) and fishing mortality from Gadget.

Year	Biomass	B40+	SSB	Rec3	Catch	HR	F
1982	18025	15374	12272	6274	4990	0.3245661	0.3847664
1983	16300	12068	12033	1325	5123	0.4245079	0.5220458
1984	14468	9084	9334	3959	3880	0.4270757	0.5229999
1985	14860	8270	8782	3047	3450	0.4171414	0.4981307
1986	16227	9204	9215	1833	3596	0.3907509	0.5264808
1987	17475	10605	10346	2541	4974	0.4690014	0.6563439
1988	17435	11061	10787	2499	5846	0.5285165	0.8249893
1989	16314	10495	10061	4578	5547	0.5284825	0.8793505
1990	15966	9684	9419	3384	5562	0.5743323	0.8793992
1991	15682	8560	8354	1157	5786	0.6758984	1.0158334
1992	14604	7507	7756	3296	5089	0.6779047	1.0520722
1993	14368	7733	8007	1755	4713	0.6094853	1.0978429
1994	14097	8274	7999	2411	4114	0.4972561	0.8319725
1995	14375	8884	8568	2848	3973	0.4471917	0.6280615
1996	14890	9384	9035	2050	4068	0.4334756	0.5904247
1997	15132	9584	9334	2064	3913	0.4082190	0.5177041
1998	15475	9988	9842	1943	4354	0.4359269	0.5794658
1999	15207	10033	9755	2848	4623	0.4607841	0.6271320
2000	14751	9644	9380	2814	3279	0.3400225	0.4581415
2001	15826	10340	9937	4191	3355	0.3244067	0.4577054
2002	17542	11071	10739	3309	4527	0.4089269	0.5202638
2003	18423	11096	10890	4592	4281	0.3858220	0.4602551
2004	20263	11966	11867	5429	4628	0.3867674	0.4721237
2005	22626	13220	12964	6666	5219	0.3947768	0.4878131
2006	25546	14516	14190	6301	7431	0.5119168	0.6649649
2007	27064	14457	14348	9850	7619	0.5270253	0.6778604
2008	30174	15273	15341	8700	9279	0.6075612	0.7640860
2009	32786	15773	15851	10480	10948	0.6940933	0.9412426

Year	Biomass	B40+	SSB	Rec3	Catch	HR	F
2010	35094	15861	16356	10546	11150	0.7030059	0.8658254
2011	38425	17389	17911	7064	9651	0.5549826	0.6341439
2012	43390	21808	22043	5336	11828	0.5423801	0.6349251
2013	45626	25731	25793	3525	11536	0.4483119	0.5414505
2014	46729	30233	29449	3713	14246	0.4712265	0.6117677
2015	43565	30785	29566	3176	13036	0.4234666	0.5472376
2016	39931	29849	28384	3196	9884	0.3311291	0.4180847
2017	38273	29615	28318	3737	8766	0.2959844	0.3561808
2018	37179	29051	28109	3264	8062	0.2775206	0.3275949
2019	36233	28226	27453	3950	8269	0.2929494	0.3399325
2020	34926	26730	26157	1306	7061	0.2641664	0.2983928
2021	34400	26304	25667	4165	3127	0.1188742	0.1332668

3.4.15 Ecosystem considerations

In 2010 to 2013, the distribution of ling expanded to the north and recruitment peaked (Figure 3.4.3 and Figure 3.4.8). These suggest favourable environmental conditions during this time; however, recruitment has returned to previous levels and therefore biomass levels are naturally expected to follow. In addition, there have been no obvious changes in maturity patterns or growth through time. Demographic patterns of ling should be monitored as other Icelandic demersal species have exhibited recent changes (e.g., haddock). Multispecies interactions are not currently considered to be a concern for the assessment.

3.4.16 References

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3.5 Ling (*Molva molva*) in subareas 3,4, 6–9, 12, and 14 (Northeast Atlantic and Arctic Ocean)

3.5.1 The fishery

Significant fisheries for ling are conducted in Subareas 3 and 4 at least since the 1870s pioneered by Swedish longliners. Since the mid-1900s, the major ling targeted fishery in Area 4.a. There Norwegian longliners fished around Shetland and in the Norwegian Deep. There is little activity in ICES Division 3.a. The Norwegian total landings in 2019 in Subareas 3 and 4 were: 83% taken by longlines, 9% by gillnets, and the remainder by trawls. The bulk of the landings from other countries were taken by trawls as bycatches, and the landings from the UK (Scotland) are the most substantial. The comparatively low landings from central and southern North Sea (4.b,c) are bycatches from various other fisheries.

The major directed ling fishery in subarea 6 is the Norwegian longline fishery. Catches of ling by trawl fisheries from the UK (Scotland) and from France are primarily bycatches.

When subareas 3–4 and 6–14 are summed over 1988–2019, 42% of the total landings were in Subarea 4, 30% in Subarea 6, and 24% in Subarea 7.

In Subarea 7, divisions b, c, and g–k provide most of the landings of ling. Norwegian landings, and some Irish and Spanish landings are from targeted longline fisheries, whereas other landings are primarily bycatches in trawl fisheries. Data split by gear type were not available for all countries, but the bulk of the total landings (at least 60–70%) were taken by trawls in these areas.

In Subareas 8 and 9, 12 and 14 all landings are bycatches from various fisheries.

The Norwegian fishery

The Norwegian longline fleet increased from 36 in 1977 to a peak of 72 in 2000, and afterwards the number of vessels decreased and then stabilized at -26 in 2015 to 2018 but increased to 30 in 2020. The number of vessels declined mainly because of changes in the law concerning the quotas for cod. The average number of days that each Norwegian longliner operated in an ICES division was highly variable for 4.a, stable for 6.b and declining for 6.a. The average number of hooks has remained relatively stable in Divisions 4.a and 6.a. During the period 1974 to 2020 the total number of hooks per year has varied considerably, but with a downward trend since 2000. This is also reflected in the number of fishing days (Figure 3.5.1).

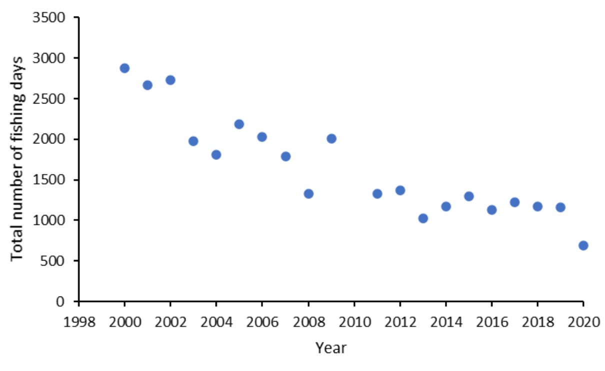

Figure 3.5.1. Total fishing days by the Norwegian longliners (20002020).

The French fishery

French fleets operating in 6, 7b-k are mainly otter trawlers, gillnetters and longliners.

The number of otter trawlers operating in the region has decreased from around 70 in the beginning of 2000 to 28 in 2018. Gillnetters have varied from 24 vessels in 2005 to 5 in 2016. In 2018 the number of vessels increased to 14. The number of longliners has increased from 1 in 2000 to 16 in 2019 (Table 3.5.3).

Since 2000, otter trawlers effort has decreased by a factor of 2. Gillnetters had a peak effort in mid-2000 followed by a steep decrease by a factor of 5 since 2010 as increase in 2017 and 2018. The recorded fishing efforts by longliners were imprecise due to lack of information in the first part of the 2000s. The activity seems to have peaked in 2007 followed by a sharp decrease to 2009. Since 2009, the effort has been steadily increasing (Figure 3.5.13).

Landings of ling by otter trawlers increased from 2004 to 2014, and since declined. For gillnetters and longliners, landings are closely related to changes in efforts.

The Spanish fishery

The Spanish catches of ling in ICES Subarea 7, are mostly in Divisions b, c and g–k, and are mainly taken by longliners. However, there are also important bycatches of ling by trawlers operating in the Subarea 7. Porcupine Bank is an important fishing area for the Spanish trawlers, therefore the data from the Porcupine Bank Spanish ground fish survey could be useful as an indicator of abundance and status of ling in the area.

3.5.2 Landings trends

Landing statistics for ling by nation in the period 1988–2019 are in Tables 3.5.1 and 3.5.2 and in Figures 3.5.2 and 3.5.3. For the early time-series, from 1988 to 2000, only international landings by area are presented (table 3.5.2), see stock annex for details of landings by country and area before 200. Detailled landings by area and country are presented for the time-series 2001-2021 only (Table 3.5.1).

There was a decline in landings from 1988 to 2003, and since lannded has been stable and slightly increasing. Areas 3–14 are pooled, the total landings averaged around 32 000 t in the period 1988–1998 and afterwards the average catch varied between 16 000 and 20 000 tons per year. The preliminary landings for 2020 is 15 257 t.

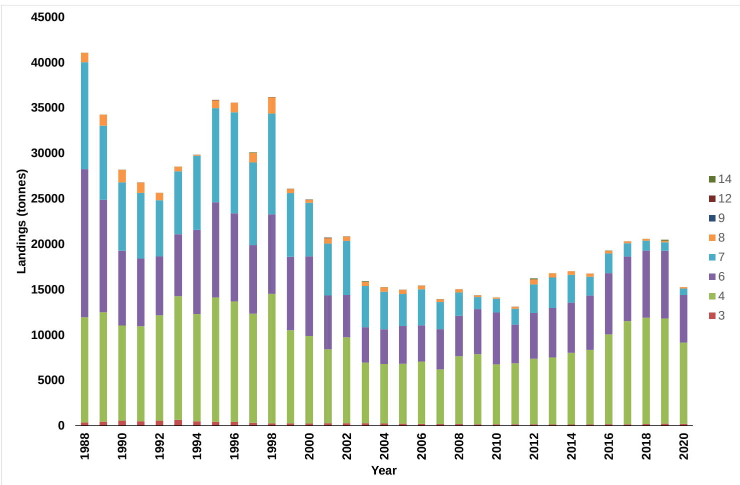

Figure 3.5.2. International landings of ling in subareas 3,4, 6–9, 12, and 14 .

