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.

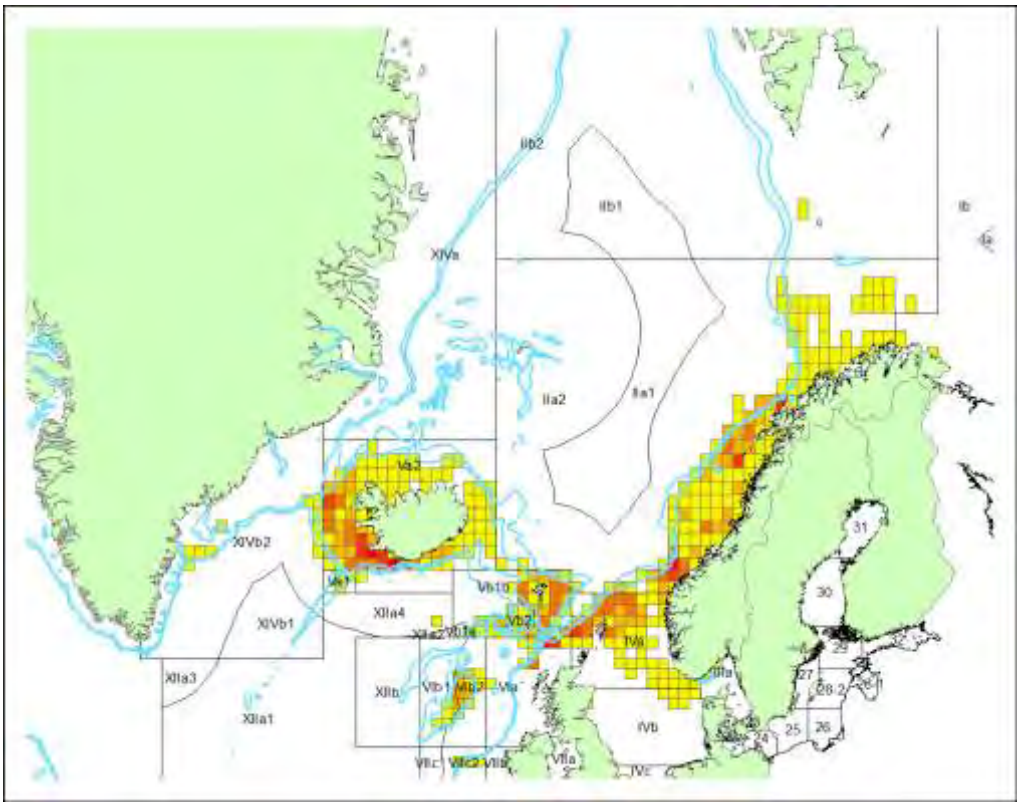

Figure 3.1. Map of fishery distribution (catches) in 2013 (data from Iceland, Faroes and Norway).

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. Ling is mainly caught by longliners. Trawlers catch it as bycatch in the saithe fishery. In 2021 the fleet which is comprised of longliners and trawlers 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). In recent years, foreign catches are mainly caught by the Norwegian longliners.

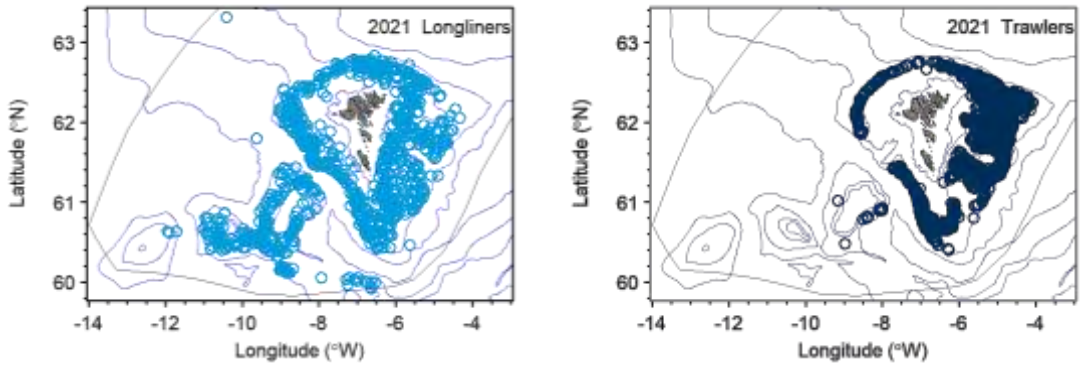

Figure 3.2.1. Ling in 5.b. Spatial distribution in 2021 of the Faroese longliner fishery (left) and pair trawler fishery (bycatch in saithe fishery, right).

3.2.2 Landings trends

Landing statistics for ling by nation for the period 1988–2021 are given in Tables 3.2.1–3.2.3 and total landings data since 1904 are available and shown in Figure 3.2.2. The history of the fishery is 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. From 1990–2005 around 20% of the catch was fished in area 5.b2, and in the period 2006–2020 it has decreased to around 10%. In 2021, 17% of the catch was fished in 5.b2. Preliminary landings of ling decreased in 2021 to 7869 tons (the second highest catch in the whole time series), of which the Faroes caught 81%. Foreign catches were low between 2011 and 2013 due to no bilateral agreement on fishing rights between the Faroes, Norway and EU.

Around 50–75% of the ling in 5.b was caught by longliners and the rest mainly by trawlers (25–40%) (Table 3.2.4).

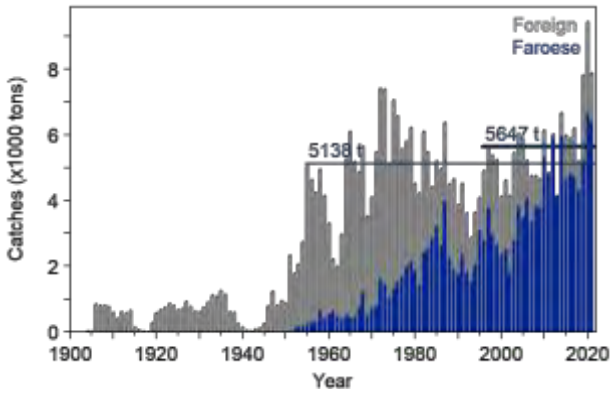

Figure 3.2.2. Ling in 5.b. Total international catches since 1904. Mean catches since 1955 were around 5100 tons. Catches in the assessment period since 1996 were approximately 5700 tons.

3.2.3 ICES Advice

ICES advises that when the MSY approach is applied, catches in 2022 should be no more than 5636 tonnes. ICES is not in a position to advice on the corresponding level of fishing effort (https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2021/2021/lin.27.5b.pdf).

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 a bilateral agreed quota exists between Norway and Faroe Islands except for 2011–2013. For 2022, catches by Norway are as follows; 3000 tons ling/blue ling, 1500 tons tusk and 800 tons of other species as by-catch in the bottom fishery in Faroese waters (fiskiveiðiavtala-millum-føroyar-og-noreg-fyri-2022.pdf).

In 2022, the Faroese Government will allow 5 Russian 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 3 vessels can simultaneously be operating. 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-2022.pdf).

In 2022, a bilateral agreement between the Faroes and UK allows a catch of 225 tonnes of blue ling/ling in the Faroese fishing zone (semja-millum-føroyar-og-bretland-um-sínamillum-fiskirættindi-fyri-2022.pdf).

The EU regulation of fishing opportunities for 2022 has a table for ling and blue ling in Faroese waters of 5.b. The EU quota is set to zero catches.

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 Faroese commercial longliners and trawlers and from two groundfish surveys (Figures 3.2.3–3.2.5).

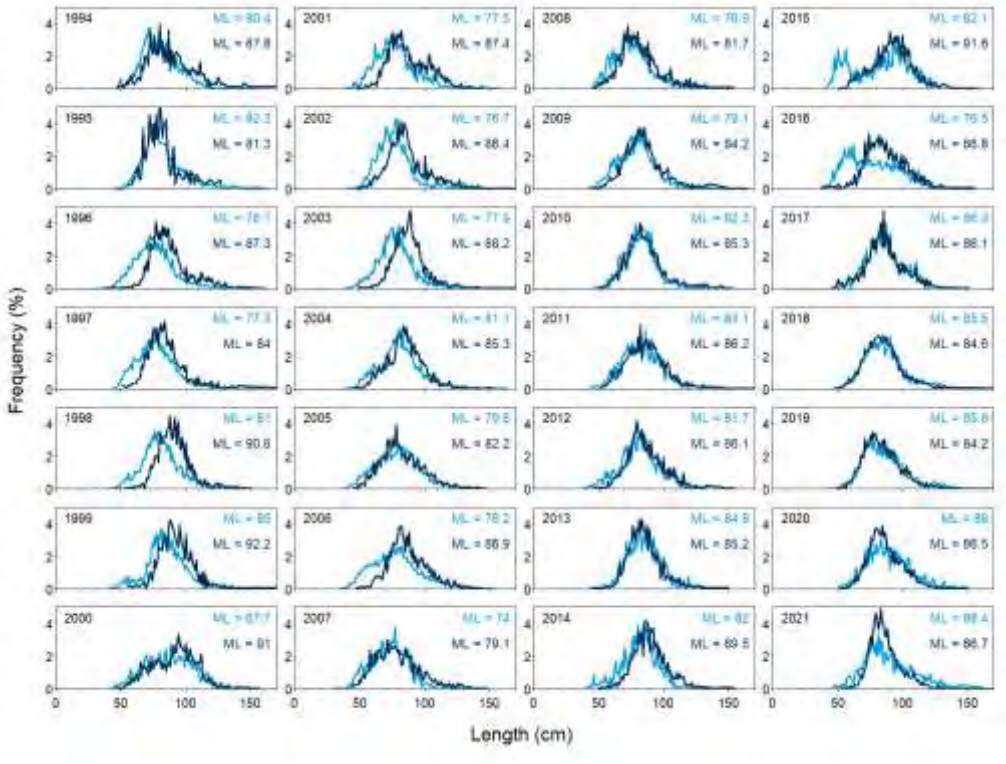

Figure 3.2.3. Ling in 5.b. Length frequencies from the landings of ling from Faroese longliners (>110 GRT, turquoise line) and Faroese trawlers (>1000 HP, dark blue line) since 1994. ML- mean length.

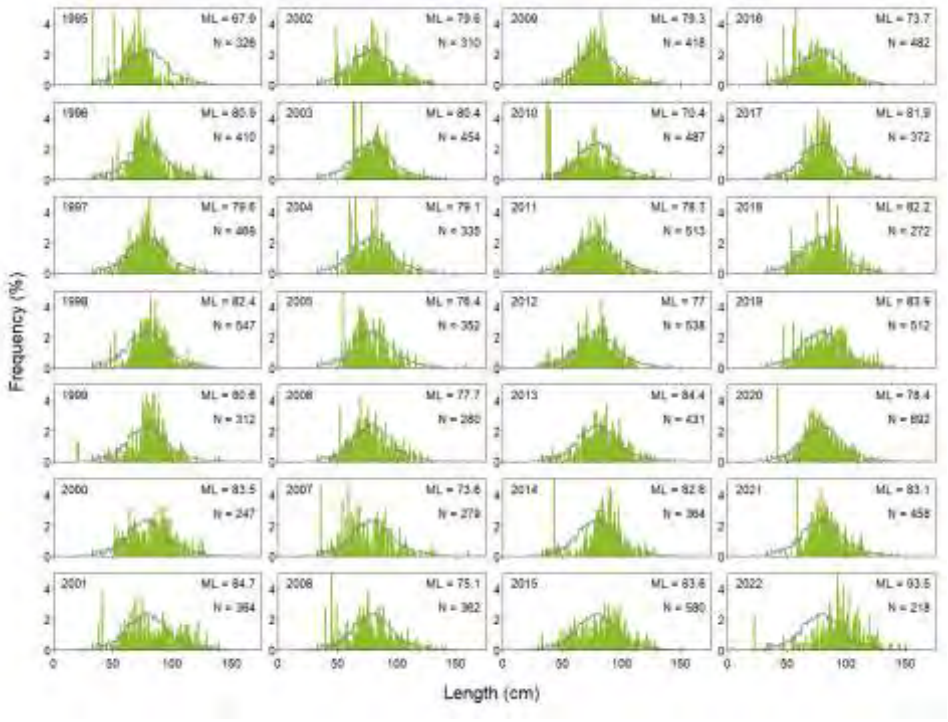

Figure 3.2.4. Ling in 5.b. Length frequencies from the groundfish spring survey. ML- mean length, N–number of calculated length measurements, grey line- mean of all years. Small individuals are often sampled from a subsample of the total catch and scaled up to total catch.

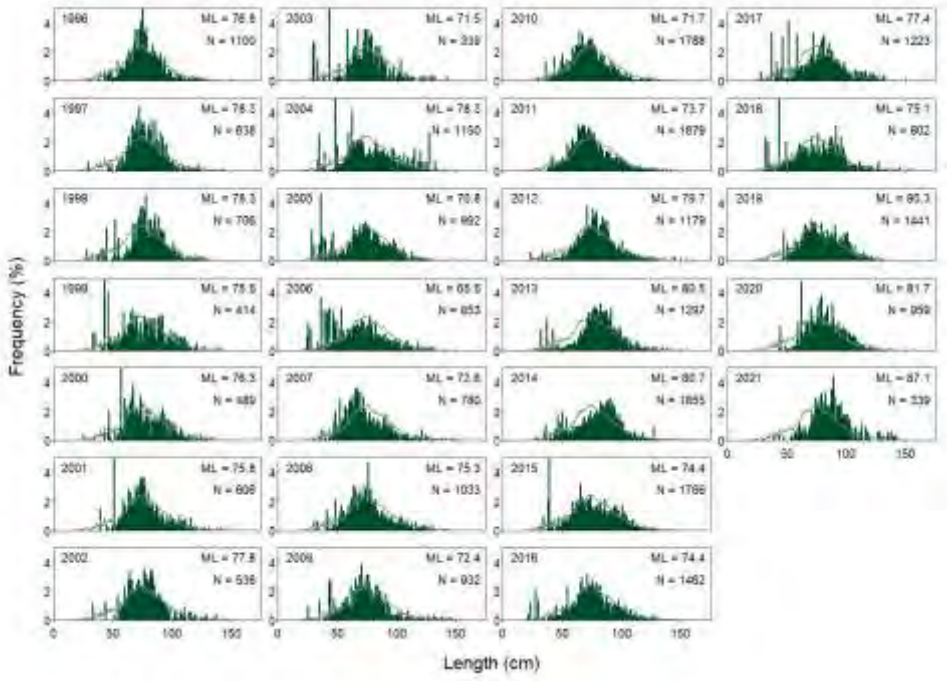

Figure 3.2.5. Ling in 5.b. Length frequencies from the groundfish summer survey. ML- mean length, N–number of calculated length measurements, grey line- mean of all years. Small individuals are often sampled from a subsample of the total catch and scaled up to total catch

3.2.5.3 Catch-at-age

Catch-at-age data are available from the Faroese fishery in 5.b since 1996. In 2020, a new ALK-program was used to calculate catch number at age (see ICES, 2021, Stock annex). The most frequent age classes in the landings are 5-9 years old (Figure 3.2.6 and Table 3.2.7). Consistency plots of the catch at age data is shown in Figure 3.2.7.

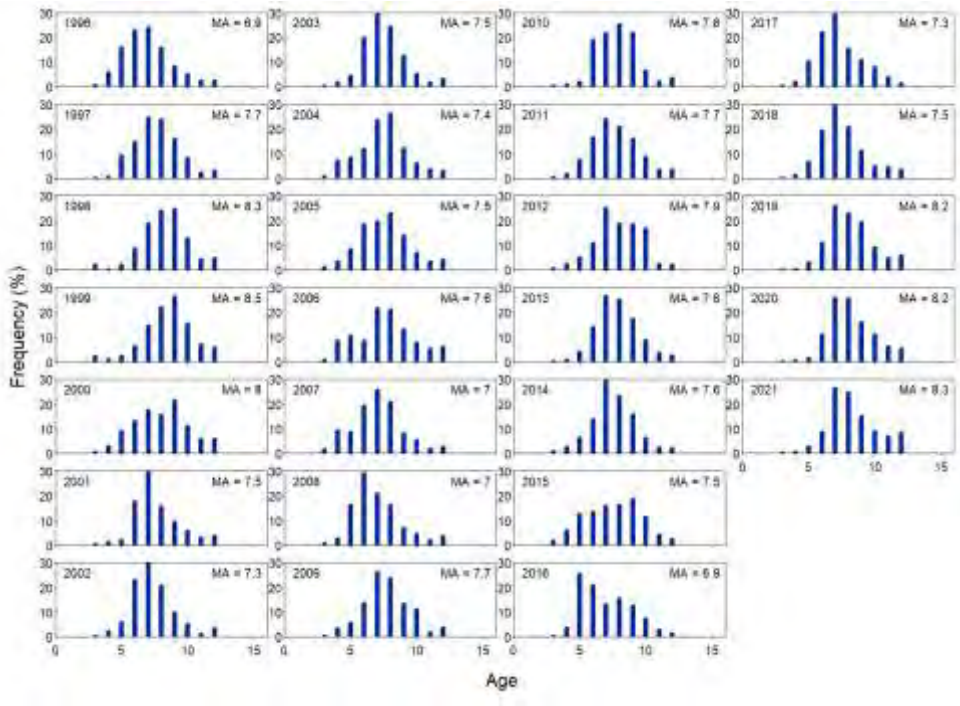

Figure 3.2.6. Ling 5.b. Catch-at-age from the commercial fleets in the assessment. MA- mean age.