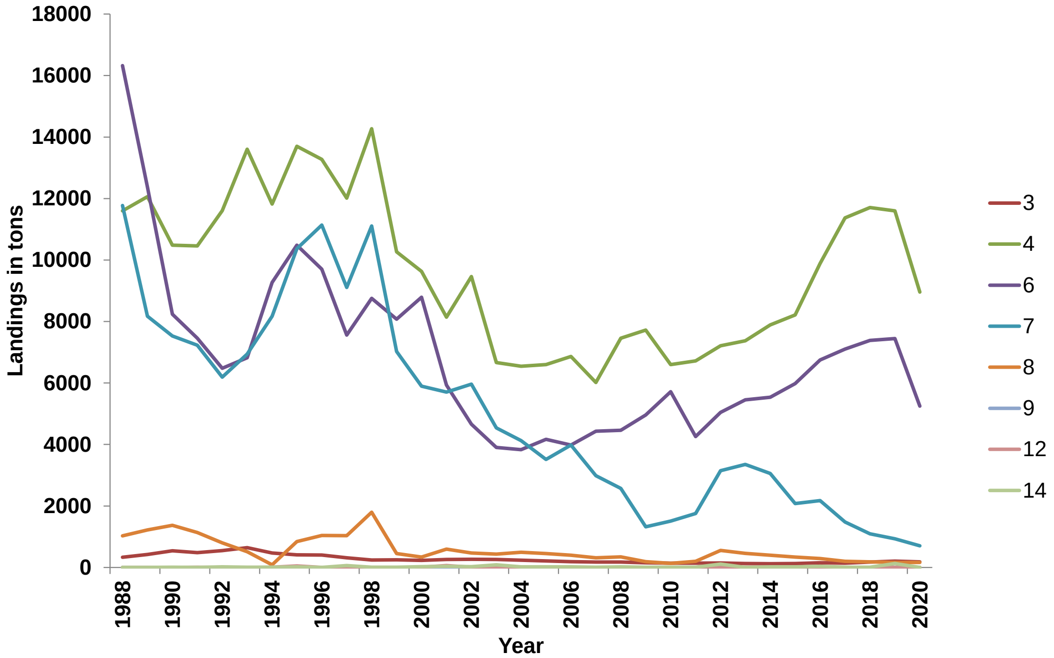

Figure 3.5.3. International landings of ling in subareas 3,4, 6–9, 12, and 14 .

3.5.3 ICES Advice

Advice for 2020 to 2021: "ICES advises that when the precautionary approach is applied, catches should be no more than 18 516 tons in each of the years 2020 and 2021".

3.5.4 Management

Norway has a licensing scheme in EU waters, and in 2020 the Norwegian quota in EU waters is 8000 t. The Faroe Islands has a quota of 200 t in Divisions 6.a and 6.b. The quota for the EU in the Norwegian zone (Subarea 4) is set at 1 350 t. For 2021, provisional TACs have been set from 01.01.2021 to 31.07.2021

EU TACs in EU and international waters in the stock area and EU quota in Norwegian waters 2016–2021

	2016	2017	2018	2019	2020	2021(1)
Division 3a	87 t	87	87	170	179	68
Subarea 4 (EU waters)	2912 t	3494	3843	4035	4237	370
Subarea 4 (Norwegian waters)	950	1350	1350	1350	1350	900
Subarea 6, 7,8, 9, 10,12,14 (EU and international waters)	16 997 t.	20 396	20 396	20 396	20 396	5357

(1) provisional TACs set from 01.01.2021 to 31.07.2021

3.5.5 Data available

3.5.5.1 Landings and discards

Landings are available for all relevant fleets. Within the Norwegian EEZ and for Norwegian vessels fishing elsewhere, discarding is prohibited and therefore are no information about discards. Discards by countries are given In Table 3.5.4. for the years 2012 to 2020, In all years discards are <5%, so are considered negligible for assessment. The bulk of the discard is from UK (Scotland).

Table 3.5.4. Total discards of ling by country for the years 2012 to 2020.

	Denmark	Spain	Ireland	France	Sweden	UK (Scotland)	UK (England)	Total discard	Total catches	%discard
2012		46	176					222	16435	1.35
2013		101	160	29				290	17063	1.70
2014		54	435	15				504	17518	2.88
2015		0	0	131	4	704		839	17596	4.77
2016		1	220	72		1302	22	1598	20881	7.74
2017	1	10	105	71	2	959		1147	21443	5.35
2018	1		43	89		876	3	1012	21566	4.69
2019	3	8	70	13		993	9	1096	21837	4.85
2020	4	37	19	1	0	346	0	407		

3.5.5.2 Length composition

Data from the Norwegian reference fleet

Average fish length, weight–length relationships and the length distribution for the Norwegian longline and gillnet fishery in Divisions 4a, 6a, 6b for ling are shown in Figure 3.5.4–3.5.6, respectively. Data are from the Norwegian longline reference fleet. The length-weight relationship from sex combined is $W=0.0055*TL^{3.0120}$.

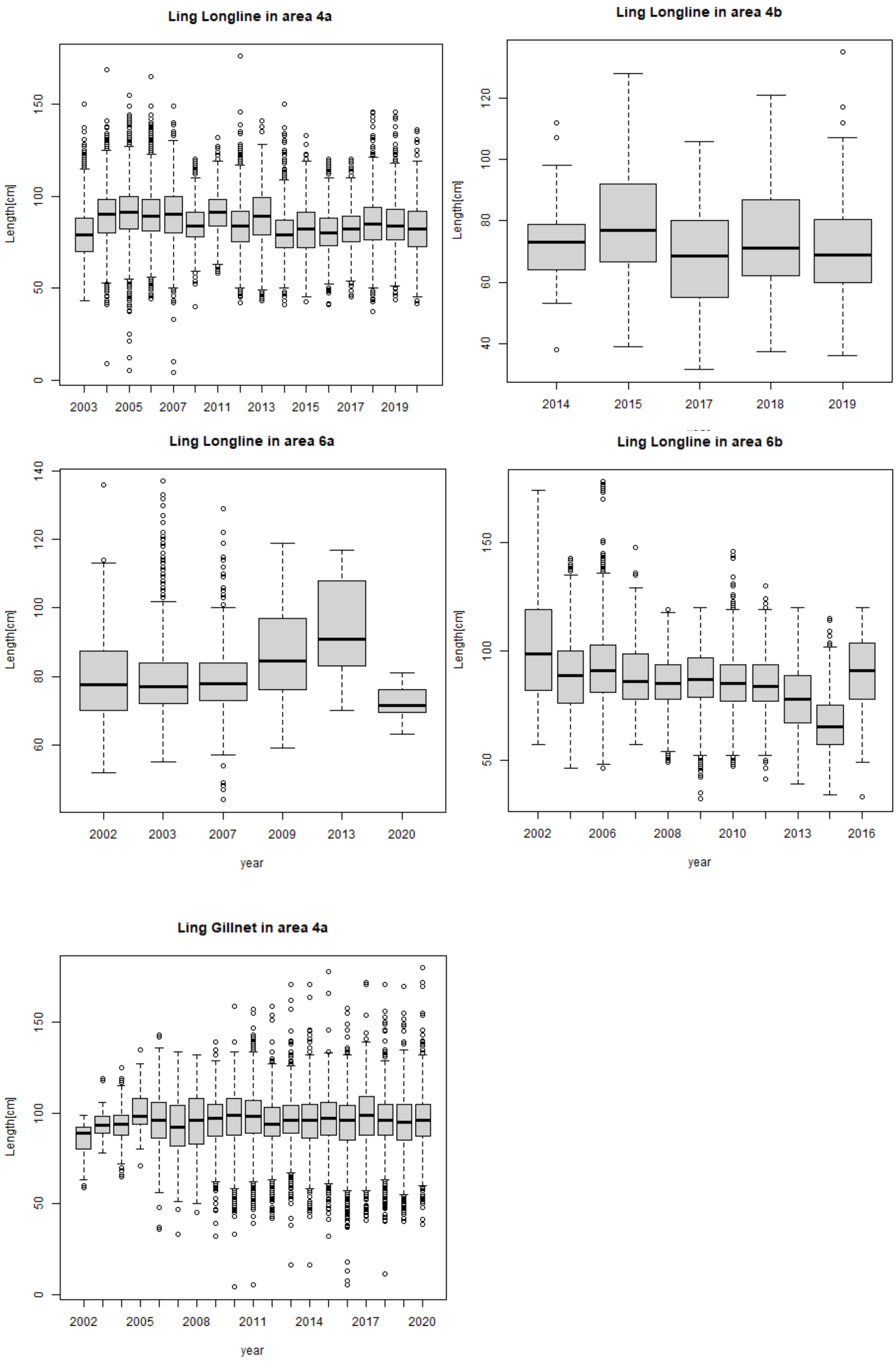

Figure 3.5.4. Time-series of mean length of ling caught by the Norwegian longline reference fleet in divisions 4.a, 4.b, 6.a and 6.b (note that some years are missing in some divisions).

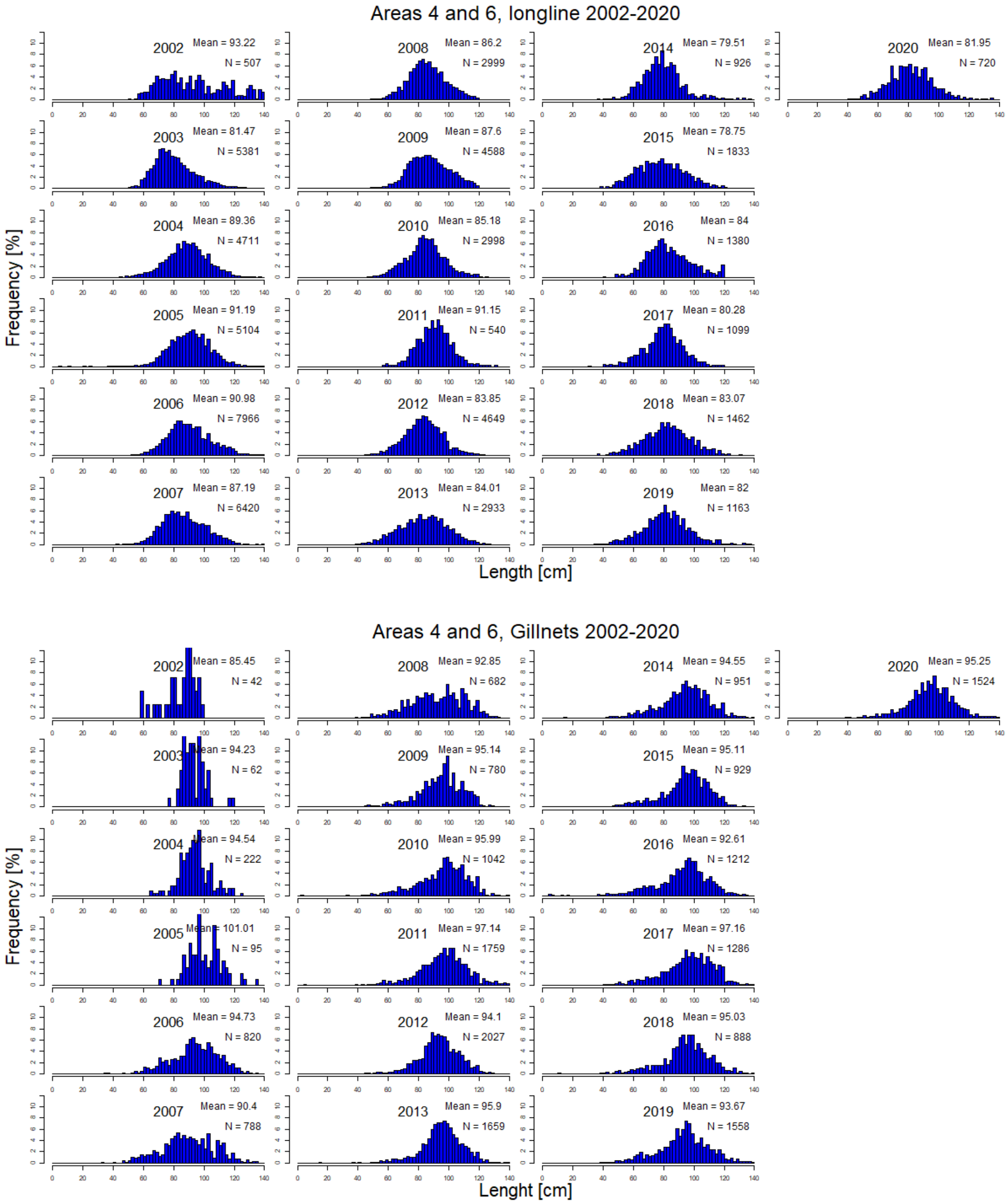

Figure 3.5.5. Length distributions of ling in Areas 3a, 4.a, 6.a and 6.b based on data from the Norwegian reference fleet.

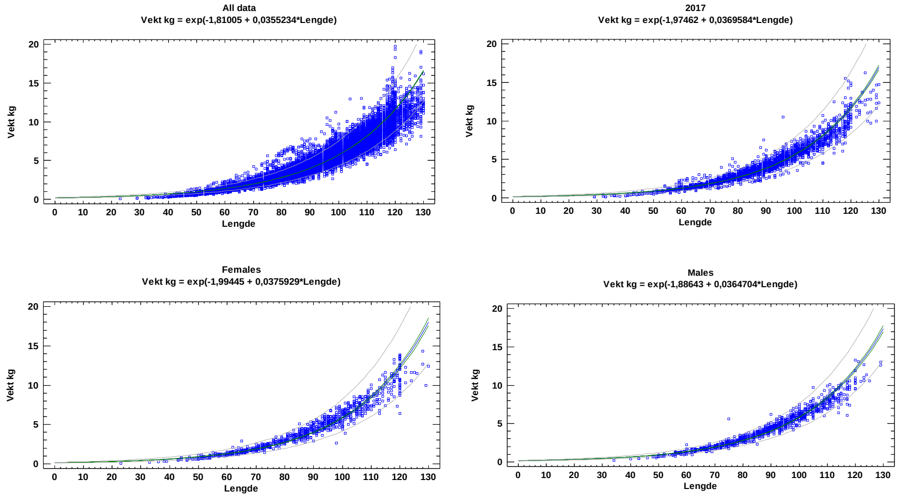

Figure 3.5.6. Weight as a function of length for ling based on all available Norwegian data.

Estimated Length distributions based on the Spanish Porcupine Bank (NE Atlantic) surveys

The length distribution of catches of ling in the Spanish Porcupine survey, reflect first the declining of number caught in this survey (3.5.7). Further individual remaining in the two last year are small for more information see Ruiz-Pico *et al*. (WD 2020).

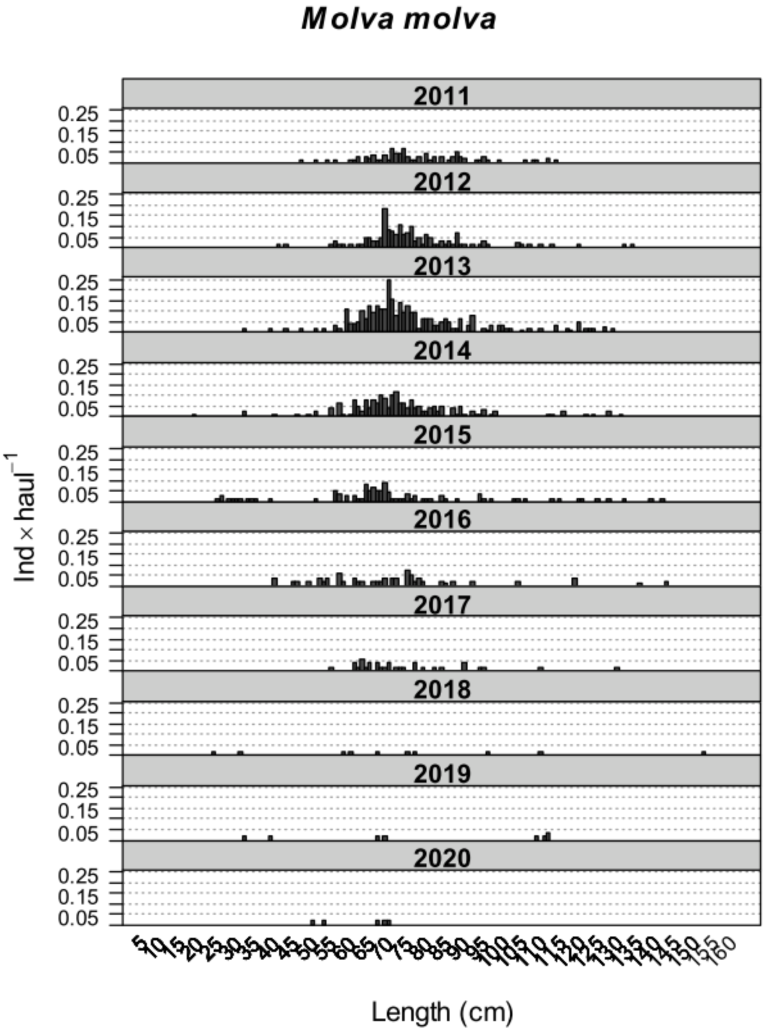

Figure 3.57. Estimated length distributions of ling (*M. molva*) based on the Porcupine Bank Spanish survey in the period 2011–2020.

3.5.5.3 Age compositions

Estimated age distributions for the years 2009–2019 based on data from the Norwegian Reference fleet for all areas combined (Figures 3.5.8) and box and whisker plots for the age composition of the fish taken by longliners and gillnetters in Area 4.a (Figure 3.5.9).

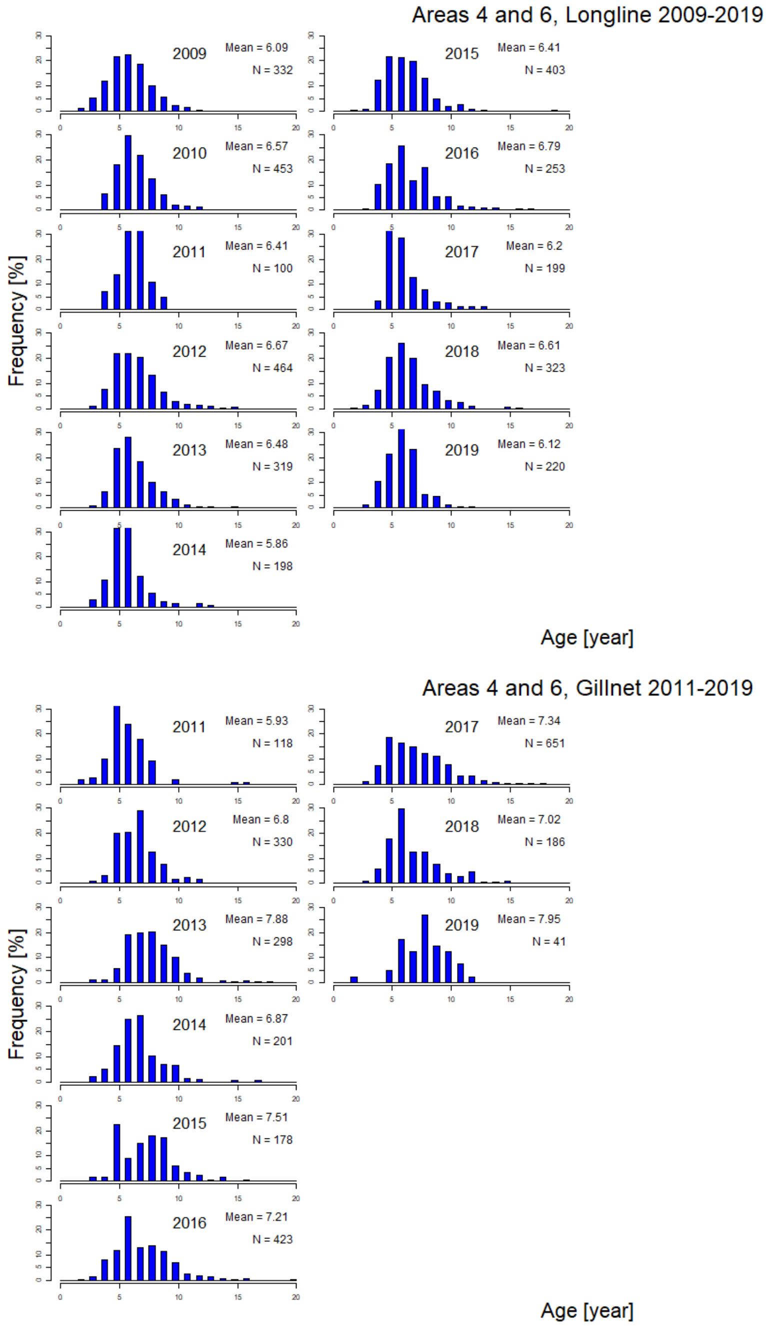

Figure 3.5.8. Age distributions for ling areas combined for all catches taken by longliners and by gillnetters.