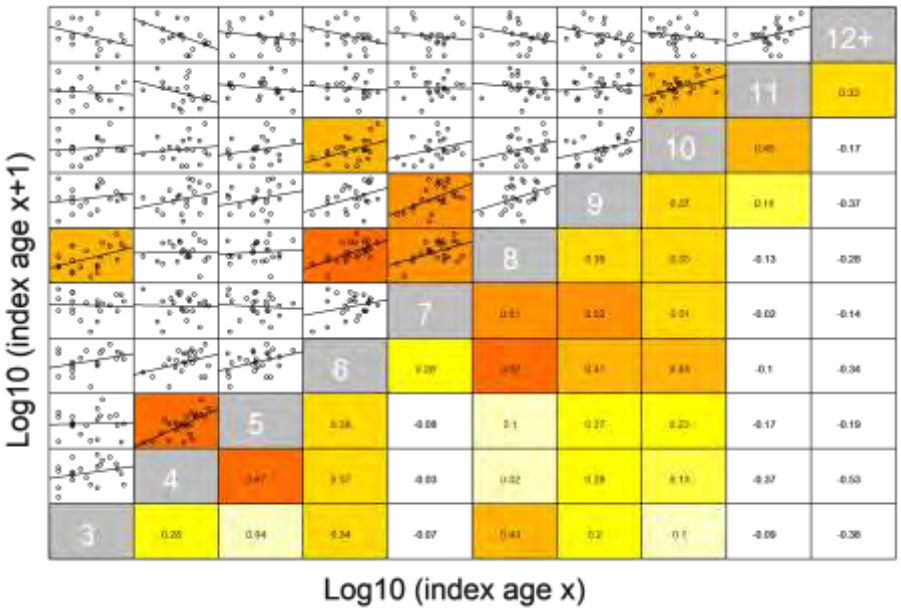

Figure 3.2.7. Ling 5.b. Consistency plots of catch-at-age used in the assessment.

3.2.5.4 Weight-at-age

Mean weight-at-age data from the landings in 5.b is available (Stock annex, ICES, 2021). There are no long term trends in the mean weights over the period (Figure 3.2.8 and Table 3.2.8).

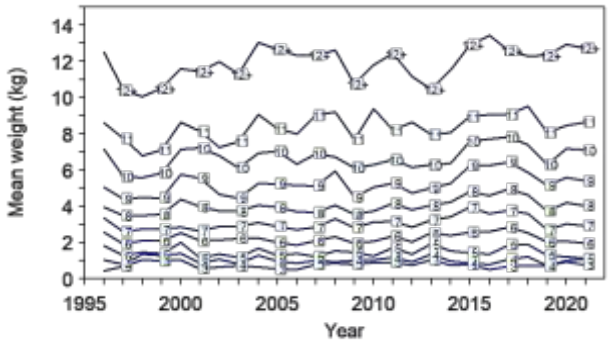

Figure 3.2.8. Ling in 5.b. Mean weight-at-age in the catches since 1996.

3.2.5.5 Maturity and natural mortality

Fixed proportion mature at age used in the assessment is presented in the table below. More information of this and maturity ogives of ling are presented in the stock annex.

Age	3	4	5	6	7	8	9	10	11	12+
Prop 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

Catch per unit of effort (CPUE) data is available from three commercial series; the Faroese longliners, the Faroese pair trawlers (bycatch in saithe fishery) and Norwegian longliners fishing in Division 5.b. Although no obvious problems were detected in 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 of the Faroese fishery are described in stock annex for ling in 5b whilst the standardized CPUE data from Norwegian longliners operating 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 indices (kg/h) for ling are available from the annual groundfish trawl surveys on the Faroe Plateau targeting cod, haddock and saithe. The spring survey takes place in February/March (ICES acronym: G1264) while the summer survey is conducted in August (ICES acronym: G3284). Both surveys cover the main fishing grounds and a large part of the stock spatial distribution. More detailed information on the surveys and standardization of the data are described in the stock annex. WKBARFAR benchmark adopted the groundfish surveys as a tuning series of the assessment model (ICES, 2021).

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). Length composition data are similar in both Faroese trawlers and longliners. Mean length from 2003 to 2009 from the Norwegian longline fleet in Faroese waters is estimated at 87 cm.

Length composition from the two groundfish surveys on the Faroe Plateau shows high interannual variation in mean length. The length varies 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

Faroese longline CPUE series and trawl bycatch CPUE series show an increasing trend since around 2001 (Figure 3.2.9). Norwegian longline series display an increase since 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, but they have decreased from 2020 to 2021 (Figure 3.2.10).

A size based recruitment index is compiled for individuals smaller than 40 cm (Figure 3.2.13). The index indicates high recruitment in the period 2013-2018. There has been a decrease since 2016 and has been on a very low level since 2019 in both surveys. In addition, another recruitment index is calculated based on small juveniles (2–3 cm in length) from the annual 0-group survey on the Faroe Plateau since 1983. The index also showed indications of high recruitment in some years (Figure 3.2.12). No juvenile ling individuals are found in the 0-group survey since 2020.

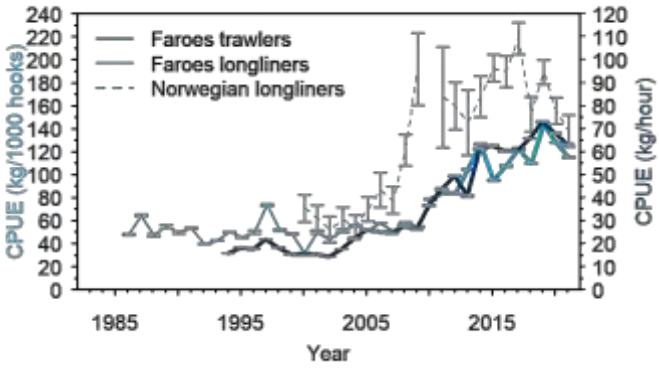

Figure 3.2.9. Ling in 5.b. Standardized CPUE from Faroese pair trawlers (bycatch, dark blue line), Faroese longliners (turquoise line) and Norwegian longliners (turquoise stippled line) fishing in Faroese waters. Data from Faroese trawlers are from hauls where ling was caught and saithe >60% of the total catch. Data from Faroese longliners (>110 GRT) are from sets where ling >30% of the total catch. The error bars show SE. Vertical bars display 95% confidence intervals in the Norwegian data.

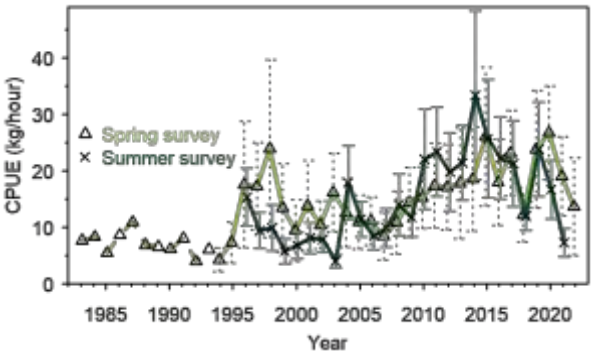

Figure 3.2.10. Ling in 5.b. Standardized CPUE (kg/hour) from the two annual Faroese groundfish surveys on the Faroe Plateau with standard errors. The data for 1983–1993 were not standardized.

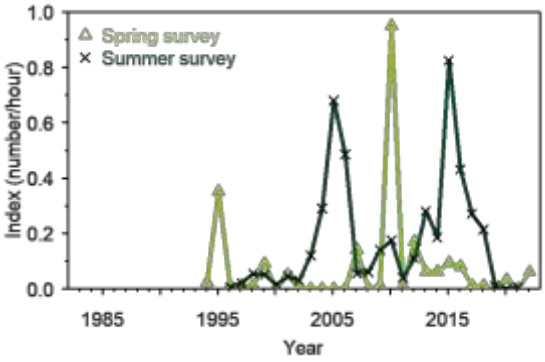

Figure 3.2.11. Ling in 5.b. Index (number/hour) of ling smaller than 40 cm from the spring- and summer survey on the Faroe Plateau.

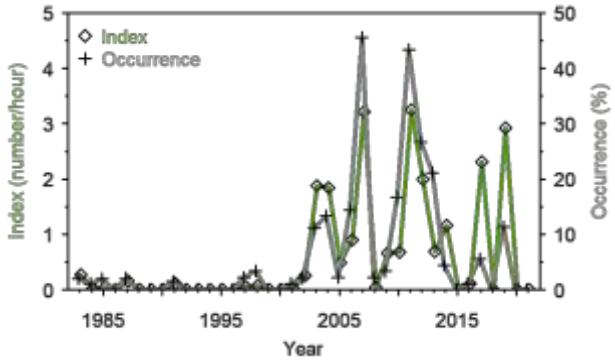

Figure 3.2.12. Ling in 5.b. Index (number/hour) and occurrence (%) of ling (2–3 cm in length) caught in the annual 0-group survey on the Faroe Plateau.

3.2.6.2 Stock assessment

Prior to the WKBARFAR benchmark in 2021 the stock was classified as category 3 (ICES 3.2 rule) where the advice was based on survey trends (ICES, 2019) using a survey biomass index (kg/h) from the Faroese summer groundfish survey. Exploratory age disaggregated assessments based on SAM have been presented to the WGDEEP group since 2017 (ICES, 2020). At the WKBARFAR benchmark the stock was updated to Category 1 using SAM as the basis for advice (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. Maturity at age is compiled from the Faroese survey data and it is fixed for the assessment period. Natural mortality is set to 0.15 for all ages and years. The age-disaggregated tuning series were the Faroese summer survey, ages 3 to 11 (1996-2021) and the Faroese spring survey, ages 4 to 11 (1998-2021). The SAM model configuration settings are described in detail in the stock annex.

Age disaggregated indices from the spring- and summer surveys are presented in Table 3.2.9 and 3.2.10. They show periods of good year classes around 2015. Indications of good year classes are also confirmed in the 0-group survey (Figure 3.2.12). Stratified catch rates (kg per hour) shows increased levels from 2010 to 2019 in both surveys. The index has decreased from 2020 to 2021(Figure 3.2.10). The internal consistency of the summer survey measured as the correlation between the indices for the same year class in two adjacent years is good, with r^2 ranging from 0.5 to 0.7 for the best-defined age groups (Figure 3.2.13). The internal consistency of the spring index is overall inferior to that of the the summer index (Figure 3.2.14). Ling is fully recruited to the survey at around age 5.

The results and diagnostics of the final assessment **Ling5b_wgdeep2022** (stockassessment.org) are presented in Tables 3.2.11-3.2.14 and Figures 3.2.15-3.2.19.

Results from the adopted SAM assessment shows that the spawning stock biomass (SSB) has been the largest from 2017 to 2021 although it has decreased from around 25 000 tonnes in 2020 to around 22 000 tonnes in 2021 (Figure 3.2.15, Tables 3.2.11, 3.2.13). Fishing mortality ($F_{6\text{-}10}$) has fluctuated around the historical average ($F_{6\text{-}10}$=0.4). It decreased to levels closed to F_{MSY} in 2017 and 2018 as a consequence of lower catches. It is estimated to $F_{6\text{-}10}$=0.4 in 2021 (Figure 3.2.15, Tables 3.2.11, 3.2.12).

Spawning stock biomass is well above MSY $B_{trigger}$ and fishing mortality above F_{MSY} but below F_{pa} and F_{lim}.

The model diagnostics are 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 reasonably well. Model residuals are randomly distributed and the leave one out analysis shows that the model is robust. 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 -5%, 18% and 51% for the spawning stock biomass, F and recruitment, respectively.

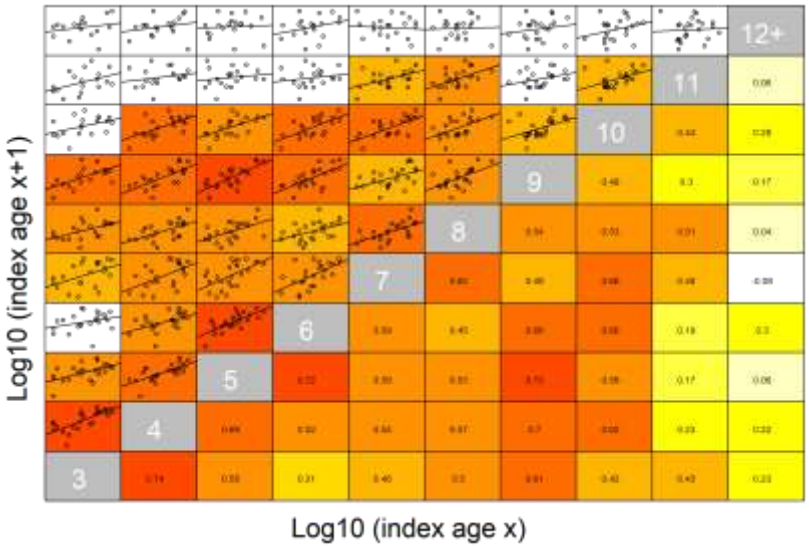

Figure 3.2.13. Ling in 5.b. Consistency plot of catch-at-age in the summer survey tuning series in the assessment.

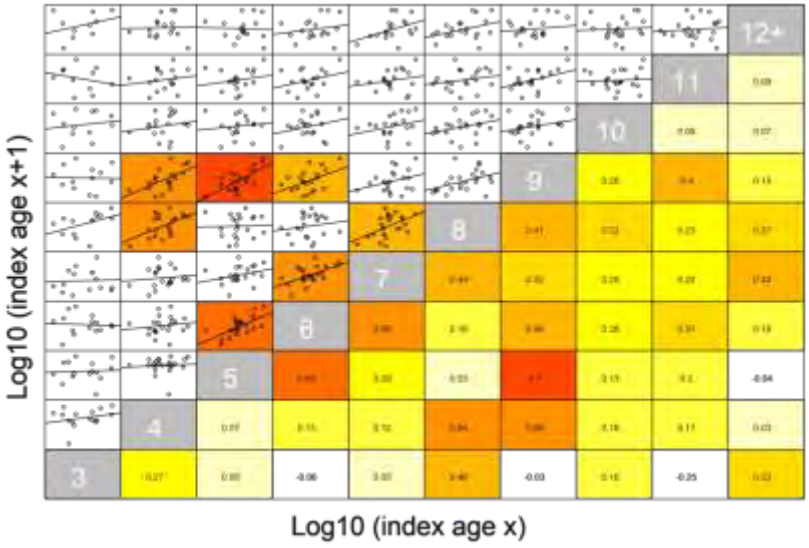

Figure 3.2.14. Ling in 5.b. Consistency plot of catch-at-age in the spring survey tuning series in the assessment.