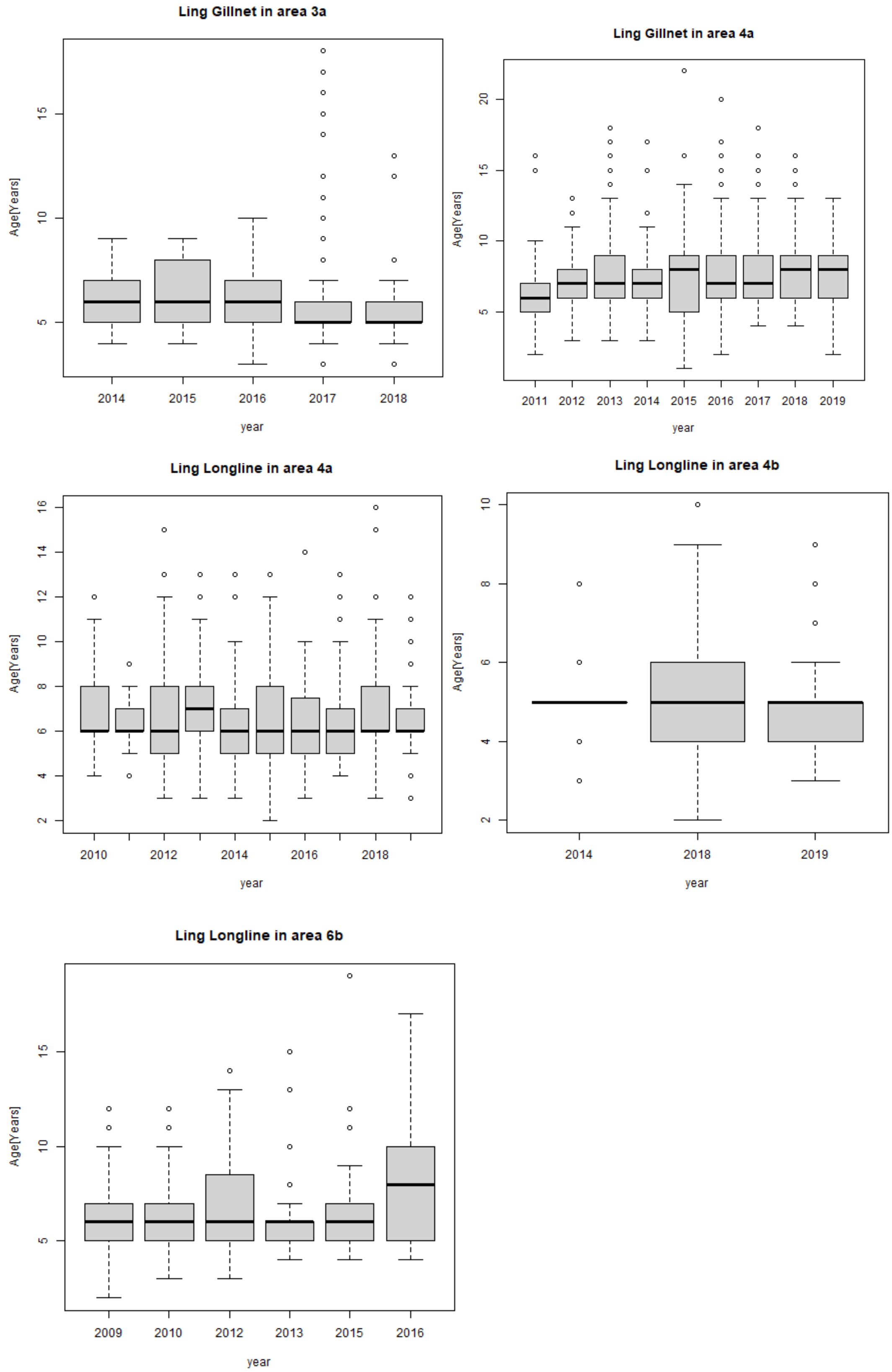

Figure 3.5.9. Average age of ling catches by longliners and gillnetters by area.

3.5.5.4 Weight-at-age

Weight and length at age for all age readings of ling from divisions 4.a and 6.a from 2009 to 2017 sampled from the longliners in the Norwegian reference fleet show quite linear relationships (Figure 3.5.10).

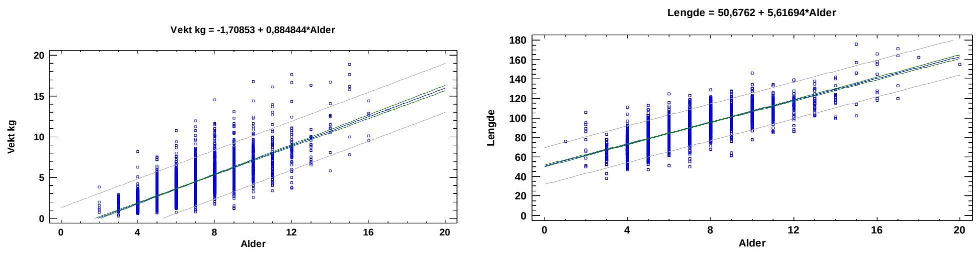

Figure 3.5.10. Weight versus age and length versus age for ling (combined data from 2009 to 2017) for divisions 4.a and 6.a based on the Norwegian longliner reference fleet.

3.5.5.5 Maturity and natural mortality

The maturity parameters used for the stock are:

Stock	L_{50}	N	A_{50}	N	Source
Lin-lin.27.3.a4.a6-91214	63.6	1472	4.8	336	Norwegian long liners (Reference fleet) and survey data

Similar estimates have been found in other area, e.g. Age at fist maturity around 5–7 years (60–75 cm lengths) with males maturing at a slightly younger age than females (Magnusson *et al.*, 1997).

There was no new data in 2021.

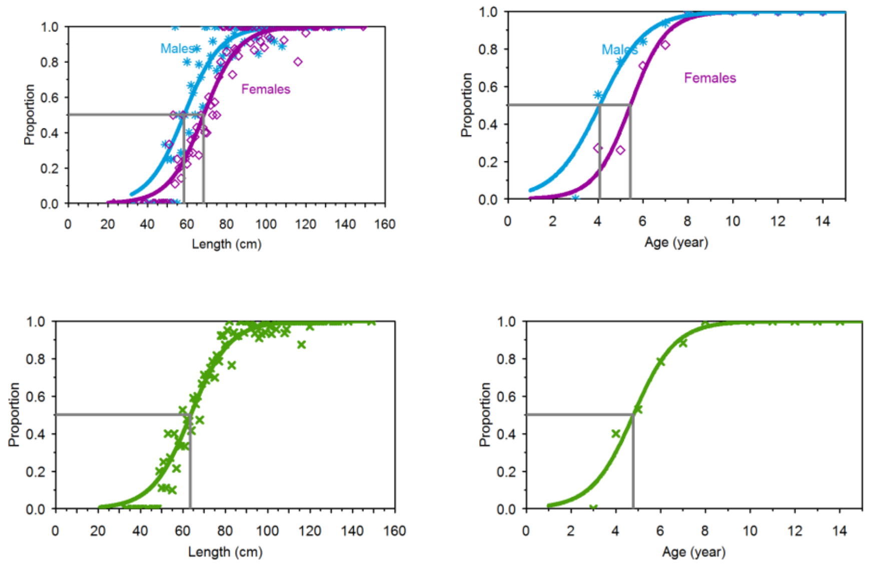

Figure 3.5.10. Ling (lin.27.3a4a6-91214), maturity ogives for age and length for males and females (top panel) and sexes combined (lower panel).

3.5.5.6 Growth

Preliminary new estimates of growth of ling were presented for the Celtic Sea, an area with no previous growth estimates for the species (Vieira and Visconti, 2021). Despite that growth parameters are necessary for length-based indicators (LBIs), they remain limited for ling (Table 3.5.7). Estimates from various studies in and out of the stock area differ.

Table 3.5.7. Growth estimated of ling

L∞	K	t_0	Sex	Area	Data from the stock area	Reference
119	0.136			Faroe Bank	No	Magnussen 2007
189	0.08			Northern North Sea	Yes	Bergstad & Hareide 1996
183	0.118		Female	Faeroe Islands	No	Joenoes 1961
166	0.103			West of Scotland	Yes	Bergstad & Hareide 1996
158	0.087			Rockall	Yes	Bergstad & Hareide 1996
141	0.143			Norwegian Sea		Bergstad & Hareide 1996
170	0.132		Male	Faeroe Islands	No	Joenoes 1961
124	0.163			Faeroe Islands	No	Bergstad & Hareide 1996
148	0.11	-2.19		Celtic Sea	Yes	Vieira and Visconti, 2021

3.5.5.7 Natural mortality

Natural mortality is also poorly known. For the adjacent stocks in the Faroese and Icelandic ecoregions (lin.27.5a and lin.27.5b) a natural mortality of 0.15 is assumed, the same is used here.

3.5.5.8 Catch, effort and research vessel data

Spanish Porcupine Bottom Trawl Survey

Spanish Porcupine Bottom Trawl Survey (SP-PORC) in ICES divisions 7.c and 7.k has been carried out annually since 2001 to study the distribution, relative abundance and biological parameters of commercial fish in these areas (ICES, 2010a; 2010b). The survey provides estimates of biomass and abundance indices. The stratification and location of station is shown in Figure 3.5.11.

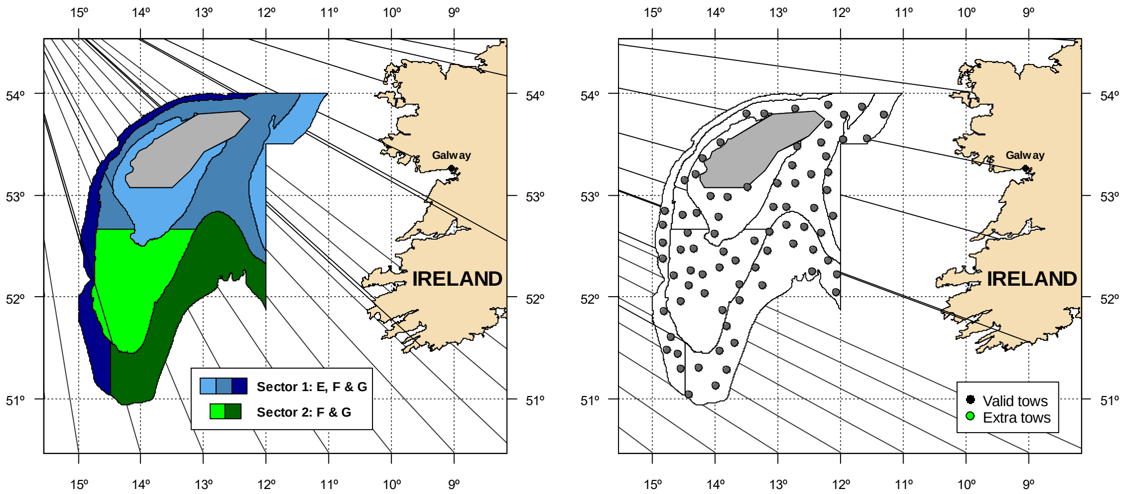

Figure 3.5.11. Left: Stratification design used in the Porcupine surveys starting in 2003: Previous years were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank denotes a large non-trawl able area. Right: distribution of hauls in 2020.

French Southern Atlantic Bottom trawl survey (EVHOE)

Ling are caught in small numbers in the French Southern Atlantic Bottom trawl survey (EVHOE). Population indices (based on swept area for biomass, mean length, etc.) for the Bay and Biscay and Celtic Sea (ICES divisions 7g-k and 8a,b,d) combined were provided for years 1997–2020 (Figure 3.5.15). The survey covers depths from 30 to 600 m and is stratified by depth and latitude. The percentiles are based on a very small number of ling per year and that is the reason for the small error bar in the percentile graph.

Commercial cpues

French lpue

A crude lpue based on landings and effort, measured in hours at sea have been presented in previous years and was not updated in 2020 considering that a properly standardised lpue might be informative of abundance trends.

Norwegian longline cpue

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2020. Selected vessels were those with a total landed catch of ling, tusk and blue ling of more than 8 t per year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. The quality of the Norwegian logbook data is poor for 2010 due to changes from paper to electronic logbooks. Since 2011 data quality has improved considerably and data from the entire fleet were available.

Standardised cpue series are calculated for the Norwegian fleet using data from official logbooks starting from 2000 (Helle *et al.* 2015). Two standardized time-series of cpue are calculted using all catch data, and a subset where ling make up more than 30% of the total catch. This subset is considered to represent targeted fishing.

3.5.6 Data analyses

Length data analysis

Mean length of the commercial catches by the Norwegian longlining reference fleet fluctuate around 90 cm in Divisions 4a abd 6.a, in Division 6b there may have been a decline in mean length up to 2015 then larger fish were landed in 2016. More recent data are missing. In division 4b, catches are slightly smaller than in 4.a. (Figure 3.5.3). When all data for these areas are combined for longline and for gill netters the average length is about 10 cm higher for gill netters than for longliners (Figure 3.5.4)

The estimated length distributions of ling caught in SP-PORC survey suggest a disappearance of large fish. Ling smaller than 50 cm are not caught in significant number in Surveys (Figure 3.5.14). For more information, see Ruiz-Pico *et al.*, WD 2020.

Ling are caught in small numbers (average of 14 individuals per year since 1997) in EVHOE therefore, populations indices from this survey are not considered representative of stock trends and not used for advice purposes. They are however presented (Figure 3.5.12) and their overall trend suggest a decline of ling in the survey area.

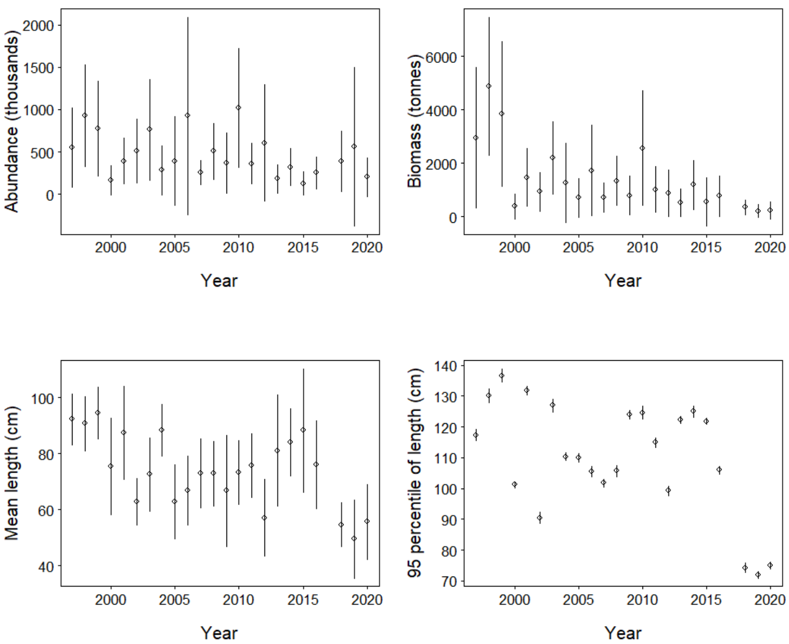

Figure 3.5.12. Population indices (swept area raised abundance and biomass, mean length and 95 percentile of the length distribution) of ling in the Bay and Biscay and Celtic Sea (ICES divisions 7.g,hjk and 8a,b,d) from the French EVHOE survey (W-IBTS-Q4), 1997–2020 (except 2017).

Spanish Porcupine Bank survey

Estimated biomass and abundance indices based on data from the Porcupine Survey for the years 2001–2020 are in Figure 3.5.13. The abundance indices for ling based on the survey were quite stable from 2001–2012. After the peak in 2013 there has been a large decline to a very low level.

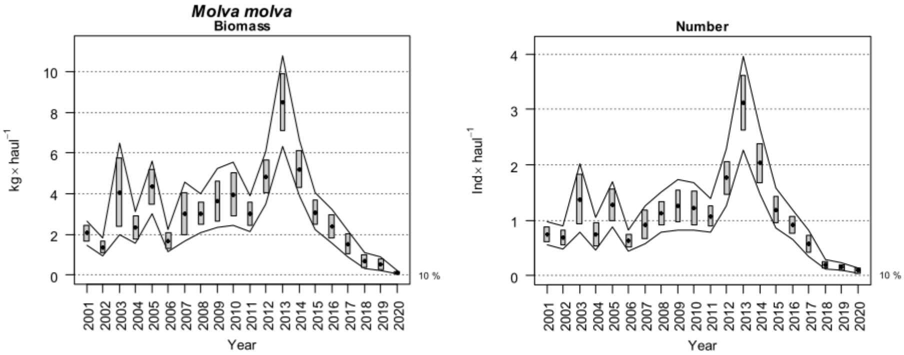

Figure 3.5.13. Estimated biomass and abundance indices based on the Porcupine Survey for the years 2001–2020. Boxes mark the parametric, based standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

Cpue series based on the Norwegian longline fleet

Figure 3.5.14 shows the Norwegian CPUE series from 2000 to 2020. In Division 4a there was a steady increase in CPUE from 2002 until 2016 then a stabilization. This trend can be seen both when all data was used and when ling was targeted. In Divisions 6a and 6b there was also an increasing trend from 2002 to 2016 followed by a stabilization in 6.a and a decrease in 6.b.