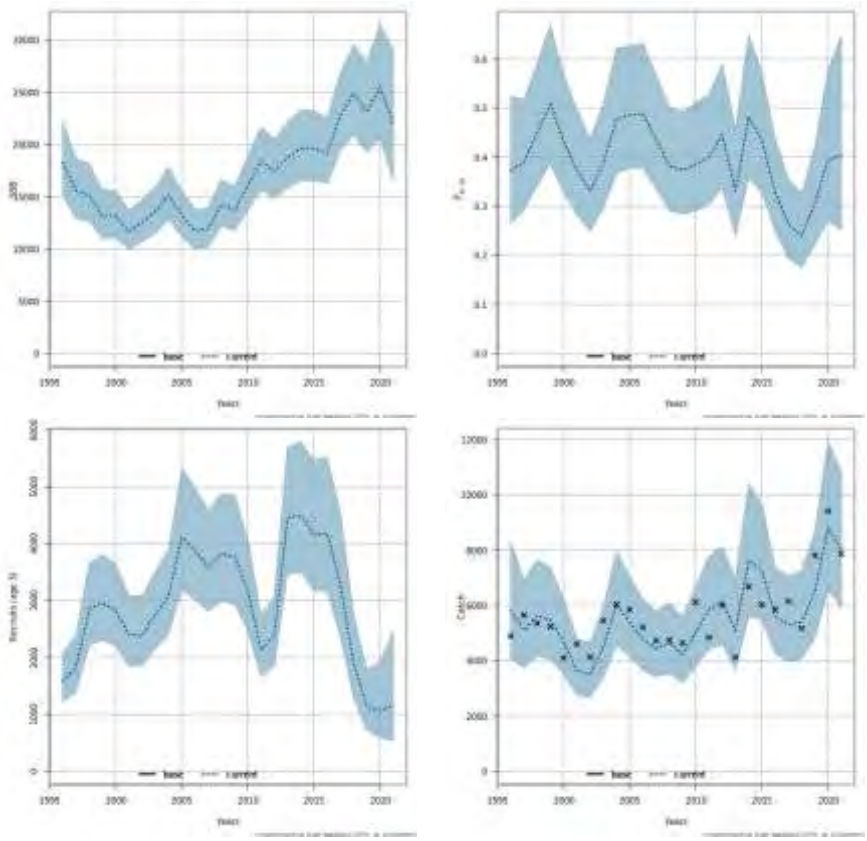

Figure 3.2.15. Ling in 5.b. Output from SAM. Results per year for spawning stock biomass (tonnes, upper left), fishing mortality ($F_{6\text{-}10}$, upper right), recruitment (age 3, thousands, lower left) and catch (tonnes, lower right). Stippled line is median, shaded area is 95% CI and x- is actual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

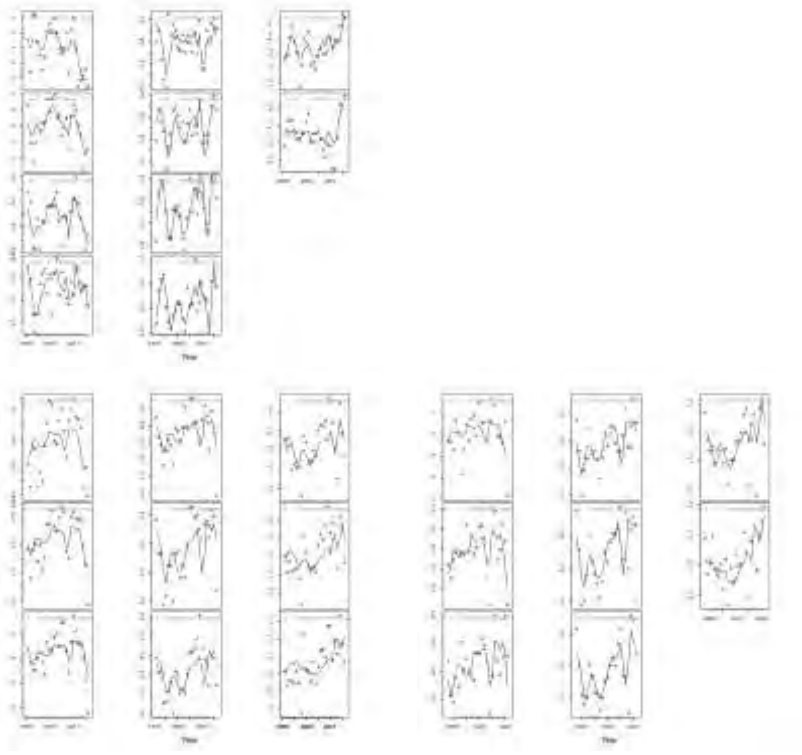

Figure 3.2.16. Ling in 5.b. Output from SAM. Model fit of data; catch (upper left), summer survey (lower left) and spring survey (lower right).

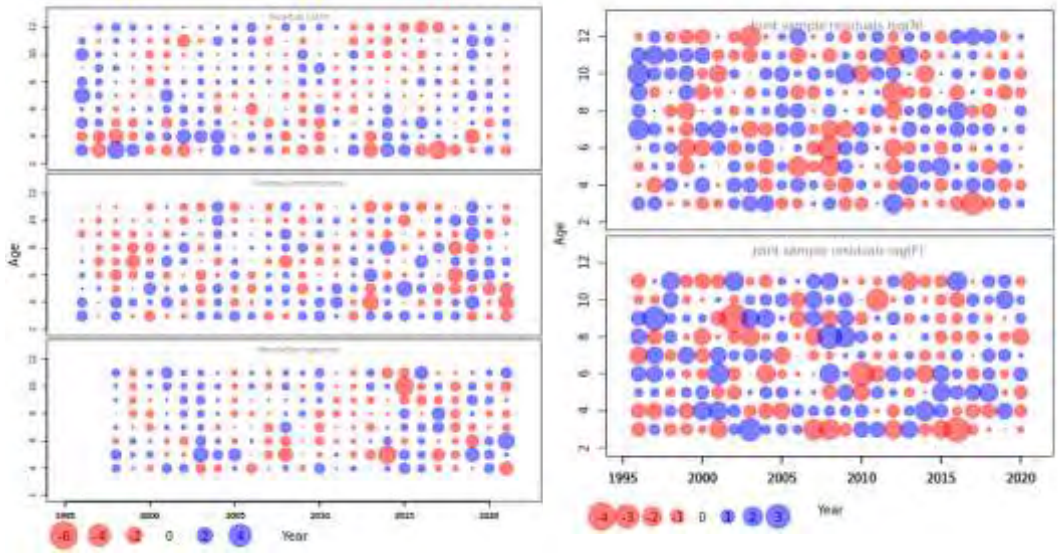

Figure 3.2.17. Ling in 5.b. Output from SAM. Model residuals (left) and process errors (right).

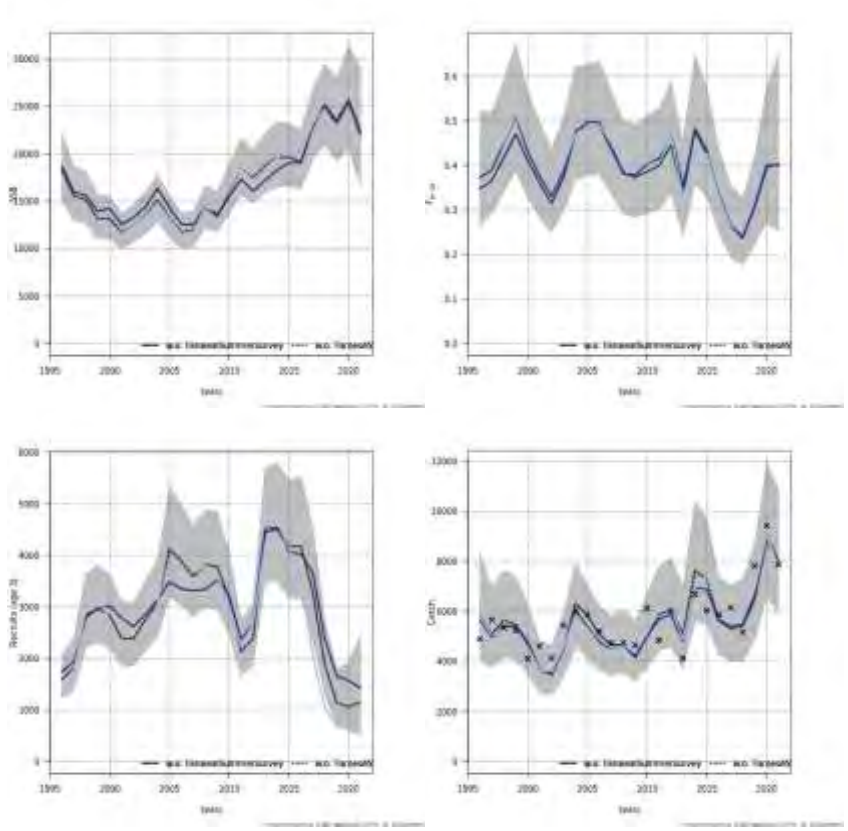

Figure 3.2.18. Ling in 5.b. Output from SAM. Leave-one-out analysis of SSB (upper left), fishing mortality (upper right), recruitment (lower left) and catch (lower right).

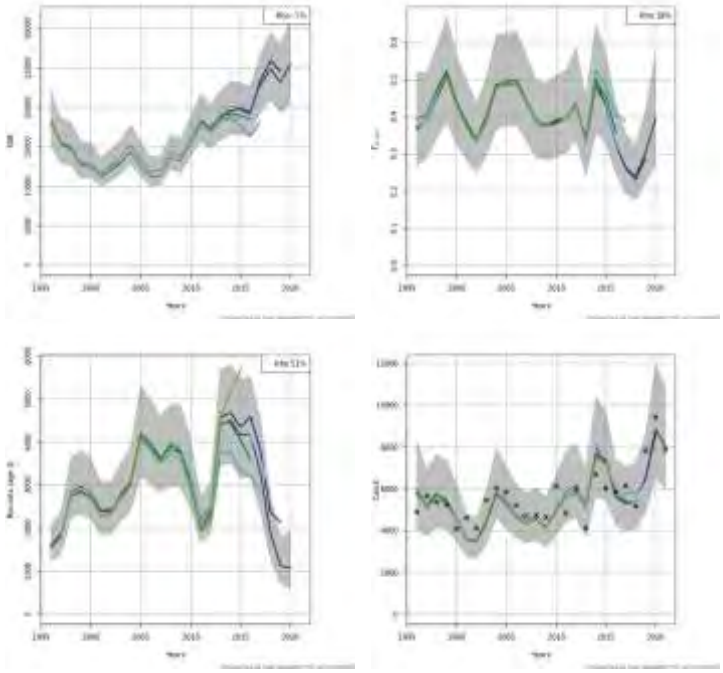

Figure 3.2.19. Ling in 5.b. Output from SAM. Retrospective analysis of SSB (upper left), fishing mortality (upper right), recruitment (lower left) and catch (lower right).

3.2.6.3 Quality of the assessment

Ling 5.b was benchmarked in 2021 (ICES, 2021), where the assessment was upgraded from a trend-based assessment (Category 3) to the SAM state-space model. Exploratory assessment for ling in 5.b has been performed 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

Settings for the short term forecast are presented in the stock annex and the output in **Ling5b_wgdeep2022** (stockassessment.org).

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
$F_{ages\ 6–10}$ (2022)	0.403	$F_{sq} = F_{2021}$
SSB (2023)	15 125	Short-term forecast fishing at F_{sq}; Tonnes.
$R_{age\ 3}$ (2022/2023)	2 966	Median recruitment, resampled from the years 1996–2020; Thousands.
Total catch (2022)	7 045	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 3 552 tonnes in 2023, resulting in an SSB in 2023 of 15 125 tonnes, when assuming a recruitment of 2 966 thousands in 2022 and 2023. Under these conditions, SSB will in 2023 be at 15 125 tonnes and in 2024 at 14 529 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	0.403	0.256	0.644	1175	541	2576	22126	16966	29535	7929	5934	10592	27479	21026	36559
2022	0.403	0.256	0.644	2966	1068	4509	19363	12866	27986	7045	5577	9086	25295	17715	35070
2023	**0.23**	0.146	0.368	**2966**	1068	4509	**15125**	8648	23986	**3552**	2630	4745	22351	14542	32456
2024	**0.23**	0.146	0.368	**2966**	1068	4509	**14529**	8015	23726	3326	2330	4633	23283	15491	33459

3.2.8 Reference points

Biological 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. In 2021 the definition of F_{pa} of 0.62 was changed to be the same as $F_{p0.5}$.

$MSY_{Btrigger}$	$5thPerc\_SSB_{msy}$	B_{pa}	B_{lim}	F_{pa}	F_{lim}	F_{p05}	$F_{msy\_unconstr}$	F_{MSY}
11627	21707	11627	9340	0.6	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. The substantial drop in recruitment since 2016 suggests that the stock will probably decline in coming years.

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, but there has been a drop in recruitment since 2016 so the stock will probably decline in coming years (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 2022.

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
2021*		5074	11		1444		0		6529

***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

Year	Faroes	France	Norway	Scotland	Total
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
2021*	1268		72		1340

***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

Year	5.b1	5.b2	5.b
1998	4029	1330	5359
1999	4571	666	5238
2000	3479	629	4109
2001	3686	923	4609
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
2021*	6529	1340	7869

***Preliminary.**

Table 3.2.4. Ling in 5.b. Catch distribution by fleet and total catch in 1996 to 2021. * preliminary catch.

Year	Trawl (%)	Longline (%)	Other (%)	Total catch (tonnes)
1996	31	68	1	4896
1997	37	62	1	5657

Year	Trawl (%)	Longline (%)	Other (%)	Total catch (tonnes)
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
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
2021	23	77	0	7869*
Average	32	67	1	5647

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

	Lengths			Gutted weights			Ages		
Year	Longliners	Trawlers	Other	Longliners	Trawlers	Other	Longliners	Trawlers	Other
1996	5003	1426	48	290	120	0	709	375	0

	Lengths			Gutted weights			Ages		
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
2021	1220	3002	0	1220	3002	0	414	840	0

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	Sum-mer	Other	Spring	Sum-mer	Other	Spring	Sum-mer	Other	Spring	Sum-mer	Other

	Lengths			Round weights			Ages			Gender and maturity		
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
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
2020	649	900	274	578	884	273	181	140	99	182	140	99
2021	427	339	415	391	338	413	199	288	227	199	288	227
2022	214		15	210		15	152		11	152		11

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	0.68	3.78	21.72	208.12	495.24	492.7	303.7	205.84	115.21	96.53
2021	0.2	5.02	42.28	134.06	414.55	386.18	231.97	139.74	102.93	129.46

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
2021	0.757	1.096	1.114	1.943	2.926	4.039	5.394	7.108	8.649	12.734

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
2021	100	0.77	9.08	79.38	138.28	114.14	75.59	30.44	35.88

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
2021	200	3.50	5.34	7.96	25.03	88.40	94.08	62.70	36.97	23.06

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	$Fbar_{(6\text{-}10)}$	Low	High	TSB	Low	High
1996	1594	1221	2080	18303	15095	22192	0.373	0.266	0.524	29250	24684	34661
1997	1821	1385	2394	15554	12943	18691	0.39	0.293	0.518	22766	19388	26734
1998	2847	2223	3646	15171	12671	18165	0.45	0.341	0.593	24193	20845	28079
1999	2966	2310	3808	13136	11002	15684	0.509	0.386	0.67	22576	19541	26081
2000	2835	2208	3639	13179	11151	15576	0.432	0.328	0.568	25148	21859	28932
2001	2395	1851	3098	11689	9953	13729	0.375	0.283	0.498	19567	17001	22520
2002	2390	1855	3079	12536	10701	14686	0.33	0.249	0.438	21528	18700	24785
2003	2760	2167	3515	13567	11538	15953	0.388	0.296	0.508	21947	19034	25305
2004	3069	2413	3903	15118	12822	17825	0.478	0.367	0.623	25408	22082	29233
2005	4126	3198	5323	13249	11239	15617	0.487	0.378	0.627	22350	19462	25666
2006	3888	3028	4991	11749	10000	13804	0.489	0.378	0.633	21368	18628	24510
2007	3592	2817	4582	11935	10209	13953	0.437	0.336	0.568	23595	20582	27049
2008	3822	2992	4883	14270	12231	16647	0.382	0.291	0.502	27560	24019	31623
2009	3777	2936	4860	13711	11741	16010	0.374	0.284	0.491	26307	22912	30204
2010	3180	2482	4076	16101	13738	18872	0.386	0.291	0.512	28715	24948	33051
2011	2135	1665	2739	18439	15689	21672	0.4	0.303	0.527	31689	27452	36580
2012	2390	1858	3075	17424	14789	20529	0.446	0.337	0.59	27336	23631	31623
2013	4441	3464	5693	18748	15881	22132	0.331	0.24	0.456	32388	28043	37408
2014	4509	3508	5796	19641	16519	23353	0.483	0.358	0.651	31957	27633	36958
2015	4165	3174	5466	19616	16566	23227	0.434	0.329	0.573	33152	28721	38266
2016	4185	3167	5530	19145	16256	22547	0.33	0.249	0.438	32243	27842	37340
2017	3286	2375	4547	22845	19410	26888	0.263	0.194	0.356	38787	33252	45243
2018	1888	1295	2753	24882	20961	29537	0.24	0.175	0.327	39419	33346	46598
2019	1140	726	1790	23194	19249	27948	0.306	0.222	0.42	31985	26624	38426
2020	1068	594	1920	25466	20599	31483	0.395	0.271	0.576	32815	26525	40596
2021	1155	540	2467	21971	16584	29108	0.403	0.251	0.648	27194	20567	35956

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	0.002	0.013	0.055	0.152	0.309	0.381	0.469	0.554	0.451	0.451
1997	0.002	0.009	0.04	0.125	0.291	0.396	0.516	0.619	0.507	0.507
1998	0.002	0.008	0.035	0.119	0.308	0.454	0.62	0.749	0.618	0.618
1999	0.002	0.008	0.034	0.12	0.335	0.522	0.718	0.849	0.699	0.699
2000	0.001	0.008	0.03	0.107	0.287	0.447	0.617	0.7	0.579	0.579
2001	0.001	0.007	0.027	0.101	0.266	0.387	0.523	0.6	0.483	0.483
2002	0.001	0.008	0.03	0.109	0.269	0.358	0.433	0.481	0.384	0.384
2003	0.001	0.012	0.042	0.144	0.34	0.439	0.498	0.519	0.418	0.418
2004	0.002	0.019	0.063	0.19	0.431	0.541	0.598	0.63	0.503	0.503
2005	0.003	0.021	0.067	0.192	0.422	0.536	0.609	0.674	0.566	0.566
2006	0.003	0.021	0.066	0.186	0.407	0.519	0.611	0.723	0.618	0.618
2007	0.003	0.021	0.066	0.184	0.388	0.465	0.533	0.615	0.52	0.52
2008	0.002	0.015	0.051	0.151	0.327	0.395	0.469	0.57	0.481	0.481
2009	0.001	0.01	0.037	0.121	0.291	0.376	0.481	0.599	0.514	0.514
2010	0.001	0.008	0.03	0.104	0.268	0.387	0.53	0.641	0.564	0.564
2011	0.001	0.008	0.033	0.106	0.262	0.386	0.568	0.676	0.593	0.593
2012	0.001	0.01	0.039	0.118	0.279	0.417	0.651	0.763	0.649	0.649
2013	0.001	0.006	0.028	0.085	0.194	0.301	0.508	0.568	0.507	0.507
2014	0.001	0.011	0.052	0.146	0.305	0.438	0.767	0.757	0.648	0.648
2015	0.001	0.012	0.058	0.15	0.286	0.405	0.662	0.666	0.57	0.57
2016	0.001	0.009	0.05	0.132	0.238	0.329	0.489	0.463	0.411	0.411
2017	0	0.005	0.034	0.101	0.2	0.276	0.389	0.348	0.318	0.318
2018	0	0.004	0.027	0.086	0.182	0.262	0.36	0.308	0.296	0.296
2019	0	0.004	0.026	0.09	0.209	0.339	0.48	0.411	0.402	0.402
2020	0	0.004	0.032	0.109	0.257	0.423	0.641	0.547	0.543	0.543
2021	0	0.005	0.034	0.117	0.266	0.427	0.637	0.571	0.585	0.585

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	1594	2067	2397	2379	1872	1014	450	186	75	118
1997	1821	1354	1744	1928	1747	1186	600	243	92	106
1998	2847	1587	1176	1383	1434	1121	688	308	113	103
1999	2966	2442	1394	1010	1011	882	613	318	125	101
2000	2835	2503	2096	1230	791	596	442	260	116	97
2001	2395	2482	2124	1711	1002	531	320	200	112	103
2002	2390	2082	2135	1777	1325	679	321	161	93	115
2003	2760	2086	1819	1763	1386	869	410	185	85	122
2004	3069	2382	1839	1522	1279	849	480	214	98	118
2005	4126	2607	1997	1497	1093	714	426	229	97	113
2006	3888	3546	2191	1562	1070	618	361	198	101	104
2007	3592	3336	2940	1766	1106	619	318	171	81	95
2008	3822	3052	2756	2310	1257	654	339	158	81	91
2009	3777	3327	2554	2189	1625	807	389	182	77	92
2010	3180	3307	2807	2135	1627	1005	485	211	86	87
2011	2135	2777	2897	2320	1648	1053	577	247	96	85
2012	2390	1793	2405	2399	1775	1083	620	280	108	85
2013	4441	1977	1466	2026	1867	1131	606	282	111	86
2014	4509	3957	1688	1247	1561	1394	679	322	134	101
2015	4165	3828	3512	1422	947	996	794	255	130	104
2016	4185	3440	3300	2764	1130	628	571	347	113	112
2017	3286	3650	2796	2644	2038	810	387	309	186	127
2018	1888	2933	3151	2259	2035	1408	525	232	188	196
2019	1140	1620	2558	2673	1839	1354	958	324	151	248
2020	1068	974	1356	2212	2131	1301	808	510	188	231
2021	1155	901	803	1172	1726	1403	744	356	256	211

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

Parameter name	par	Sd(par)	Exp(par)	Low	High
logFpar_0	-9.92	0.178	0	0	0
logFpar_1	-8.947	0.132	0	0	0
logFpar_2	-8.271	0.117	0	0	0
logFpar_3	-7.52	0.117	0.001	0	0.001
logFpar_4	-7.03	0.117	0.001	0.001	0.001
logFpar_5	-6.824	0.119	0.001	0.001	0.001
logFpar_6	-6.6	0.123	0.001	0.001	0.002
logFpar_7	-6.382	0.13	0.002	0.001	0.002
logFpar_8	-9.703	0.183	0	0	0
logFpar_9	-8.643	0.089	0	0	0
logFpar_10	-7.812	0.087	0	0	0
logFpar_11	-7.202	0.087	0.001	0.001	0.001
logFpar_12	-6.913	0.088	0.001	0.001	0.001
logFpar_13	-6.623	0.09	0.001	0.001	0.002
logFpar_14	-6.511	0.097	0.001	0.001	0.002
logSdLogFsta_0	-1.147	0.209	0.318	0.209	0.482
logSdLogN_0	-1.244	0.179	0.288	0.201	0.412
logSdLogN_1	-2.741	0.373	0.064	0.031	0.136
logSdLogObs_0	-0.666	0.067	0.514	0.449	0.588
logSdLogObs_1	-0.173	0.132	0.841	0.645	1.096
logSdLogObs_2	-0.513	0.132	0.599	0.46	0.779
logSdLogObs_3	-0.64	0.111	0.528	0.422	0.659
logSdLogObs_4	-0.171	0.136	0.843	0.642	1.107
logSdLogObs_5	-1.086	0.082	0.337	0.286	0.398
transfIRARdist_0	-1.541	0.246	0.214	0.131	0.35
transfIRARdist_1	-0.388	0.205	0.678	0.45	1.023
itrans_rho_0	1.381	0.283	3.979	2.26	7.003

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}	2021	0.403	1175	22126	7929	27479
	2022	0.403	2966	19363	7045	25295
	2023	0.23	2966	15125	3552	22351
	2024	0.23	2966	14529	3326	23283
$F=F_{sq}$, then 0	2021	0.403	1175	22126	7929	27479
	2022	0.403	2966	19363	7045	25295
	2023	0	2966	15125	0	22351
	2024	0	2966	18510	0	27447
$F=F_{sq}$, then $F_{pa}=F_{p0.5}$	2021	0.403	1175	22126	7929	27479
	2022	0.403	2966	19363	7045	25295
	2023	0.6	2966	15125	7483	22351
	2024	0.6	2966	10110	4745	18782
$F=F_{sq}$, then F_{lim}	2021	0.403	1175	22126	7929	27479
	2022	0.403	2966	19363	7045	25295
	2023	0.85	2966	15125	9343	22351
	2024	0.85	2966	8141	4658	16701
$F=F_{sq}$	2021	0.403	1175	22126	7929	27479
	2022	0.403	2966	19363	7045	25295
	2023	0.403	2966	15125	5607	22351
	2024	0.403	2966	12195	4355	20868

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 2021 the gillnet fishery was landing 53 % and longliners 41 % 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 and in 2021. There was no fishery in the NEAFC regulatory area in 2021.

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 26. 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 2021 the total number of hooks per year has varied considerably, but with a downward trend since 2002.(for more information see Helle, WD 2022).

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.

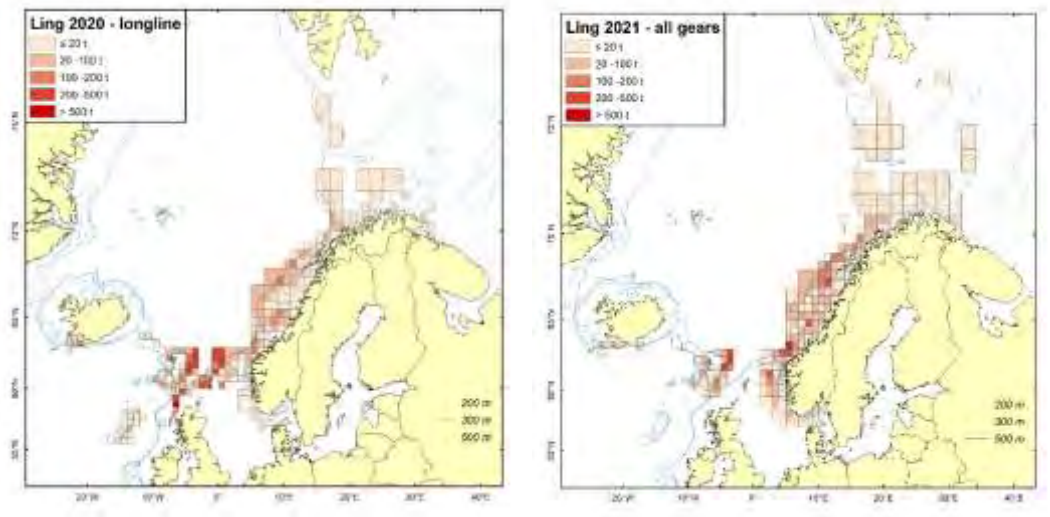

Figure 3.3.1. Distribution of the total catch of ling in Subareas 1 and 2 taken by the Norwegian longline fishery in 2020 and i2021.

3.3.2 Landings trends

Landing statistics by nation in the period 1988–2021 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 2021 are 9 700 t. Total international landings in Areas 1 and 2 are given in Figure 3.3.2.

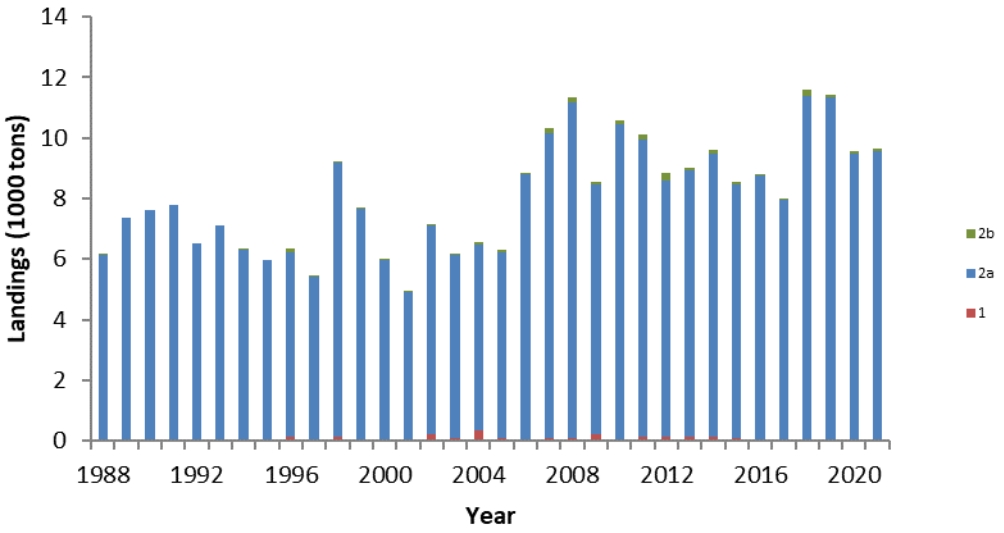

Figure 3.3.2. Total international landings of ling in Subareas 1 and 2.

3.3.3 ICES Advice

Advice for 2022 and 2023: ICES advises that when the precautionary approach is applied, catches should be no more than 10 454 tonnes in each of the years 2022 and 2023.

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.

In international and union waters of 1 and 2 UK has a TAC of 7 tons, while EU has a TAC of 24 tons.

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 2021. 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 2021. 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.

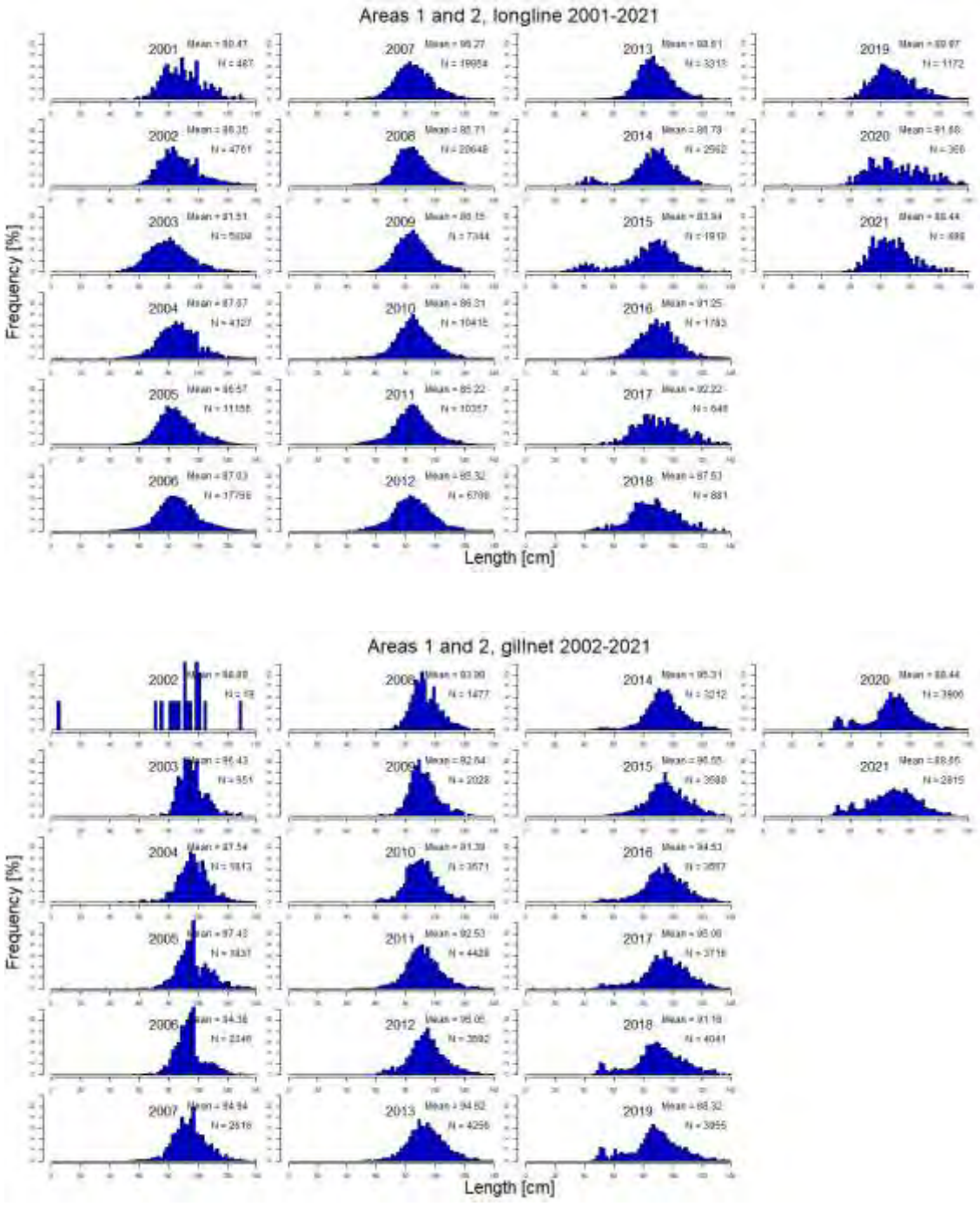

Figure 3.3.3. Plots of the length distributions of ling in Subareas 1 and 2 combined for the period 2001 to 2021 from the Norwegian Reference fleet.

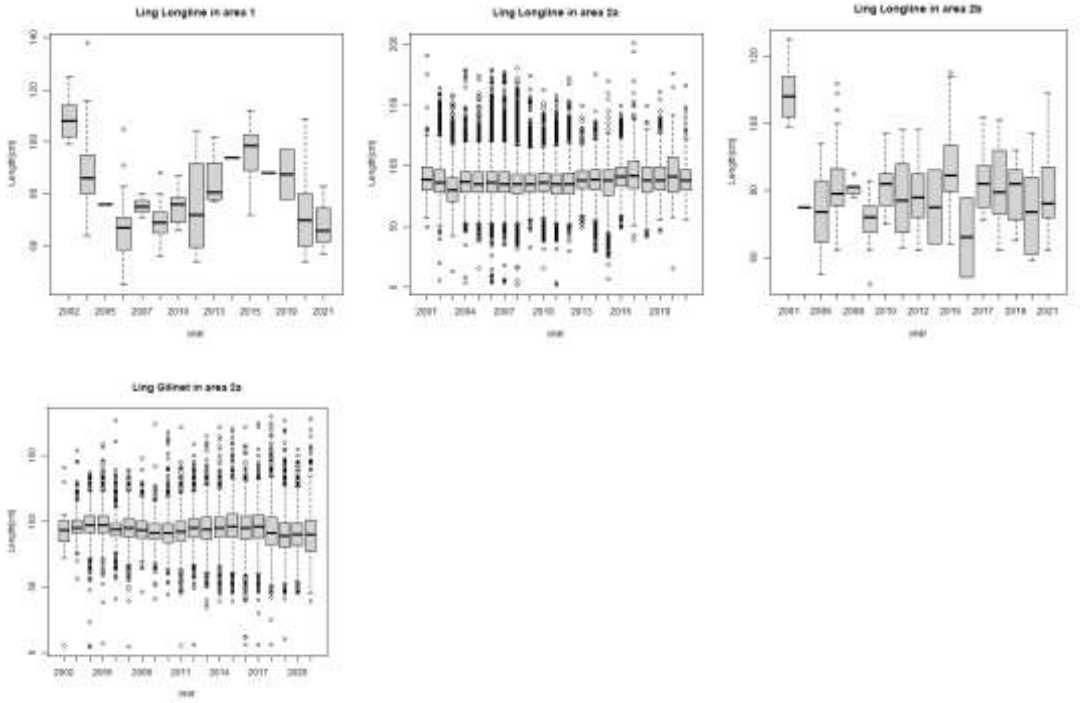

Figure 3.3.4. Box and whiskers plots for the length of ling in Areas 1, 2a and 2b for the period 2001 to 2021 from the Norwegian Reference fleet.