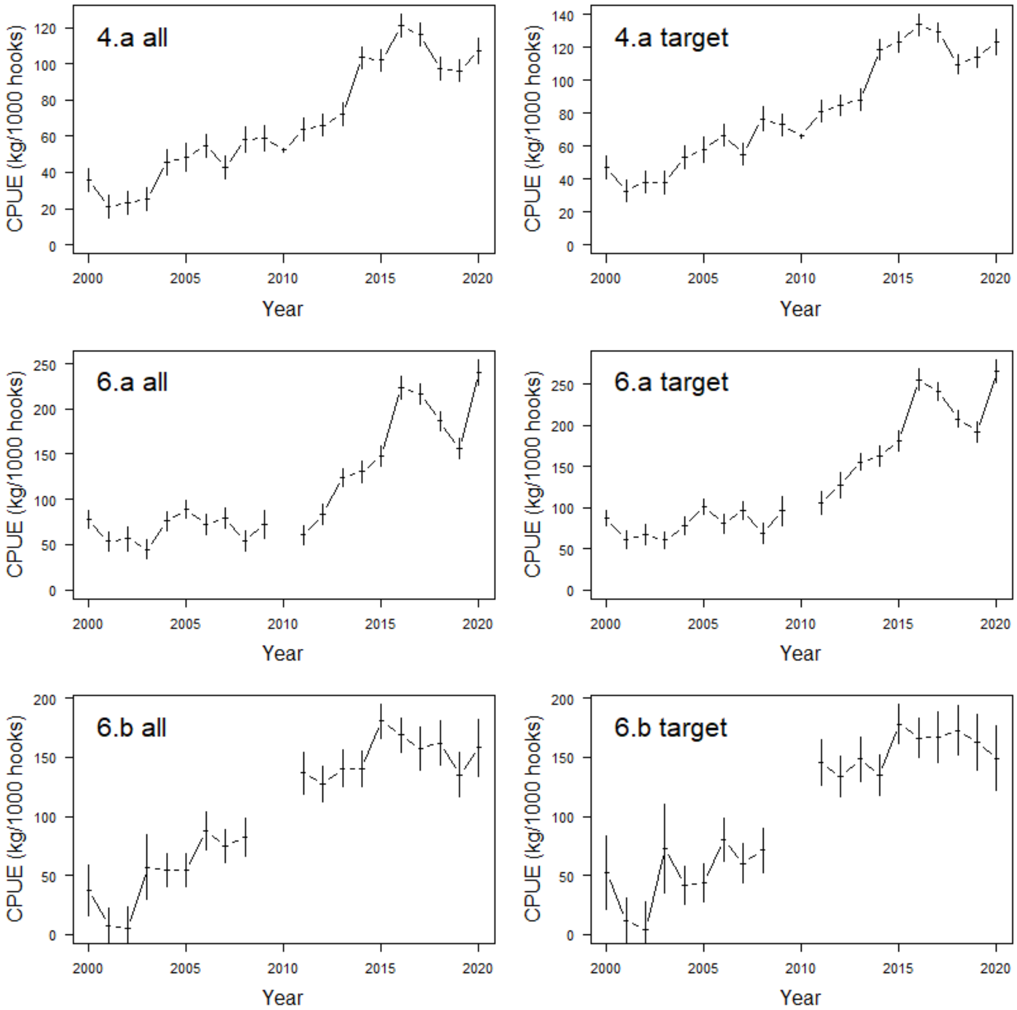

Figure 3.5.14. Cpue series for ling for the period 2000–2020 based on all available data and when ling was targeted. The bars denote the 95% confidence intervals.

The index used for advice on the stock is the combination of all data for the 3 areas, the index used since 2015 is the cpue when ling was targeted (Figure 3.5.16 right). Nevertheless, the time-series is similar when targeted fishing and all fishing for ling are considered (Figure 3.5.15).

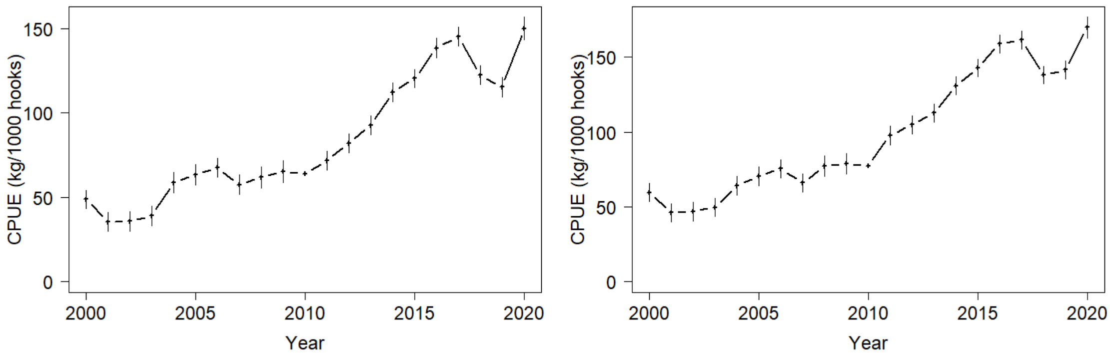

Figure 3.5.15. Cpue series for ling, areas 4a, 4b, 6a and 6b combined, for the period 2000–2020 for all data available (left) and for target fishing (right). The bars depict the 95% confidence intervals.

3.5.7 Biological reference points: length-based indicators

In 2020, Length based indicator (LBIs) were recalculated, using recent data and update parameters to investigate further the application of MSY proxy reference points. SPiCT was not run.

The length data used in the LBI model are data from the Norwegian longline fleet. The length data are not weighted and therefore do not represent the length distribution of the entire catch. For calculating the LBIs, the assumption M=0.15 was used with the length at first maturity (Lmat= 64 cm) and the length-weight relationship from Norwegian data. Three pairs of L_∞ and k, from the same model fit were trialled. These are estimates from sampling fish caught by the Norwegian fleet (L_∞ = 183 cm and k=0.118) and the extreme pairs of all available estimates (L_∞ = 189 cm, k=0.08 and L_∞ = 124 cm, k=0.163). The length- weight relationship w=0.0055*Lt^3.0120 estimated on samples from the Norwegian longline fleet.

Table 3.5.6 Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Input parameters for LBI.

	Parameter				
set	M	L_{mat}	L_∞	k	M/k
Set1	0.15	0.64	183	0.118	1.27
Set 2	0.15	0.64	189	0.08	1.88
Set 3	0.15	0.64	124	0.163	0.92

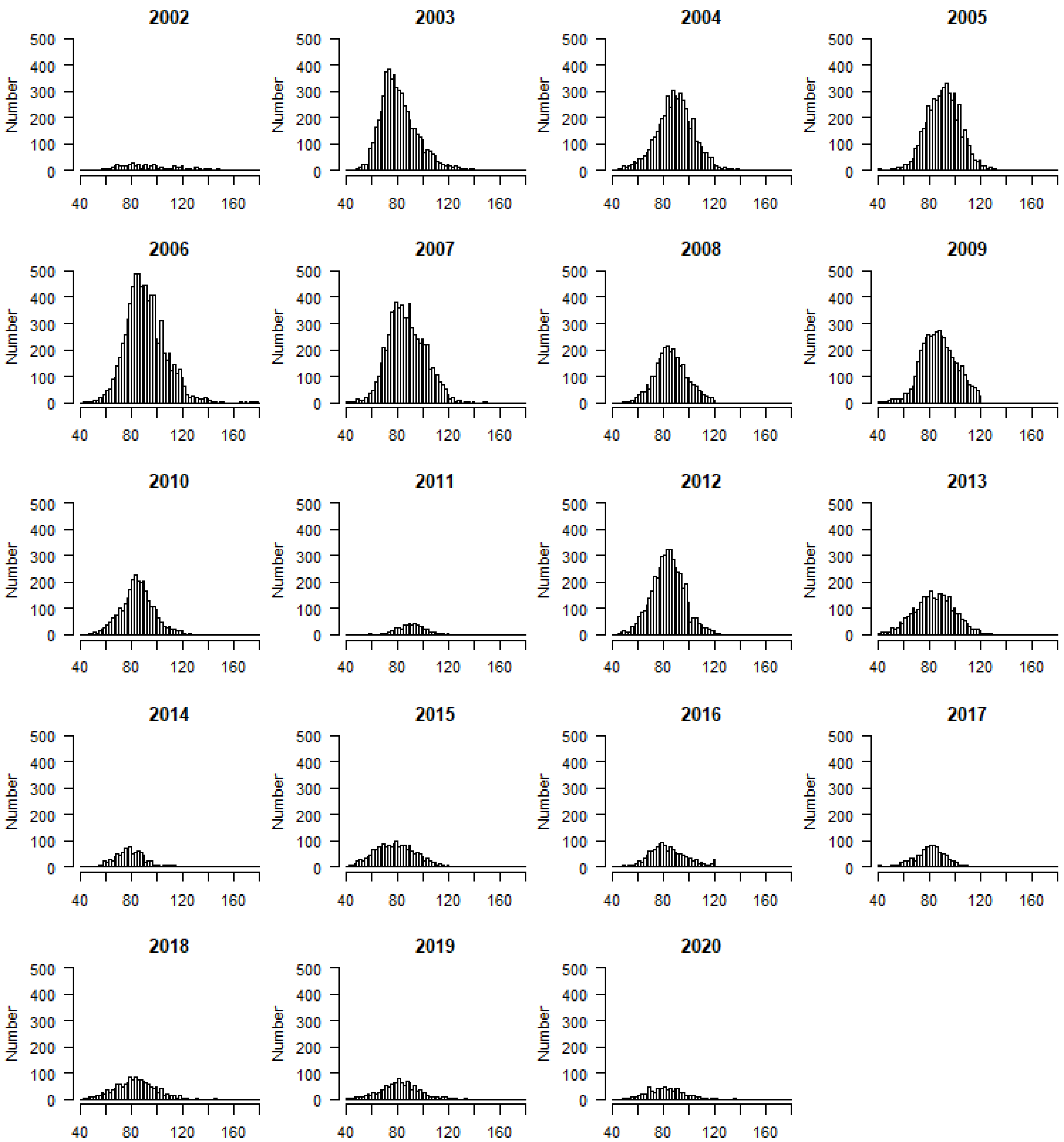

Figure 3.5.16 **Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Length composition of the catch from the Norwegian longliner fleet, for the period 2002–2020 by 2 cm length classes (sex combined).**

Outputs

The stock status for the most recent three years is given in Figure 3.5.17 for the three sets of input parameters. In all case the conservation of immature (Lc/Lmat and $L_{25\%}$/Lmat) is achieved, which is consistent with the empirical knowledge that small ling are generally not caught in significant numbers by commercial fisheries. In contrast, the conservation of adults is not achieved, suggesting that the proportion of large ling in the stock is small compared to an unexploited stock. large ling. The optimal yield is only achieve with the parameter set 3, which combines the smaller L_{∞} *with* the larger *k* and the MSY criterion is mostly not achieved. Overall it can be considered that biological parameters of the stock are too uncertain (in particular M for which assumed value were borrowed from other stocks) to rely on LBIs, which however suggest that the stock is likely overexploited.

Parameters Set 1

	Conservation				Optimizing Yield	MSY
Year	L_c / L_{mat}	$L_{25\%}$ / L_{mat}	$L_{max\,5}$ / L_{inf}	P_{mega}	L_{mean} / L_{opt}	L_{mean} / $L_{F=M}$
2018	1.08	1.14	0.65	0	0.69	0.87
2019	1.17	1.14	0.65	0	0.70	0.85
2020	1.08	1.14	0.63	0	0.67	0.85

Parameters Set 2

	Conservation				Optimizing Yield	MSY
Year	L_c / L_{mat}	$L_{25\%}$ / L_{mat}	$L_{max\,5}$ / L_{inf}	P_{mega}	L_{mean} / L_{opt}	L_{mean} / $L_{F=M}$
2018	1.08	1.14	0.63	0.01	0.76	0.94
2019	1.17	1.14	0.63	0.01	0.77	0.90
2020	1.08	1.14	0.61	0.01	0.74	0.92

Parameters Set 3

	Conservation				Optimizing Yield	MSY
Year	L_c / L_{mat}	$L_{25\%}$ / L_{mat}	$L_{max\,5}$ / L_{inf}	P_{mega}	L_{mean} / L_{opt}	L_{mean} / $L_{F=M}$
2018	1.08	1.14	0.96	0.10	0.93	1.00
2019	1.17	1.14	0.96	0.08	0.94	0.97
2020	1.08	1.14	0.93	0.07	0.91	0.98

Figure 3.5.17. Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Screening of length indicators ratios for sex combined under three scenarios: (a) Conservation, (b) Optimal yield, and (c) maximum sustainable yield.

3.5.8 Comments on the assessment

Data in Divisions 4.a, 6.a and 6.b were combined to make an index for the entire area. These series show the same positive trend until 2016 and after 2016 was a declining trend. This trend is also reflected in the French LPUE series based on the otter trawlers. The Norwegian data do not include area 7. The Spanish survey on the Porcupine bank showed a stable biomass from 2001- 2012, a peak in 2013 and a sharp downward trend to a record low in 2019 (Figure 3.5.14.) In area 7, the landings have decreased from around 11 000 tons in the end of the 1990ies to under 1000 tons in 2019. For other areas, the landings have been stable or increasing. It is not clear what has caused the decline in biomass and catches in this area.

However, the length-based indicator, derived from the Norwegian longline fishery data, indicates that ling are fished sustainably.

3.5.9 Management considerations

LBI estimated this year suggest that the stock is exploited beyond MSY limits. These estimates are however uncertain as a consequence of the insufficience of growth and natural mortality estimates.The CPUE series, based on commercial data, indicates an increasing trend until 2016 then a stable or slightly declining trend. During 2000-2016, there was an increasing trend, and at the end of the series, there are signs that may be declining, which has to be followed closely.

As always, it should be emphasized that commercial catch data are typically observational data; that is, there were no scientific controls on how or from where the data were collected. Therefore, it is not known with certainty if the ling CPUE series tracks the population and/or how accurate the measures of uncertainty associated with the series are (see, for example, Rosenbaum, 2002).

An notorious example of a misleading CPUE series based on commercial data was a CPUE series for Newfoundland cod that incorrectly indicated that the abundance of the cod stock was increasing greatly. Advice based on this CPUE series ultimately caused the collapse of the stock (see, e.g. Pennington and Strømme, 1998).

In general, any assessment method based only on commercial catch data needs to be applied with caution. The reason that assessments using only commercial data are problematic is because the relation between the commercial catch and the actual population is normally unknown and probably varies from year to year.

3.5.10 Recommendations

Although based on small numbers caught survey in subareas 6 and 7 suggest different abundance trends than the commercial cpue in subareas 4 and 6. Although the CPUE may not track fully stock trends, as underlined in the previous section, it would be hardly plausible to obtain an increasing CPUE with actual stock trends similar to those reflected by surveys in subareas 6 and 7. Therefore, further investigation in the stock structure within the assessment unit is necessary.

WGDEEP recommends that stock identity of ling is explore in more detail.

3.5.11 References

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3.5.12 Tables

Table 3.5.1. Ling in subareas 3,4, 6–9, 12, and 14 . WG estimates of landings.

Ling 3

Year	Belgium	Denmark	Germany	Norway	Sweden	E & W	France	Total
2001		125	+	102	35			262
2002		157	1	68	37			263
2003		156		73	32			261
2004		130	1	70	31			232
2005		106	1	72	31			210
2006		95	2	62	29			188
2007		82	3	68	21			174
2008		59	1	88	20			168
2009		65	1	62	21			149
2010		58		64	20			142
2011		65		57	18			140
2012		66	<1	61	17			144
2013		56	1	62	11			130
2014		51	1	54	14			120
2015		58	1	50	16			125
2016		77	1	57	17			152
2017		58	1	57	22			138
2018		95	1	57	25			177
2019		139		38	27		0	205
2020*		127	0	35	17		4	183

***Preliminary.**

Table 3.5.1. (continued).

Ling 4.a

***Preliminary.**

[1] Includes 4b 1988–1993.

Year	Belgium	Denmark	Faroes	France	Germany	Neth.	Norway	Sweden[1)]	E&W	N.I.	Scot.	Total
2001		702		128	54		3613	6	61		3290	7854
2002	6	578	24	117			4509		59		3779	9072
2003	4	779	6	121	62		3122	5	23		2311	6433
2004		575	11	64	34		3753	2	15		1852	6306
2005		698	18	47	55		4078	4	12		1537	6449
Year	**Belgium**	**Denmark**	**Faroes**	**France**	**Germany**	**Neth.**	**Norway**	**Sweden[1)]**	**E&W**	**N.I.**	**Scot.**	**Total**
2006		637	2	73	51		4443	3	55		1455	6719
2007		412	-	100	60		4109	3	31		1143	5858
2008		446	1	182	52		4726	12	20		1820	7259
2009		427	7	90	27		4613	7	19		2218	7408
2010		433		62	40		3914		28		1921	6398
2011		541		90	62		3790	8	18		1999	6508
2012		419		105	47		4591	6	28		1822	7018
2013		548		104	83		4273	5	15		2169	7197
2014		404		182	53		5038	3	23		2046	7749
2015		424		127	53		5369	6	90		2018	8069
2016		797		304	71		6021	5	65		2477	9740
2017		1036		308	111		6925	11	78		2761	**11230**
2018		980		842	114	2	6326	14			3270	**11548**
2019	0	1022		926	130	5	6062	16	74		3208	**11443**
2020*	0	673		653	93	15	4494	31	34	0	2855	**8848**

Table 3.5.1. (continued).

Ling 4.bc.

Year	Belgium	Denmark	France	Sweden	Norway	E & W	Scotland	Germany	Netherlands	Total
2001	46	81	1	3	23	62	60	6	2	284
2002	38	91		4	61	58	43	12	2	309
2003	28	0		3	83	40	65	14	1	234
2004	48	71		1	54	23	24	19	1	241
2005	28	56		5	20	17	10	13		149
2006	26	53		8	16	20	8	13		144
2007	28	42	1	5	48	20	5	10		159
2008	15	40	2	5	87	25	15	11		200
2009	19	38	2	13	58	29	137	17	1	314
2010	23	55	1	13	56	26	10	17		201
2011	15	59	0		85	24	11	17		211
2012	12	45	1	10	84	25	7	8		192
2013	15	47	1	5	71	0	21	12	4	176
2014	16	46	0	6	34	7	14	15	3	141
2015	11	36		6	54	10	16	14		147
2016	14	42		6	50	7	9	21	1	150
2017	9	36		9	74	4	9		2	143
2018	9	38		8	62		8	36	1	**162**
2019	13	41		12	55	2	6	26	3	**158**
2020*	16	37	0	8	31	4	0	14	0	**110**

***Preliminary.**

Table 3.5.1. (continued).

Ling 6.a.

Year	Bel-gium	Den-mark	Fa-roes	France	Ger-many	Ire-land	Nor-way	Spain)	E&W	IOM	N.I.	Scot.	To-tal
2001				774	3	70	1869	142	106			2179	5143
2002				402	1	44	973	190	65			2452	4127
2003				315	1	88	1477	0	108			1257	3246
2004				252	1	96	791	2	8			1619	2769
2005			18	423		89	1389	0	1			1108	3028
2006			5	499	2	121	998	0	137			811	2573
2007			88	626	2	45	1544	0	33			782	3120
2008			21	1004	2	49	1265	0	1			608	2950
2009			30	418		85	828	116	1			846	2324
2010			23	475		164	989	3	0			1377	3031
2011			102	428		95	683	8				1683	2999
2012			30	585		47	542	862				1589	3655
2013			50	718		54	1429	899	10			1500	4660
2014			0	937		39	1006	1005	6			1768	4761
2015				891		65	1214	961	4			1629	4764
2016			92	1005		156	1313	1109	9			1975	5659
2017			5	870		156	1530	1500	3			2244	**6308**
2018				831		156	2185	1560				1922	**6654**
2019				927		142	1616	1689	1			2168	**6543**
2020*			0	823		200	1084	913	3		0	1518	**4563**

***Preliminary. .**

Table 3.5.1. (continued).

Ling 6.b.

Year	Faroes	France)	Germany	Ireland	Norway	Spain	E & W	N.I.	Scotland	Russia	Total
2001	+	16	3	18	328		116		307		788
2002		2	2	2	289		65		173		533
2003		2	3	25	485		34		111		660
2004	+	9	3	6	717		6		141	182	1064
2005		31	4	17	628		9		97	356	1142
2006	30	4	3	48	1171		19		130	6	1411
2007	4	10	35	54	971		7		183	50	1314
2008*	69	6	20	47	1021		1		135	214	1513
2009	249	5	6	39	1859		3		439	35	2635
2010	215	2		34	2042		0		394		2687
2011	12	5		16	957		1		268		1259
2012	60	7		13	1089	3			218		1390
2013		19		8	532	6			229	1	795
2014	60	7		10	435	2			258	2	774
2015	5	10	1	16	952	11	6		211	3	1215
2016	56			35	821	2	4		170		1088
2017	5		2	59	498	7	2		219	1	**793**
2018			2	59	408	6			255		**730**
2019		5	1	102	459	9	1		326	1	**904**
2020*		1		106	247	3	0	0	330		**687**

***Preliminary..**

Table 3.5.1. (continued).

Ling 7.a.

Year	Belgium	France	Ireland	E & W	IOM	N.I.	Scotland	Total
2001	6	3	33	20			31	87
2002	7	6	91	15			7	119
2003	4	4	75	18			11	112
2004	3	2	47	11			34	97
2005	4	2	28	12			15	61
2006	2	1	50	8			27	88
2007	2	0	32	1			8	43
2008	1	0	13	1			0	15
2009	1	36	9	2			0	48
2010		28	15	1			0	44
2011	1	2	23	1			1	28
2012	2		11	1			0	14
2013	1		6				23	30
2014	2	0	11				16	29
2015	1		8				10	19
2016	1		10				13	24
2017			9				15	24
2018		1	9				8	18
2019	2		3				7	12
2020*	1	0	0	0	0	4	0	5

***Preliminary.**

Table 3.5.1. (continued).