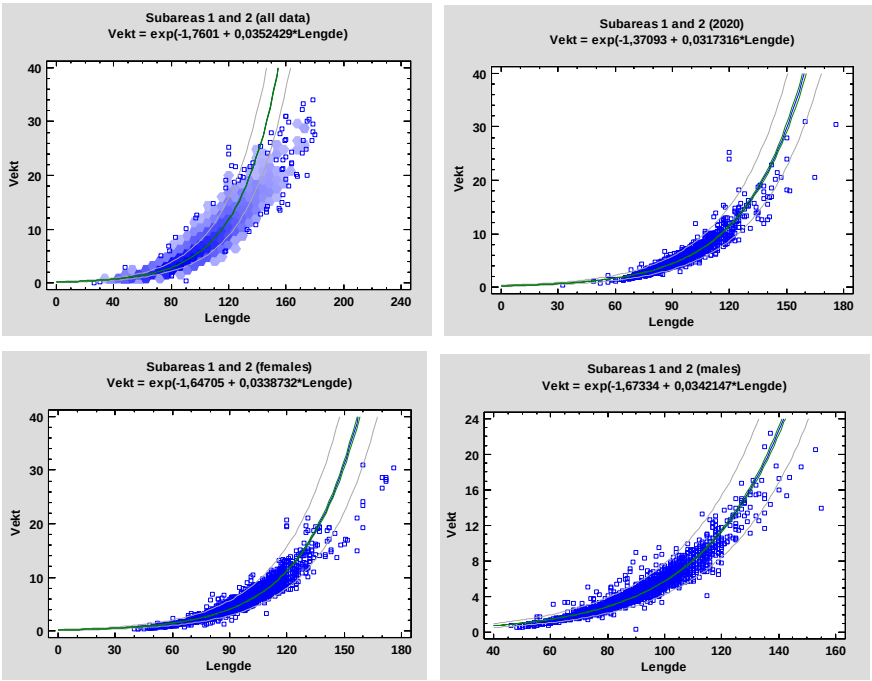

Figure 3.3.5. Weight–length relationship for the period 2008–2020, and only for 2020 (upper panel) and for females and for males, separately (lower panel). Data were collected by the Norwegian Reference Fleet.

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.

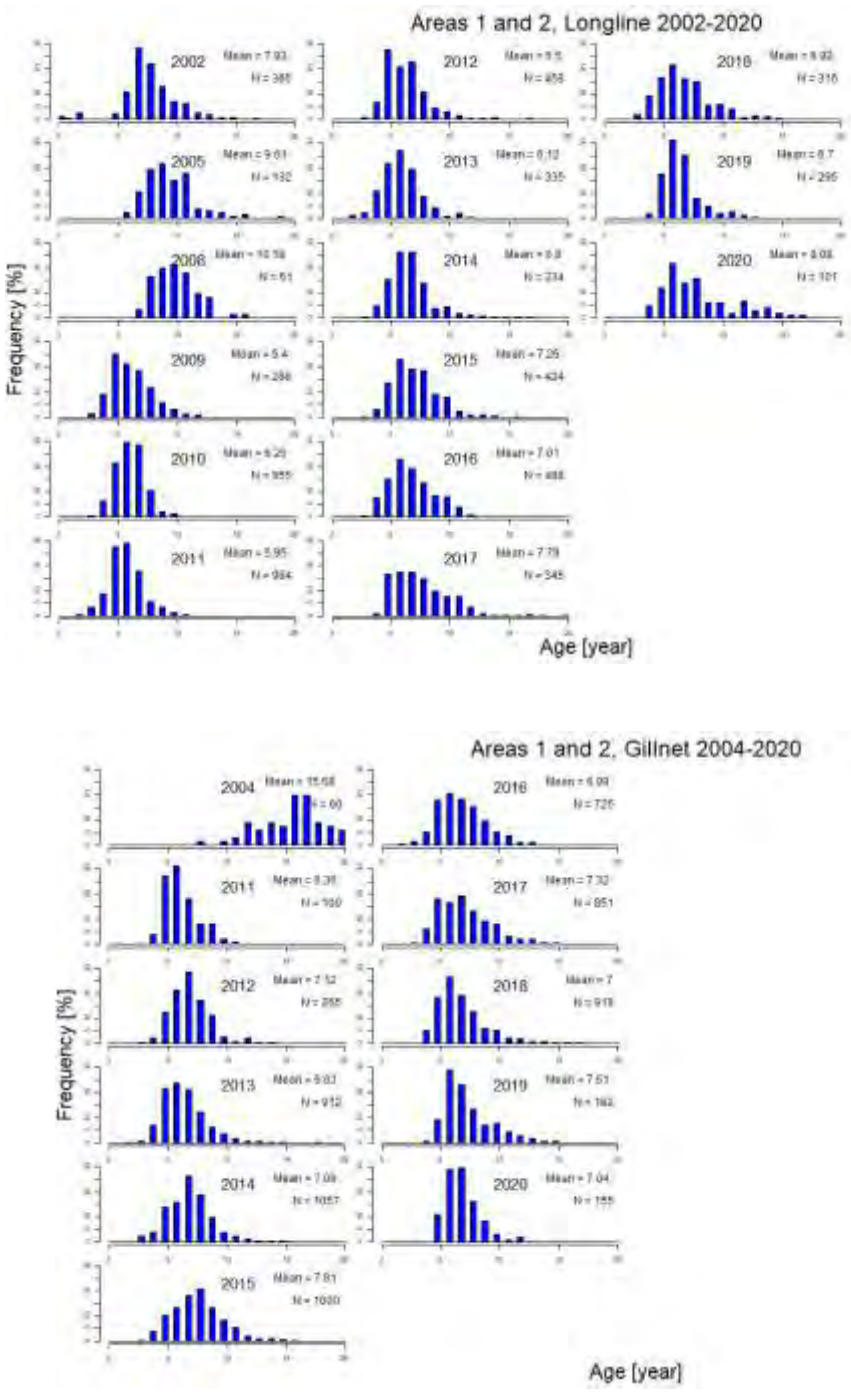

Figure 3.3.6. Ling in Areas 1 and 2, Catch-at-age compositions based on data from the Reference fleet, longliners and gillnetters.

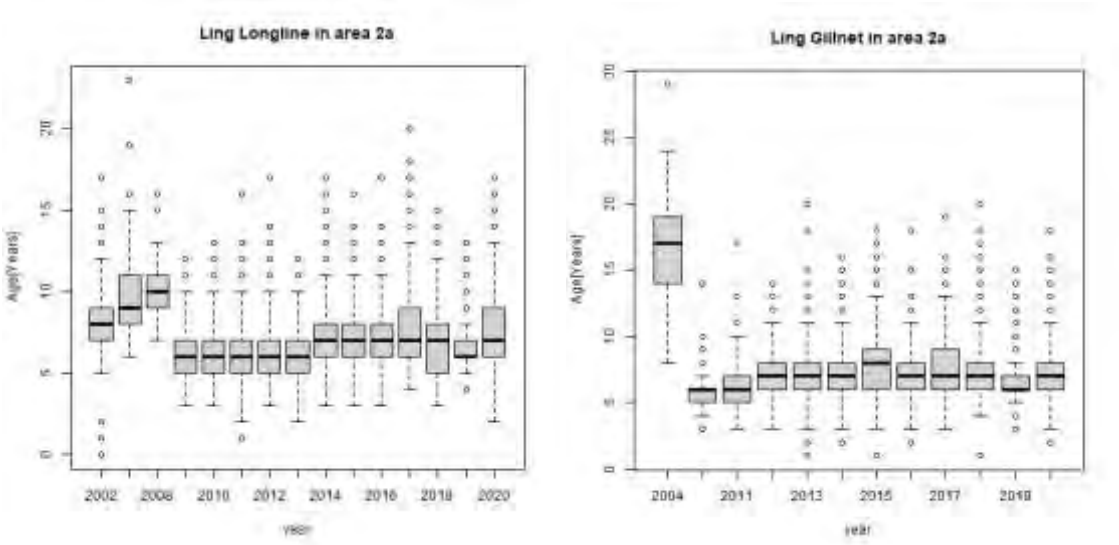

Figure 3.3.7. Age composition of the fish caught by longliners and gillnetters during the period 2002–2020.

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.

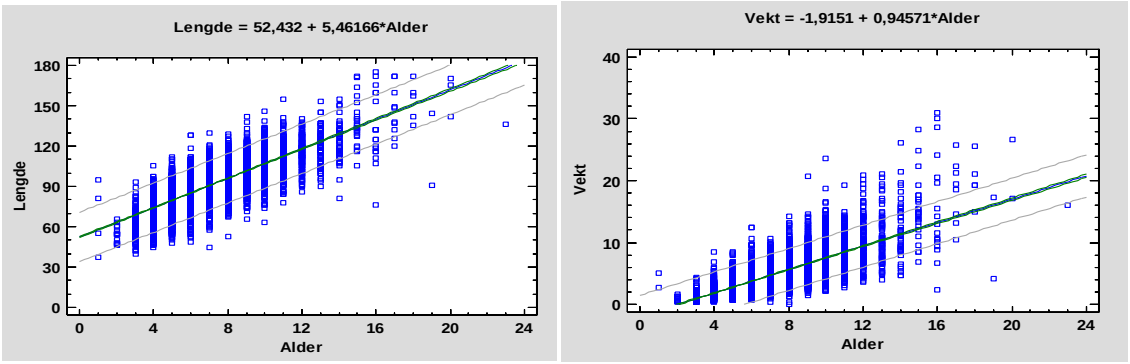

Figure. 3.3.8. Average mean length and mean weight versus age for the period 2010–2020.

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

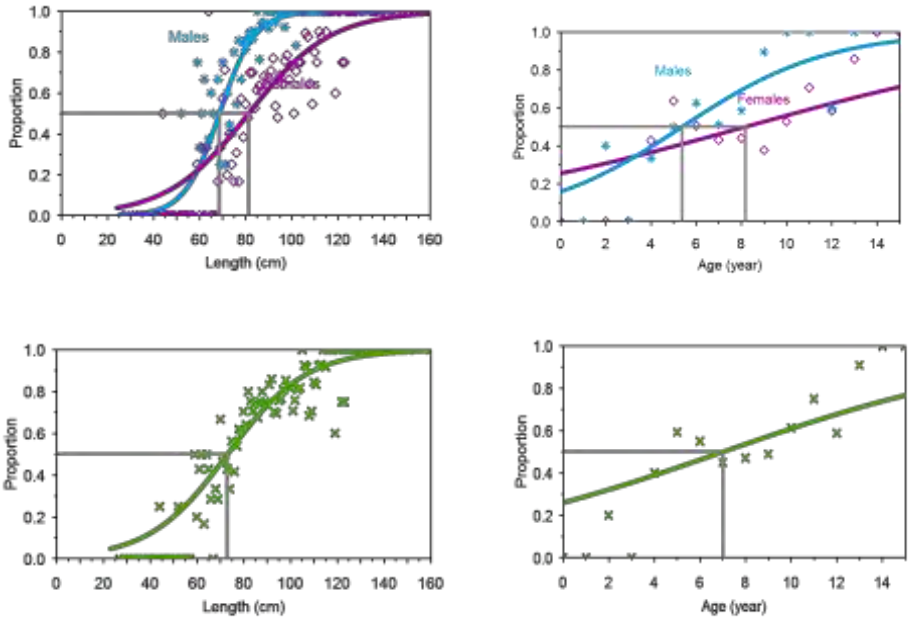

Figure 3.3.9. Maturity ogives for ling in Areas 1 and 2: males and females (upper panel) and for males and females combined (lower panel).

3.3.5.6 Catch and effort data

Two standardized cpue series for 2000–2021 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 2021. 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 2021. 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 and then stable trend. The method is described in Helle *et al.*, 2015.

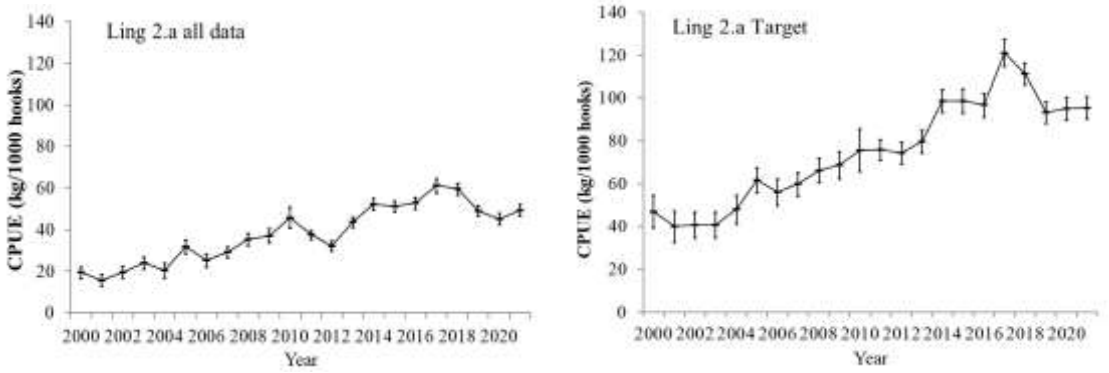

Figure 3.3.10. Estimate of cpue (kg/1000 hooks) for ling in Area 2a based; on all available data, and on catches when ling was considered the target species for 2000–2021. The bars denote the 95% confidence intervals. The data are from skipper's logbooks.

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.. Because of lower quotas for cod 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 2001–2021 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	2001–2021	Norwegian gill netters (Reference fleet) fishing in divisions 1,2a,2b	
Length–weight relation	$0.0055 * \text{length}^{3.0175}$	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	

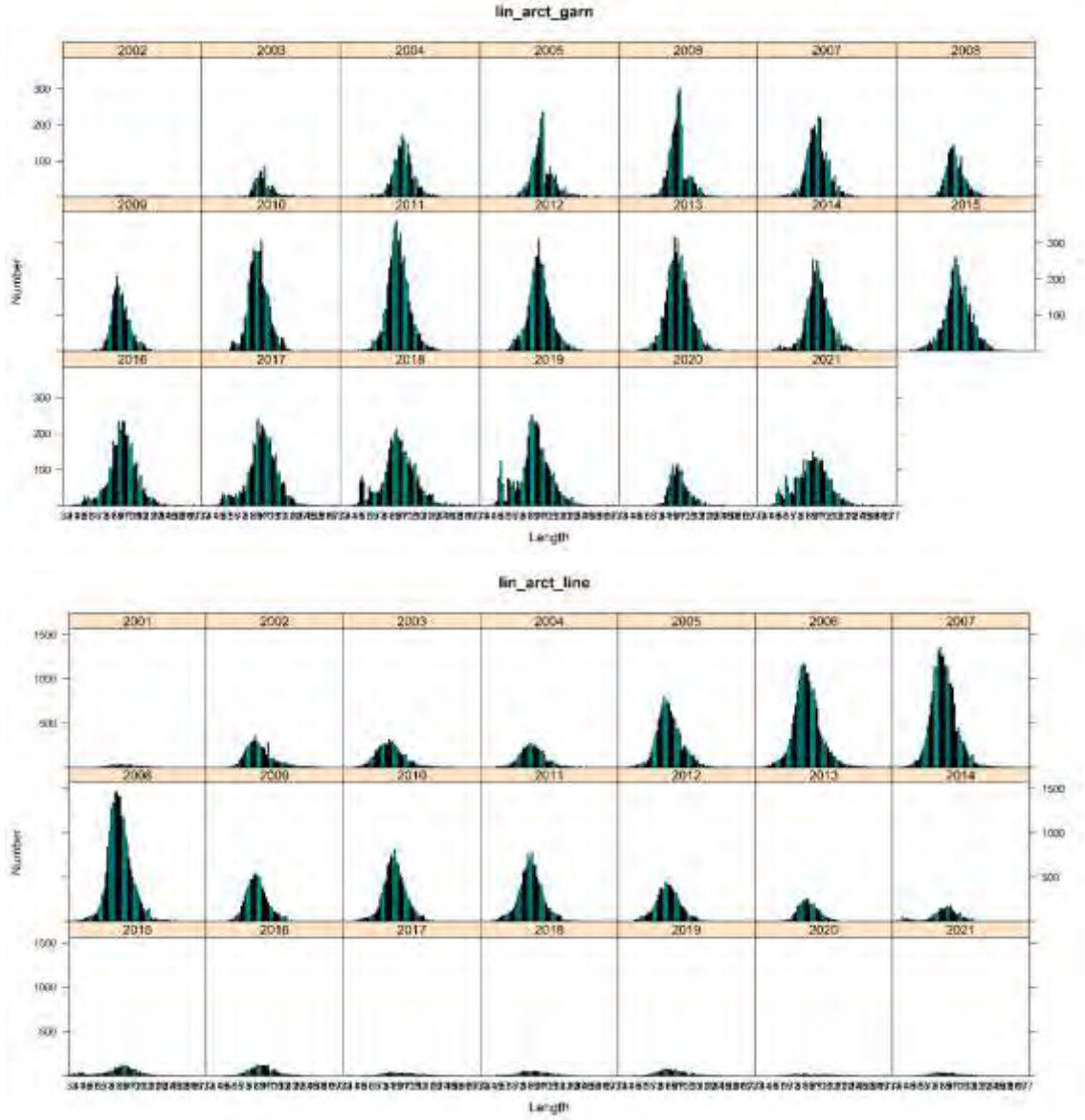

Figure 3.3.11. Ling in arctic waters (1, 2.a, 2.b), upper panel are length data from gillnetters, lower are from longliners. Catch length distributions, 2 cm length classes, for the period 2001–2021 (sex combined).