Ling 7.b, c.

Year	France	Germany	Ireland	Norway	Spain	E & W	Scotland	Total
2001	80	2	413	515		94	122	1226
2002	132	0	315	207		151	159	964
2003	128	0	270			74	52	524
2004	133	12	255	163		27	50	640
2005	145	11	208			17	48	429
2006	173	1	311	147		13	23	668
2007	173	5	62	27		71	20	358
2008	122	16	44	0		14	63	259
2009	42		71	0		17	1	131
2010	34		82	0		6	131	253
2011	29		58			28	93	208
2012	126	1	39	230	370	1	246	1013
2013	267	2	46		379	136	180	1010
2014	118		57		279	19	59	532
2015	101		53		184	144	78	560
2016	93		46	6	172	46	207	570
2017	90		32		133	34	26	315
2018	57		39		138	32		**266**
2019	53		0		238	14	8	**313**
2020*	47		25	0	67	11	4	**154**

***Preliminary. .**

Table 3.5.1. (continued).

Ling 7.d, e.

Year	Belgium	Denmark	France	Ireland	E & W	Scotland	Ch. Islands	Nether-lands	Spain	Total
2000	5		454	1	372		14			846
2001	6		402		399					807
2002	7		498		386	0				891
2003	5		531	1	250	0				787
2004	13		573	1	214					801
2005	11		539		236					786
2006	9		470		208					687
2007	15		428	0	267					710
2008*	5		348		214	2				569
2009	6		186		170			1		363
2010	4		144		138				8	294
2011	5		238		176				6	425
2012	7		255	1	164	2			7	436
2013	5		259		218					482
2014	4		338	1	262					605
2015	5		204		137			1		347
2016	3		141		149					293
2017	4		104		94					**202**
2018	3		85		32			**1**		**121**
2019	2		54		59			2		**118**
2020*	2		48	0	35	0	0	0	0	**85**

***Preliminary.**

Table 3.5.1. (continued).

Ling 7.f.

Year	Belgium	France	Ireland	E & W	Scotland	Total
2001	14	114	-	92		**220**
2002	16	139	3	295		**453**
2003	15	79	1	81		**176**
2004	18	73	5	65		**161**
2005	36	59	7	82		**184**
2006	10	42	14	64		**130**
2007	16	52	2	55		**125**
2008	32	88	4	63		**187**
2009	10	69	1	26		**106**
2010	10	42	0	17	0	**69**
2011	20	39	2	94		**155**
2012	28	80	<1	59	<1	**167**
2013	22	68	1	93	40	**224**
2014	61	182	0	91		**334**
2015	15	54	2	17		**88**
2016	25	51	1	34	3	**114**
2017	7	20	1	19		**47**
2018	5	18	1	19		**43**
2019	4	11		11		**26**
2020*	6	14	0	13	0	**33**

***Preliminary.**

Table 3.5.1. (continued).

Ling 7.g–k.

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain [(1)]	E&W	IOM	Scot.	Total
2001	16		1154	4	727	24	559	591		285	3360
2002	16		1025	2	951		568	862		102	3526
2003	12		1240	5	808		455	382		38	2940
2004	14		982		686		405	335		5	2427
2005	15		771	12	539		399	313		4	2053
2006	10		676		935		504	264		18	2407
2007	11		661	1	430		423	217		6	1749
2008	11		622	8	352		391	130		27	1541
2009	7		183	6	270		51	142		14	673
2010	10		108	1	279		301	135		14	848
2011	15		260		465		16	157		23	936
2012	23		584	2	516		201	138		56	1520
2013	24		622		495		190	74		203	1608
2014	13		535		445		177	185		202	1557
2015	11		391		366		153	131		13	1065
2016	10		383		549		107	114		9	1172
2017	10		298		392		85	91		12	**888**
2018	6		170		333		76	62			**647**
2019	7		143		212		57	43		3	**465**
2020*	8	0	117	0	205	51	44	0		2	**427**

***Preliminary. [(1)] Includes 7.b c until 2011**

Table 3.5.1. (continued).

Ling 8.

Year	Belgium	France	Germany	Spain	E & W	Scot.	Ireland	Total
2001		245		341	6	2		594
2002		316		141	10	0		467
2003		333		67	36			436
2004		385		54	53			492
2005		339		92	19			450
2006		324		29	45			398
2007		282		20	10			312
2008		294		36	15	3		345
2009		150		29	7			186
2010		92		31	11			134
2011		148		47	6			201
2012		349		201	2			552
2013		281		139	35	4		459
2014		280		110	4	1		395
2015*		269		63	5			337
2016		207		77	3			**287**
2017		156		43	2			**201**
2018		145		34	4			**183**
2019		139		23			1	**163**
2020*		147	15	0	0	0	0	**162**

Ling 9.

Year	Spain	Total
2001	0	0
2002	0	0
2003	0	0
2004		
2005		

Year	Spain	Total
2006		
2007	1	1

Table 3.5.1. (continued).

Ling 12.

Year	Faroes	France	Norway	E & W	Scotland	Germany	Ireland	Total
2001		0	29	2	24		4	59
2002		0	4	4	0			8
2003			17	2	0			19
2004								
2005				1				1
2006	1							1
2007								0
2008								0
2009		0	1					1
2010								0
2011		1						1
2012	3						1	4
2013								0
2014								0
2015								0
2016								0
2017								0
2018								0
2019								0
2020*								

Table 3.5.1. (continued).

Ling 14.

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	Russia	GREEN-LAND	Total
2001	1			35				1	37
2002	3			20				0	23
2003				83				0	83
2004				10				9	19
2005								18	18
2006								19	19
2007				5				2	7
2008					1		1	19	20
2009	+	3						5	8
2010		3						3	6
2011	2			1				5	8
2012	1		105					5	111
2013								2	2
2014	1	1	6	1	1			8	17
2015								21	21
2016	9	1		10			1	15	35
2017	1			1			2	5	7
2018								5	5
2019				128					128
2020*									

***Preliminary.**

Table 3.5.2 Ling. Total landings by subarea or division.

Year	3	4.a	4.bc	6.a	6.b	7	7.a	7.bc	7.de	7.f	7.g–k	8	9	12	14	All areas
1988	331	11 223	379	14 556	1765	5057	211	865	779	444	4415	1028		0	3	41 056
1989	422	11 677	387	8631	3743	5261	311	577	700	310	1012	1221		0	1	34 253
1990	543	10 027	455	6730	1505	4575	169	678	799	233	1077	1372		3	9	28 175
1991	484	9969	490	4795	2662	3977	125	749	680	302	1394	1139		10	1	26 777
1992	549	10 763	842	4588	1891	2552	105	1286	519	137	1593	802		0	17	25 644
1993	642	12 810	797	5301	1522	2294	219	1434	436	223	2334	510		0	9	28 531
1994	469	11 496	323	6730	2540	2185	284	1595	451	400	3254	85		5	6	29 823
1995	412	13 041	659	8847	1638		305	1944	1389	602	6131	845		50	17	35 880
1996	402	12 705	569	8577	1124		210	2201	1477	399	6850	1041		2	0	35 557
1997	311	11 315	699	6746	814		264	1780	1472	547	5045	1034	0	9	61	30 097
1998	214	13 631	627	7362	1394		198	1034	1500	561	7814	1797	2	2	6	36 142
1999	216	9810	446	6899	1175		84	1366	1060	312	4189	452	1	2	9	26 013
2000	228	9247	384	6909	1879		73	1182	846	218	3578	339	1	7	26	24 916
2001	262	7857	284	5143	788		94	1226	807	220	3360	594	0	59	37	20 720
2002	263	9152	309	4127	533		126	964	891	453	3526	467	0	8	23	20 756
2003	261	6433	234	3246	660		112	524	788	176	2940	436		19	83	15 912
2004	236	6306	241	2769	1064		97	640	801	161	2427	492		0	19	15 240
2005	210	6449	149	3028	1142		61	429	786	184	2053	450		1	18	14960

Year	3	4.a	4.bc	6.a	6.b	7	7.a	7.bc	7.de	7.f	7.g–k	8	9	12	14	All areas
2006	188	6719	144	2573	1411		88	668	687	130	2407	398		1	19	15433
2007	174	5858	159	3120	1314		43	358	710	125	1749	312		0	7	13929
2008	175	7259	200	2950	1513		15	259	569	187	1541	345		0	20	15033
2009	149	7408	314	2324	2635		48	131	363	106	673	186		1	8	14346
2010	142	6398	201	3031	2687		44	253	294	69	848	134		0	6	14107
2011	140	6508	211	2999	1259		28	208	425	155	936	201		1	8	13079
2012	145	7018	192	3655	1390		14	1013	436	167	1520	552	1	4	111	16218
2013	130	7197	176	4660	795		30	1010	482	224	1608	459		0	2	16773
2014	120	7749	141	4761	774		29	532	605	334	1557	395		0	17	17014
2015	125	8069	147	4764	1215		19	560	347	88	1065	337		0	21	16757
2016	152	9740	150	5659	1088		24	570	293	114	1172	287			35	19284
2017	138	11230	143	6308	793		24	315	202	47	888	201		0	7	20296
2018	177	11548	162	6654	730		18	266	121	43	647	183		0	5	20554
2019	205	11443	158	6543	904		12	313	115	26	465	163		0	130	20480
2020	182	8848	110	4563	687		5	154	85	33	427	162				15257

***Preliminary.**

Table 3.5.3. Number of French fishing vessels (otter trawlers, gillnetters and longliners) during the period 2000–2019.

NUMBERS OF SHIPS	OTTER TRAWLERS	GILLNETTERS	LONGLINERS
2000	65	12	1
2001	77	13	2
2002	66	15	3
2003	61	19	2
2004	52	22	0
2005	46	24	1
2006	44	20	6
2007	42	20	7
2008	37	20	7
2009	38	20	6
2010	29	21	2
2011	32	18	3
2012	36	15	4
2013	33	14	8
2014	33	13	9
2015	31	9	11
2016	28	5	12
2017	32	11	17
2018	28	14	17
2019	32	17	16