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.

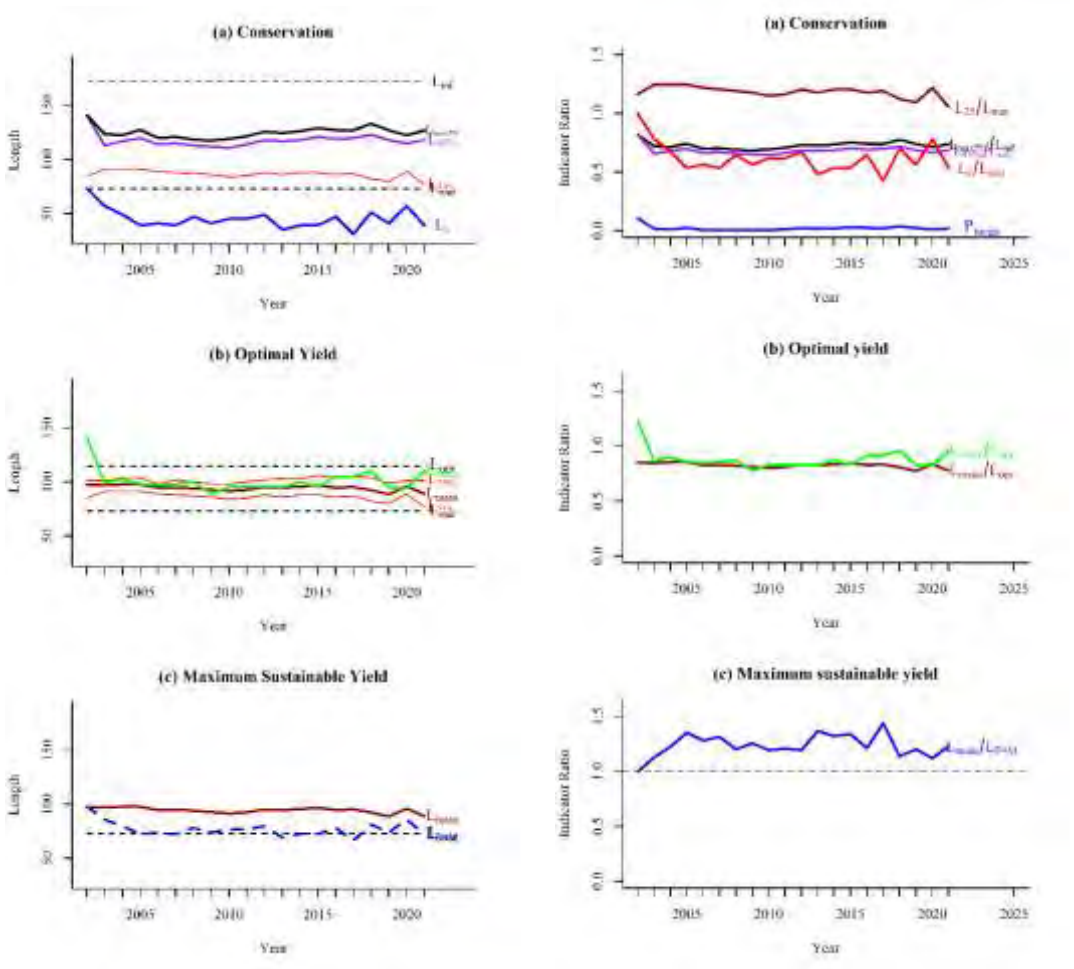

Figure 3.3.12a. Ling from gillnetters in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

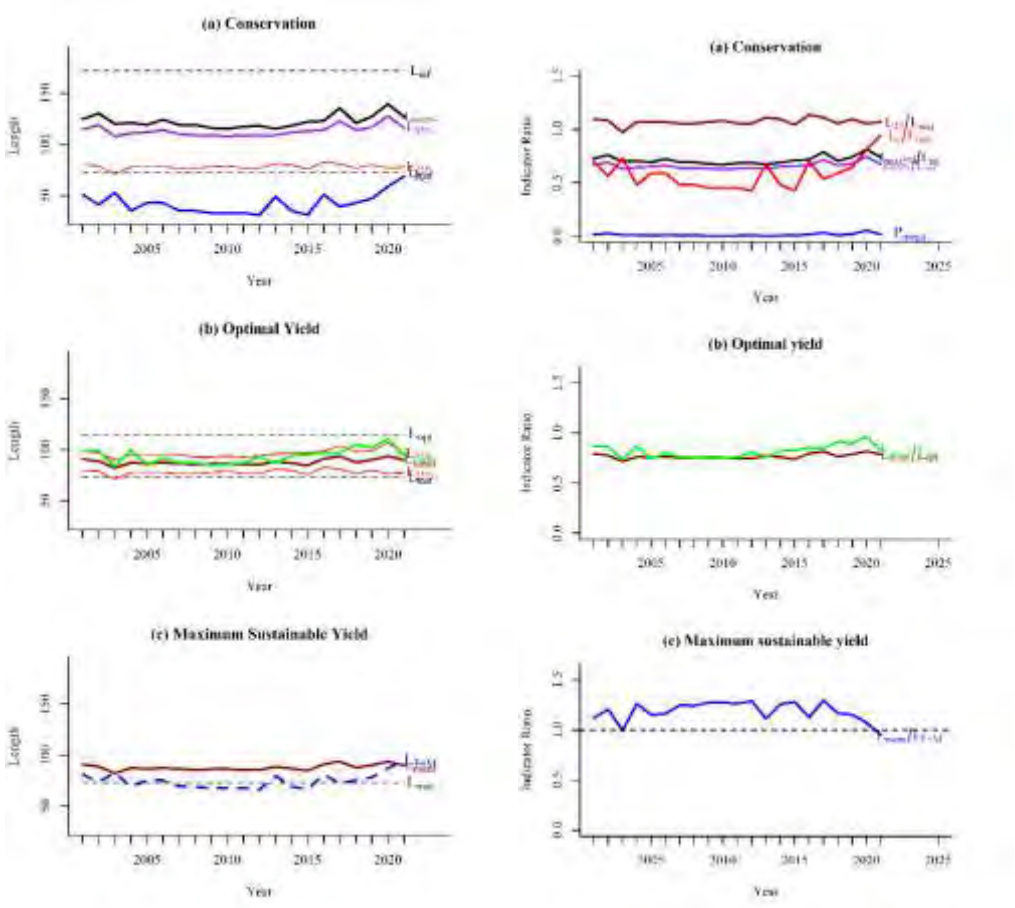

Figure 3.3.12b. Ling from longliners in arctic waters (1, 2.a, 2.b). Screening of the length indicator ratios for sex combined under three scenarios: (a) Conservation; (b) Optimal yield; and (c) maximum sustainable yield.

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 2019–2021, $L_{25\%}/L_{mat}$ 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 0.71 and 0.78 in 2019–2021 (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 2019–2021 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**
2019	0,56	1,10	0,74	2 %	0,77	1,20
2020	0,78	1,22	0,71	1 %	0,84	1,12
2021	0,53	1,05	0,74	2 %	0,78	1,23

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**
2019	0,64	1,10	0,74	2 %	0,79	1,15
2020	0,81	1,05	0,81	5 %	0,82	1,07
2021	0,95	1,07	0,74	2 %	0,78	0,95

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				
	2019	2012	**2021**	
MSY (F/F_{MSY})	✓	✓	✓	Fished sustainably

Stock size				
	2019	2020	**2021**	
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	2019	2020	2021	2019	2020	2021
L75	99	101	101	99	107	96
L25	80	89	77	80	77	78
Lmed	89	94	90	88	90	87
L90	110	110	110	111	122	108
L95	118	115	118	117	128	116
Lmean	88.61	95.88	88.95	90.23	93.58	90.00
Lc	41	57	39	47	59	69
LFeM	73.75	85.75	72.25	78.25	87.25	94.75
Lmaxy	95	94	110	102	111	94
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%	127.20	122.40	126.92	127.37	139.60	126.94
Lmean/LFeM	1.20	1.12	1.23	1.15	1.07	0.95
Lc/Lmat	0.56	0.78	0.53	0.64	0.81	0.95
L25/Lmat	1.10	1.22	1.05	1.10	1.05	1.07
Lmean/Lmat	1.21	1.31	1.22	1.24	1.28	1.23
Lmean/Lopt	0.77	0.84	0.78	0.79	0.82	0.78
L95/Linf	0.69	0.67	0.69	0.68	0.74	0.67
Lmaxy/Lopt	0.83	0.82	0.96	0.89	0.97	0.819767
Lmax5%/Linf	0.74	0.71	0.74	0.74	0.81	0.74
Pmega	0.02	0.01	0.02	0.02	0.05	0.02
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.

Helle, K., M. Pennington, N-R. Hareide and I. Fossen. 2015. Selecting a subset of the commercial catch data for estimating catch per unit of effort series for Ling (*Molva molva* L.). Fisheries Research 165: 115–120.

Helle, K. and Pennington, M. 2021. The development of the Norwegian longline fleet's fishery for ling and tusk during the period 2000-2020. Working Document to the ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).21 pp.

Magnússon JV, Bergstad OA, Hareide NR, Magnússon J, Reinert J (1997) Ling, Blue Ling and Tusk of the Northeast Atlantic. In: Nordic project report, p. 58.

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.)

Rosenbaum, P.R.2002. Observational Studies (second ed.), Springer-Verlag, New York, NY (2002) (377 pp.)

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
2021*	71					71

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

Year	Faroes	France	Germany	Norway	E & W	Scotland	Russia	Ireland	Iceland	Spain	Greenland	Poland	Total
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
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
2021*	7	38	2	9395		1	36		1				**9480**

*** *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		-			

Year	Norway	E & W	Faroes	France	Total
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
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
2021*	108				108

***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
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

Year	1	2.a	2.b	All areas
2017	43	7900	28	7971
2018	34	11332	238	11604
2019	37	11321	55	11413
2020	73	9395	96	9564
2021*	71	9480	108	9659

***Preliminary.**

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

3.4.1 The fishery

The fishery for ling in Icelandic waters has not changed substantially in recent years. Around 100-300 longliners annually report catches of ling, around 30-200 gillnetters and around 60-140 trawlers. Most of ling is caught on longlines (Figure 3.4.1 and Table 3.4.1) which has increased since 2000 to around 68% in 2021. At the same time the proportion caught by gillnets has decreased from 20–30% in 2000–2007 to less than 2% in 2021. 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. 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	140	184	287	892	704	1540	83	3284
2001	130	232	252	640	1061	1101	491	3362
2002	122	203	234	853	648	1283	1682	4519
2003	119	172	243	850	454	2215	687	4270
2004	116	165	234	977	545	2017	893	4606
2005	115	127	260	1500	501	2046	899	5198
2006	106	99	258	1697	629	3734	1133	7405
2007	105	86	251	1642	633	4042	1035	7591
2008	96	68	209	1927	477	5007	1583	9283
2009	88	78	208	2193	723	6231	1367	10945
2010	86	69	197	2529	363	6532	1304	11131
2011	82	61	201	2625	222	5594	873	9626
2012	81	62	206	2509	245	7479	1162	11817
2013	85	62	206	2808	345	6836	1356	11581
2014	78	57	206	2717	673	10624	30	14246
2015	75	55	193	2802	650	9249	23	13035

Year	Bottom trawl	Gill nets	Longlines	Bottom trawl	Gill nets	Longlines	Other	Total catch
2016	71	55	173	2426	681	6545	20	9884
2017	70	48	157	2063	556	5975	11	8766
2018	68	47	137	2114	387	5366	18	8062
2019	61	32	135	2009	115	5964	9	8269
2020	67	36	114	1985	138	4765	15	7061
2021	66	39	108	2074	126	4828	10	7128

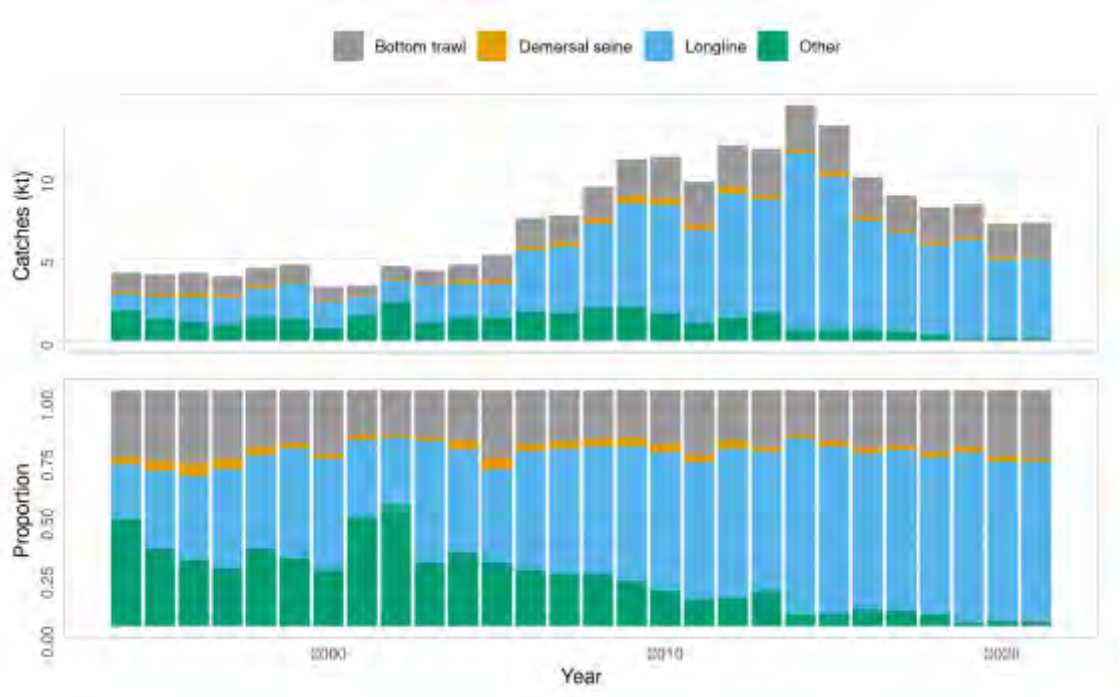

Figure 3.4.1: Ling in 5.a. Commercial catches by gear as registered in Icelandic logbooks.

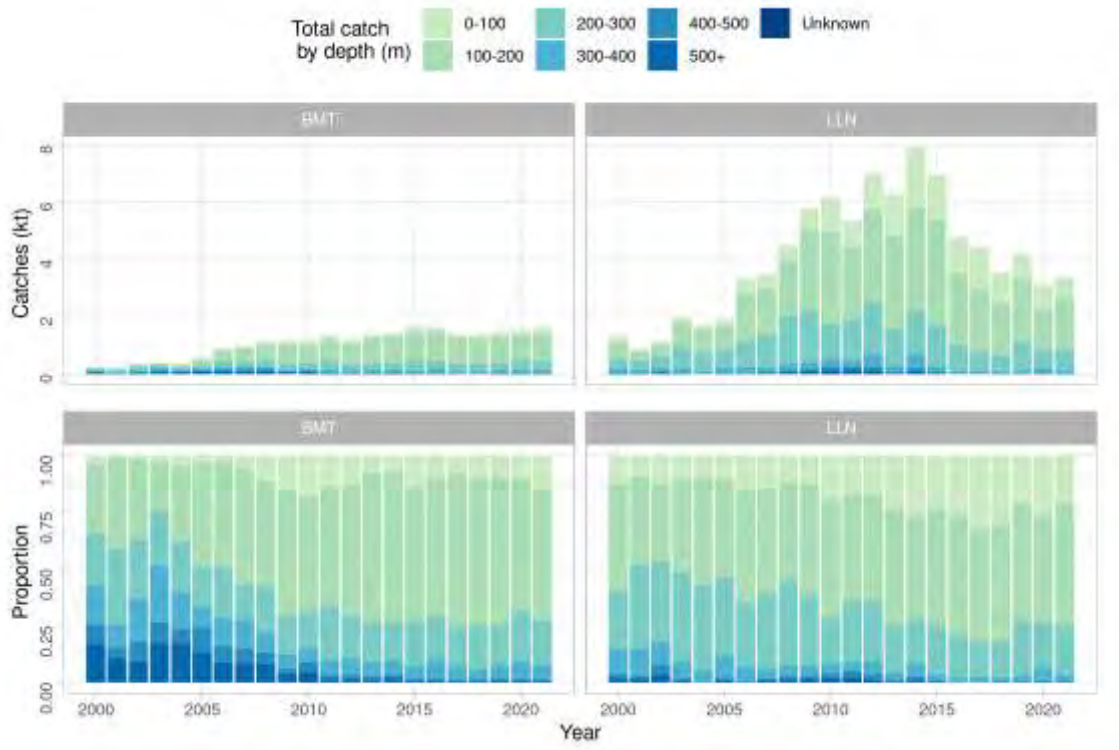

Figure 3.4.2: Ling in 5.a. Depth distribution of catches in 5.a according to logbooks. All gears combined.

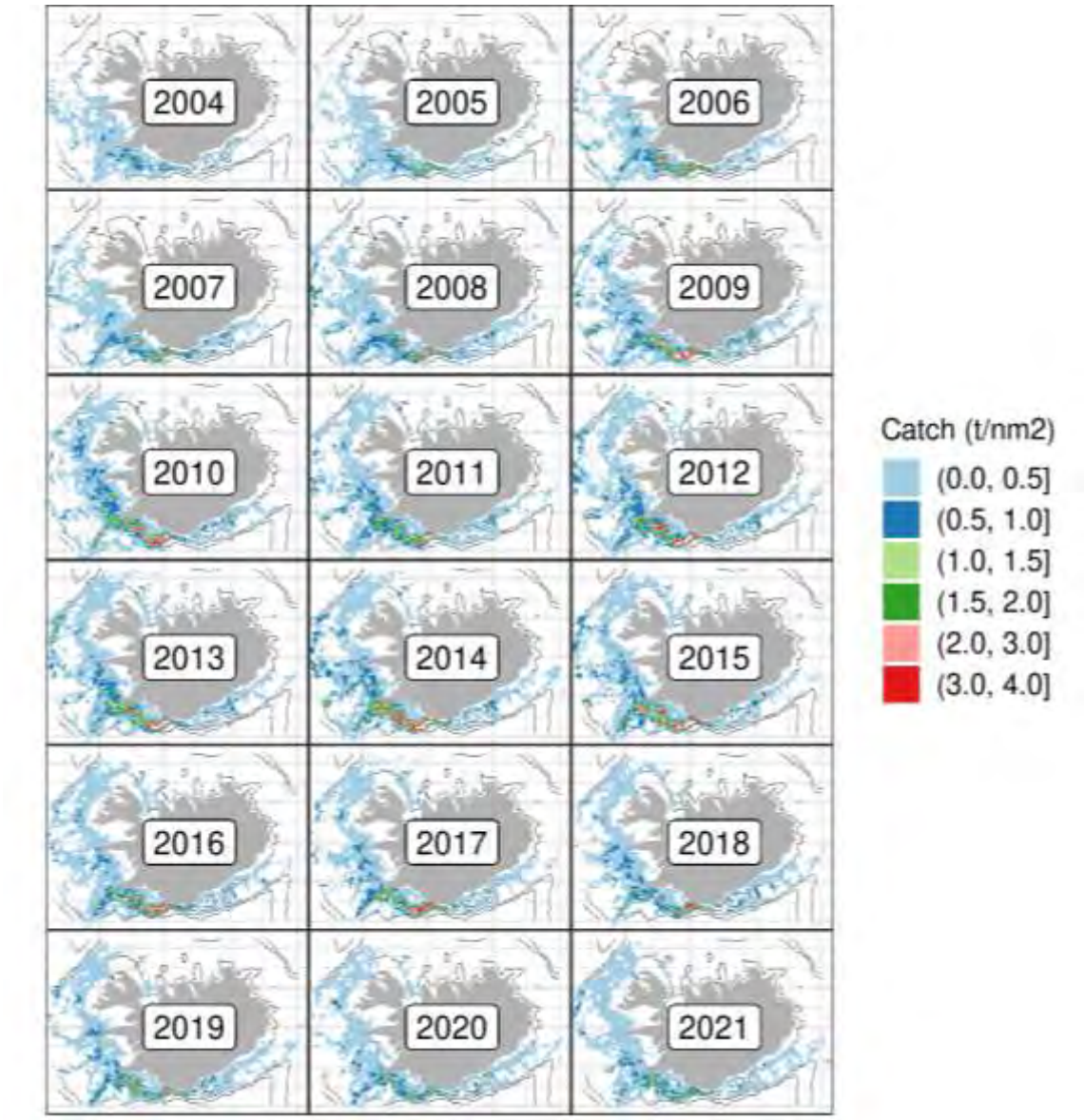

Figure 3.4.3: Ling in 5.a. Spatial distribution of the Icelandic fishery catches as reported in logbooks. All gears combined.

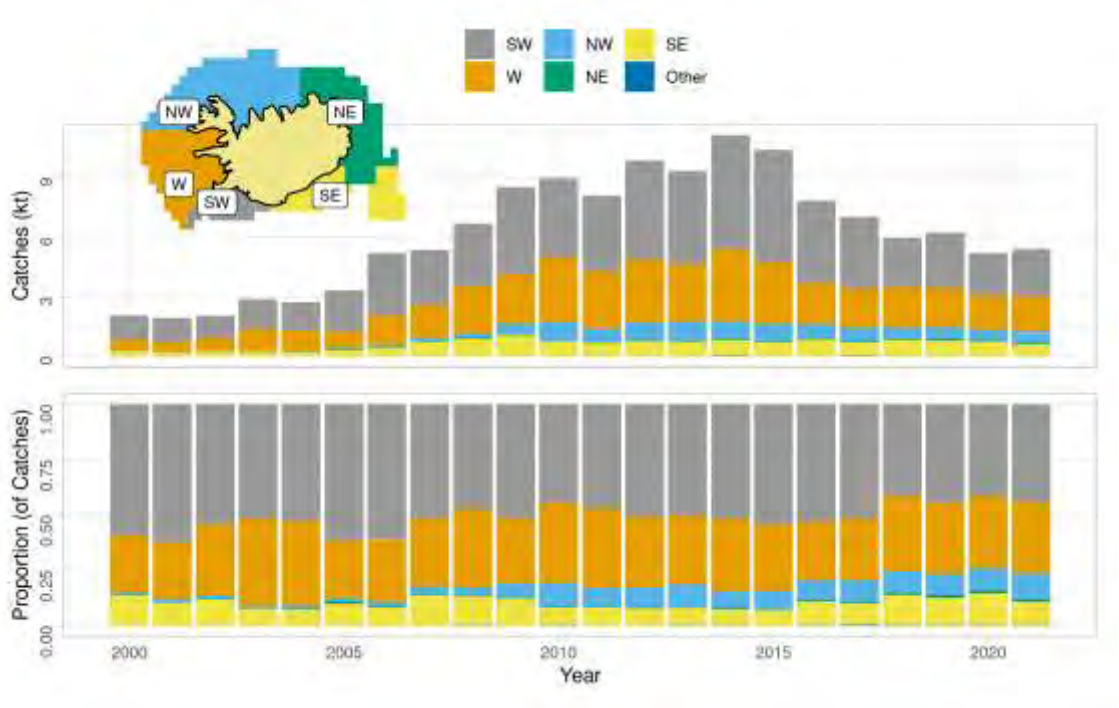

Figure 3.4.4: Ling in 5.a. Changes in spatial distribution of the Icelandic fishery as reported in logbooks. All gears combined.

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 7128 tonnes in 2021 (Table 3.4.2 and Figure 3.4.5).

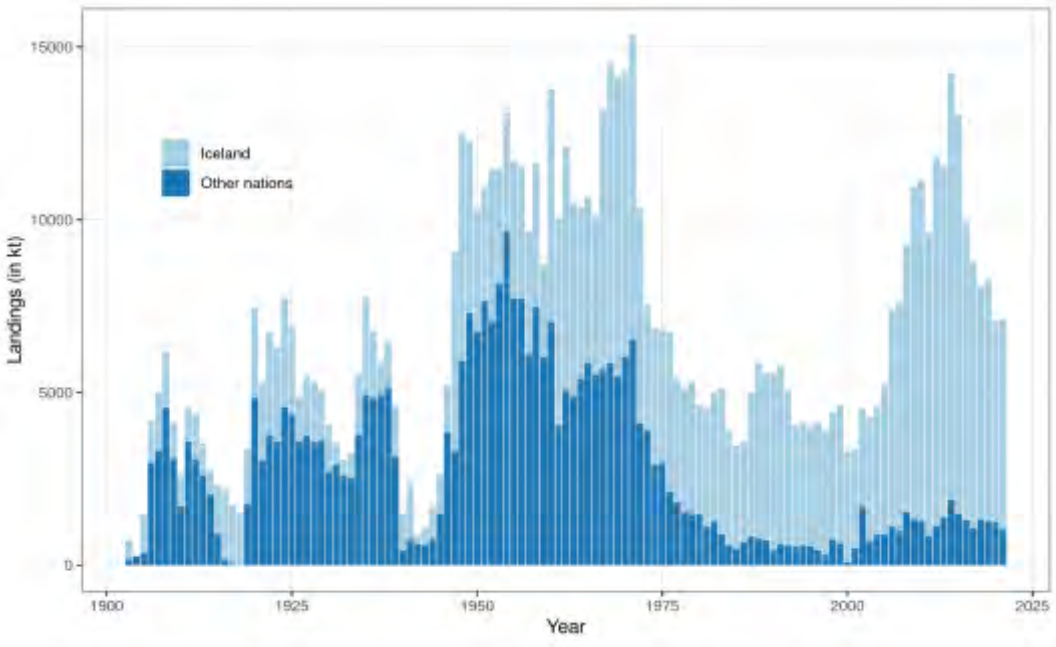

Figure 3.4.5: Ling in 5.a. Landings in 5.a

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

Year	Bottom trawl	Gill nets	Longlines	Other	Total
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
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
2021	29	2	68	1	7128

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)).

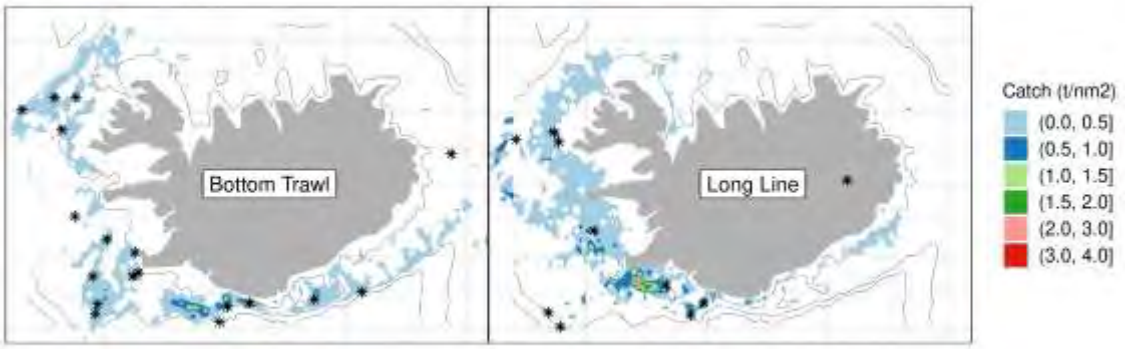

Figure 3.4.6: Ling in 5.a. Fishing grounds in 2021 as reported by catch in logbooks (tiles) and positions of samples taken from landings (asterisks) by longliners and trawlers.

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 longline 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 (2022) 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 trawling 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 increased fishing effort. Mean length has gradually increased since 2015 and the mean length in 2020 was 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.

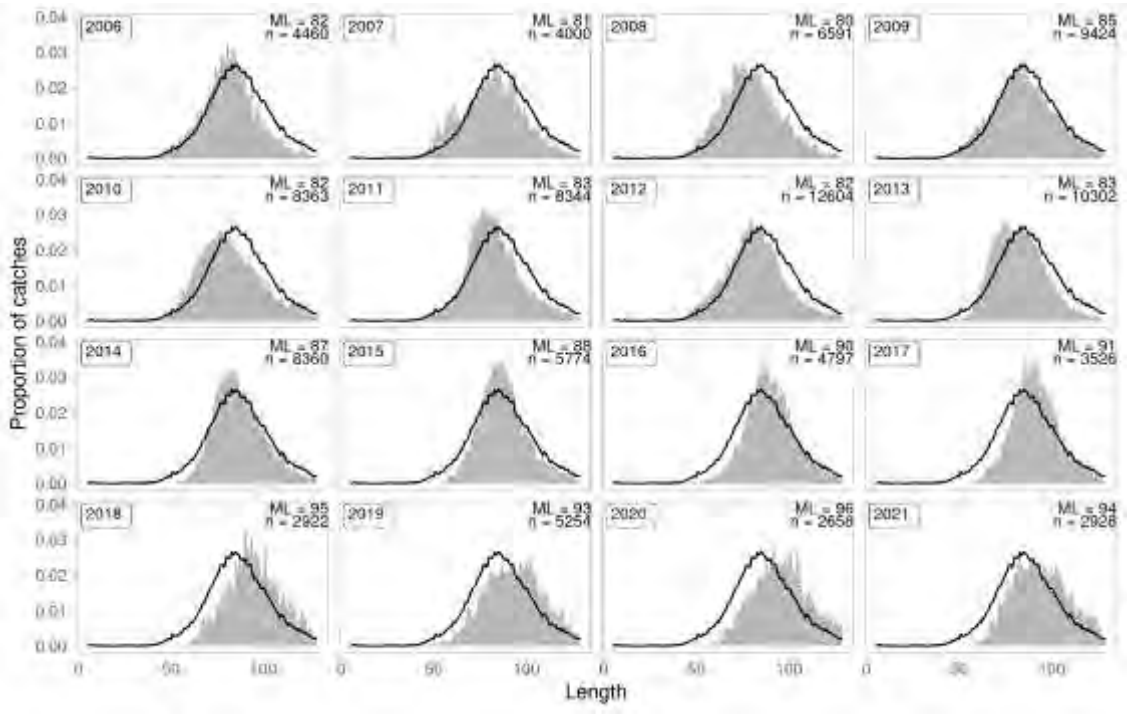

Figure 3.4.7: Ling in 5.a. Length distribution from the Icelandic fleet (grey area) from 2005-2020. Black line is the average mean of the period.

Table 3.4.3: Ling in 5.a. 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
2013	993	122	267	9405	1344	2590	100	50	350	450	3540

Year	Length measurements					Age measurements					
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
2021	2028	0	0	1056	0	180	0	0	398	0	578

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. 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. In addition, a gillnet survey is conducted in areas closer inshore every April during cod spawning periods, designed to sample the cod spawning stock. A detailed description of the Icelandic spring, autumn groundfish surveys and the gillnet surveys are 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.

April (gillnet) survey indices at length and age were available from 2002. Northern extensions to the survey were added in 2002 so 1998 - 2001 data were excluded. ALKs from the spring survey were used directly as this survey occurs directly after that spring survey.

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.

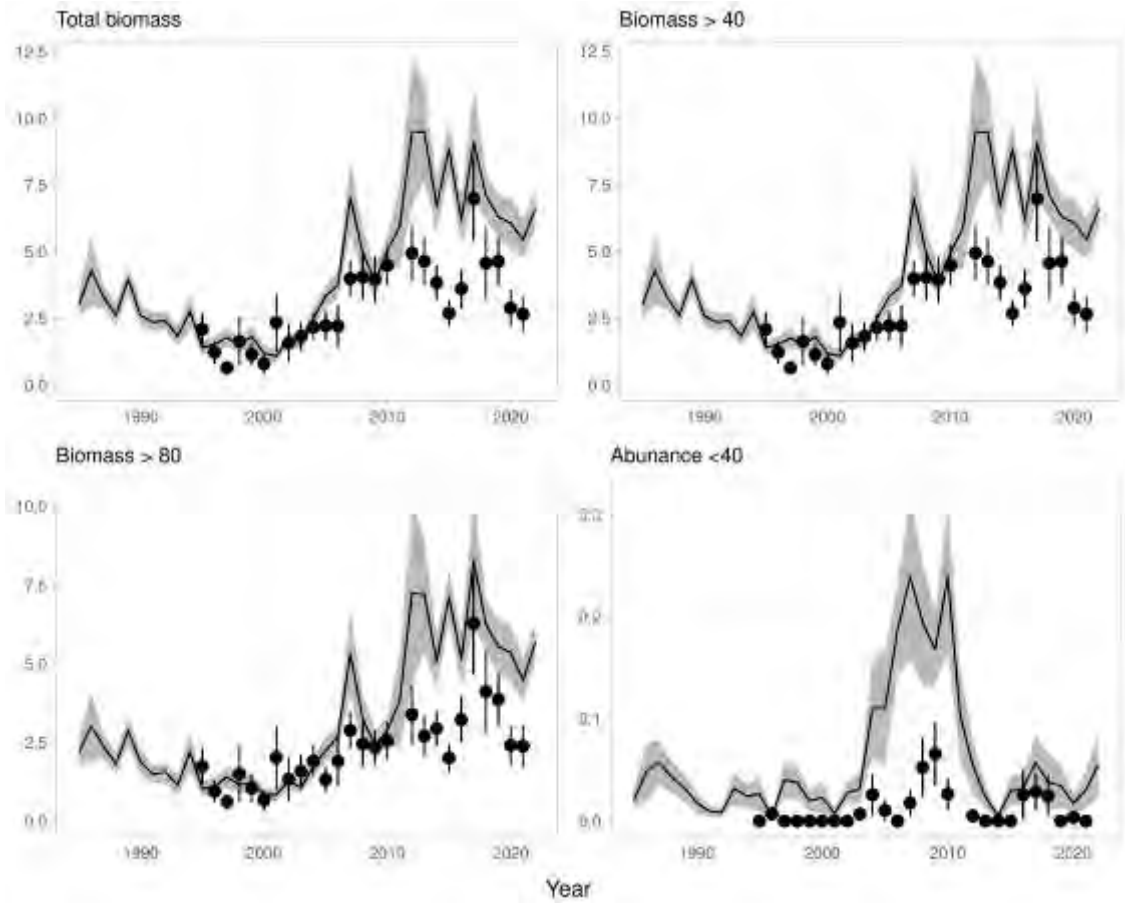

Figure 3.4.8: Ling in 5.a. Total biomass indices, biomass indices larger than 40 cm, biomass indices larger than 80 cm and abundance indices <40 cm. The lines with shaded area show the spring survey index from 1985 and the points with the vertical lines show the autumn survey from 1997. The shaded areas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

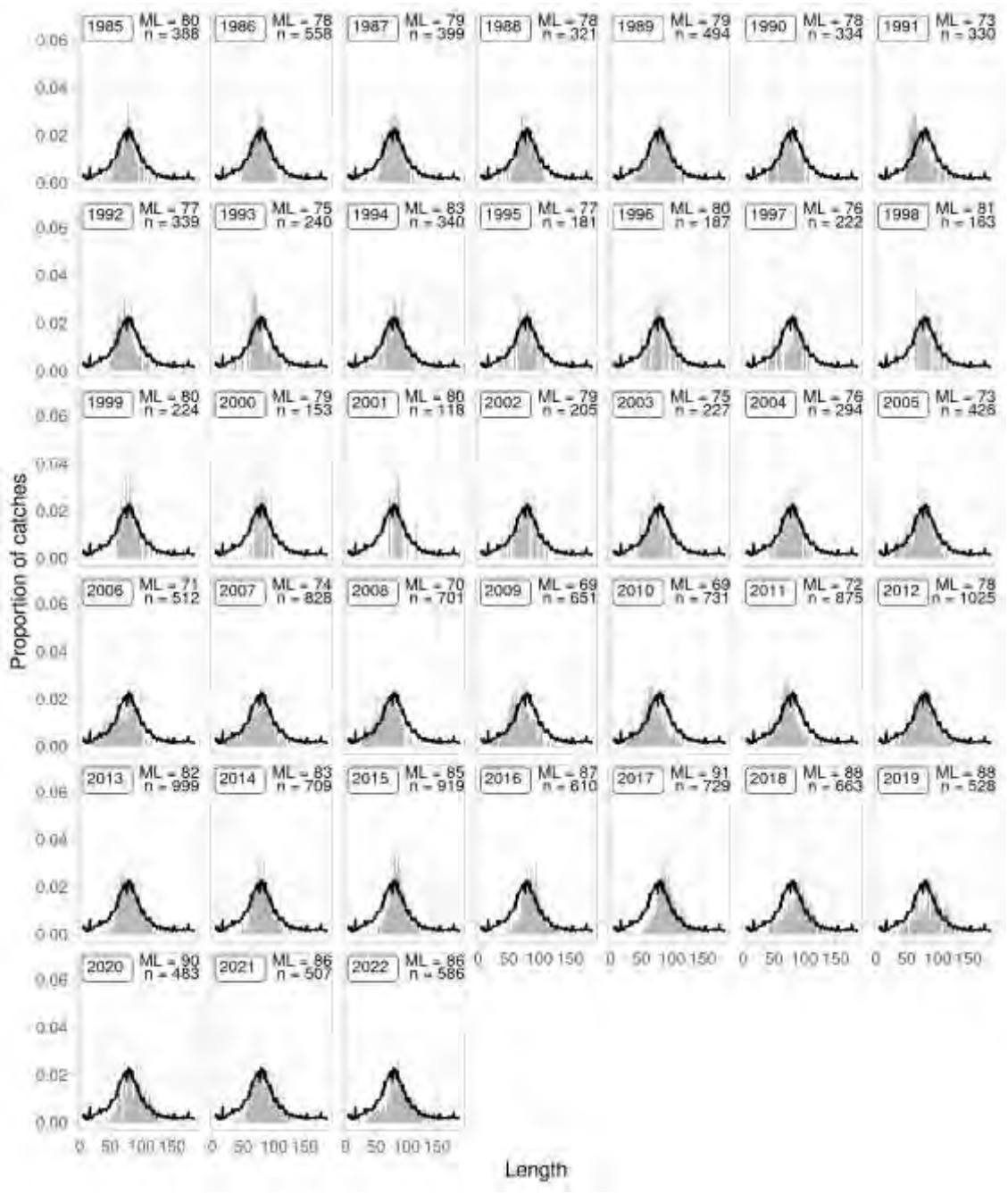

Figure 3.4.9: Ling in 5.a. Length distribution (grey area) from the spring survey. Black lines are the average mean of the period.

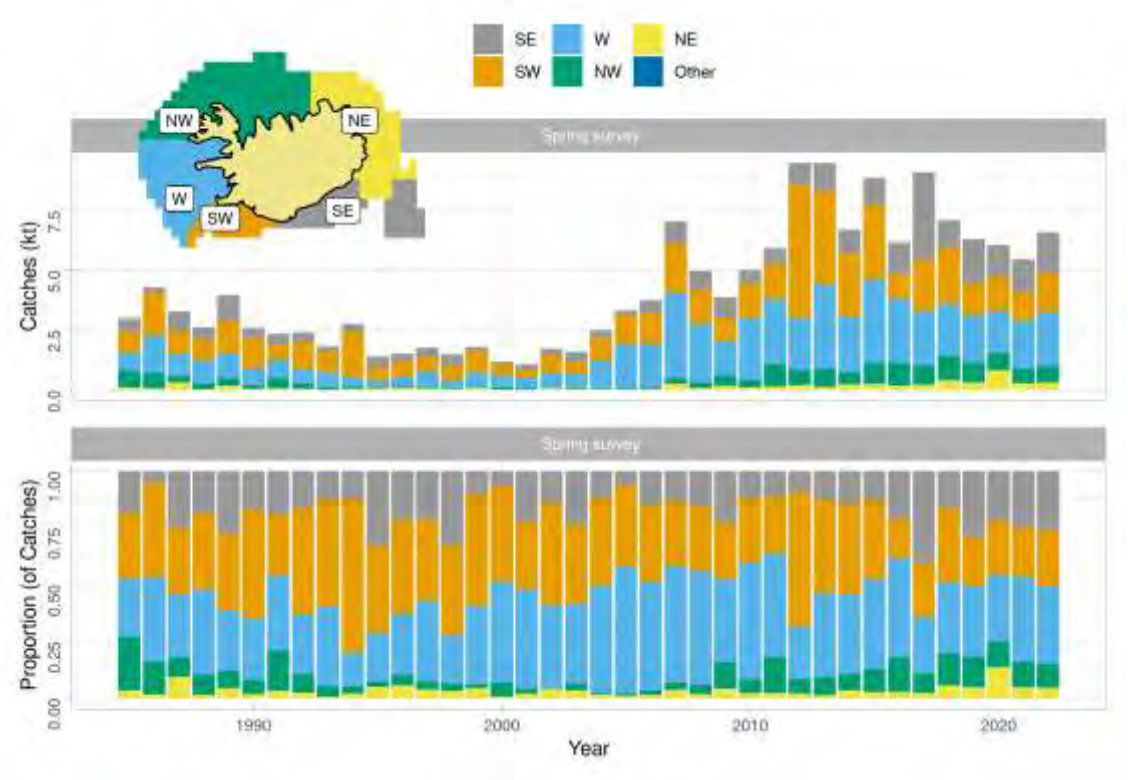

Figure 3.4.10: Ling in 5.a. Estimated survey biomass in the spring survey by year from different parts of the continental shelf (upper figure) and as proportions of the total (lower figure).

3.4.8 Data analyses

3.4.8.1 Analytical assessment using SAM

In 2022, Ling in 5.a was re-assessed as the previously benchmarked Gadget model had begun to show great instability in retrospective patterns in recent years. As a part of a Harvest Control Evaluation requested by Iceland, the stock was benchmarked (WKICEMSE 2022) which resulted in changes in the assessment method and updated reference points. Model setup and settings are described in the Stock Annex (ICES 2022).

3.4.8.2 Data used and model settings

Data used for tuning are given in the stock annex.

3.4.9 Diagnostics

3.4.9.1 Model fit

Figure 3.4.13 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.

The model fit to survey indices and catch are shown in figure 3.4.11 and 3.4.12

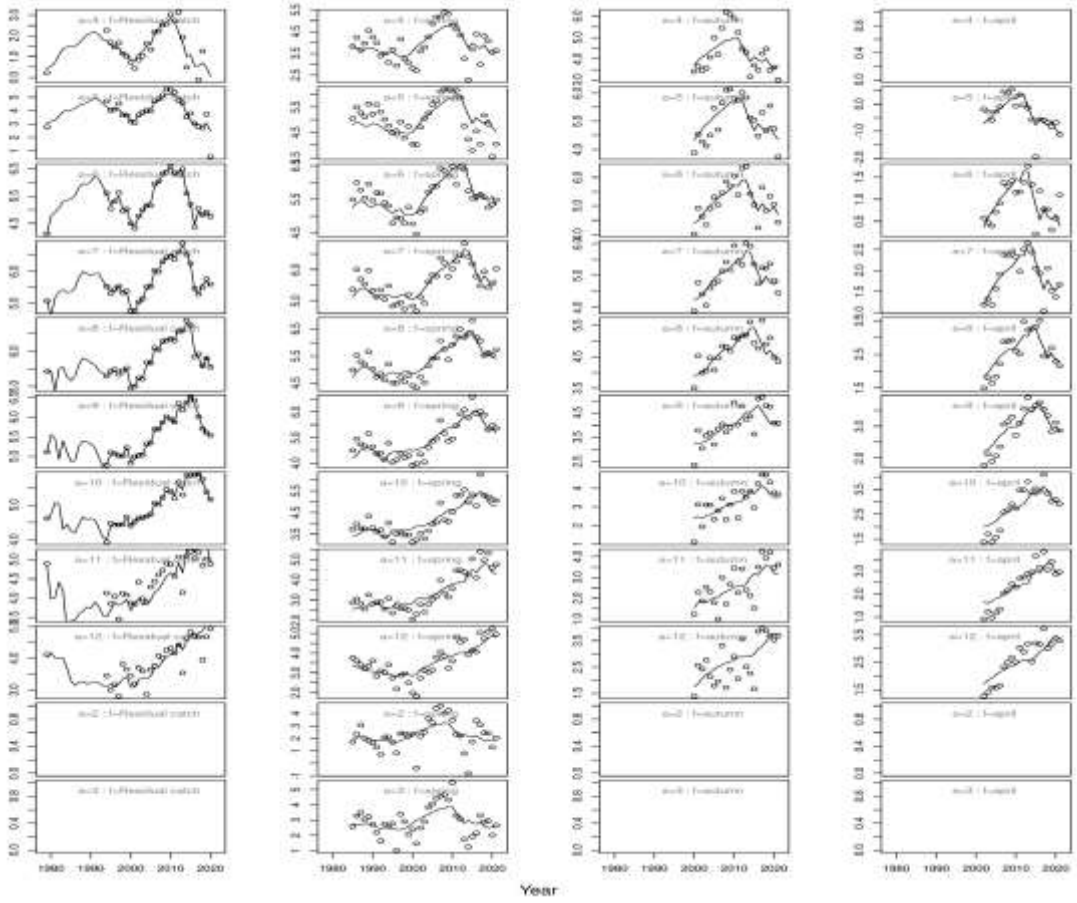

Figure 3.4.11: Ling in 5.a. Model fit to catches, spring survey, autumn survey and gillnet indices.

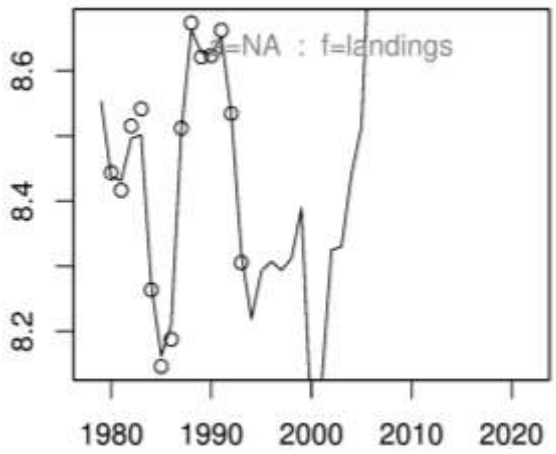

Figure 3.4.12: Ling in 5.a. Fit to the landings input data to the SAM model.

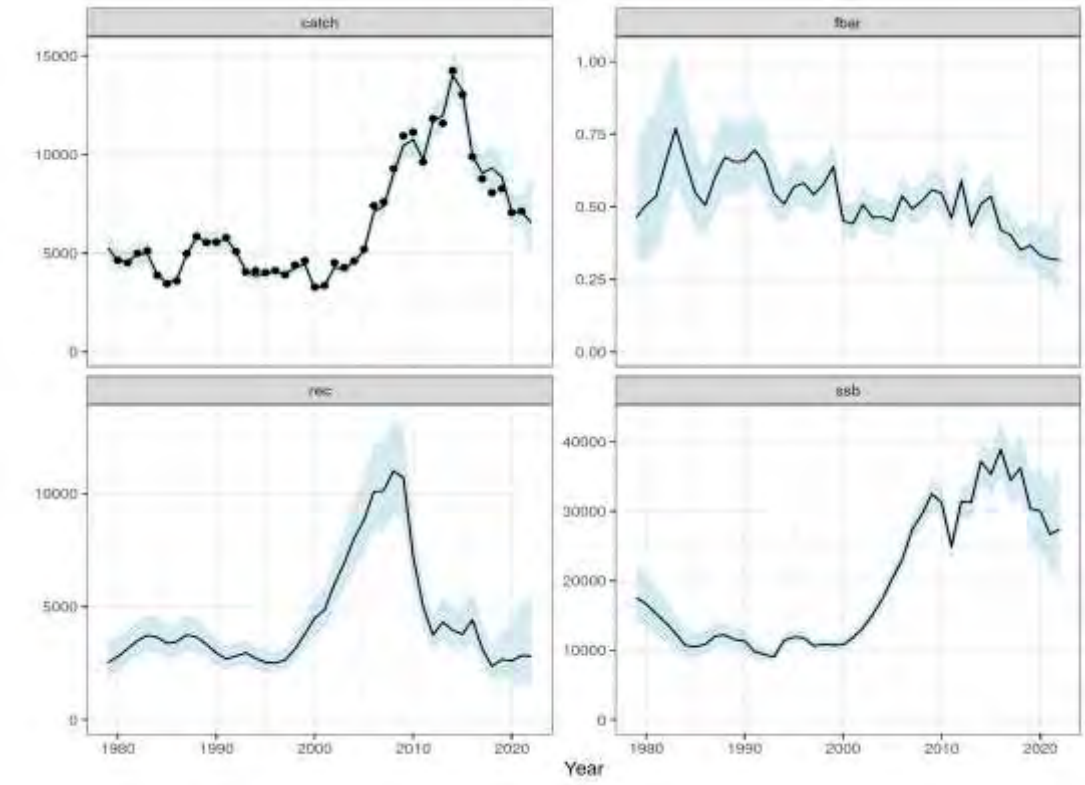

Figure 3.4.13: Ling in 5.a. Model results of population dynamics overview: estimated catch, average fishing mortality over ages 8 - 11 (Fbar), recruitment (age 2), and spawning stock biomass (SSB).

3.4.10 Results

Population dynamics of the ling estimated in this model show a clear trend of a high recruitment period from 2004 - 2010, corresponding with increased spawning stock biomass (SSB) and catches during the 2010 - 2019 period. Despite this trend, fishing mortality has remained rather steady or slightly declined (Fig. 3.4.13).

The overall scale of model results, including SSB (kt), fishing mortality, and recruitment at age 3, are very similar between the previously used Gadget model and the SAM model (Figure 3.4.14).

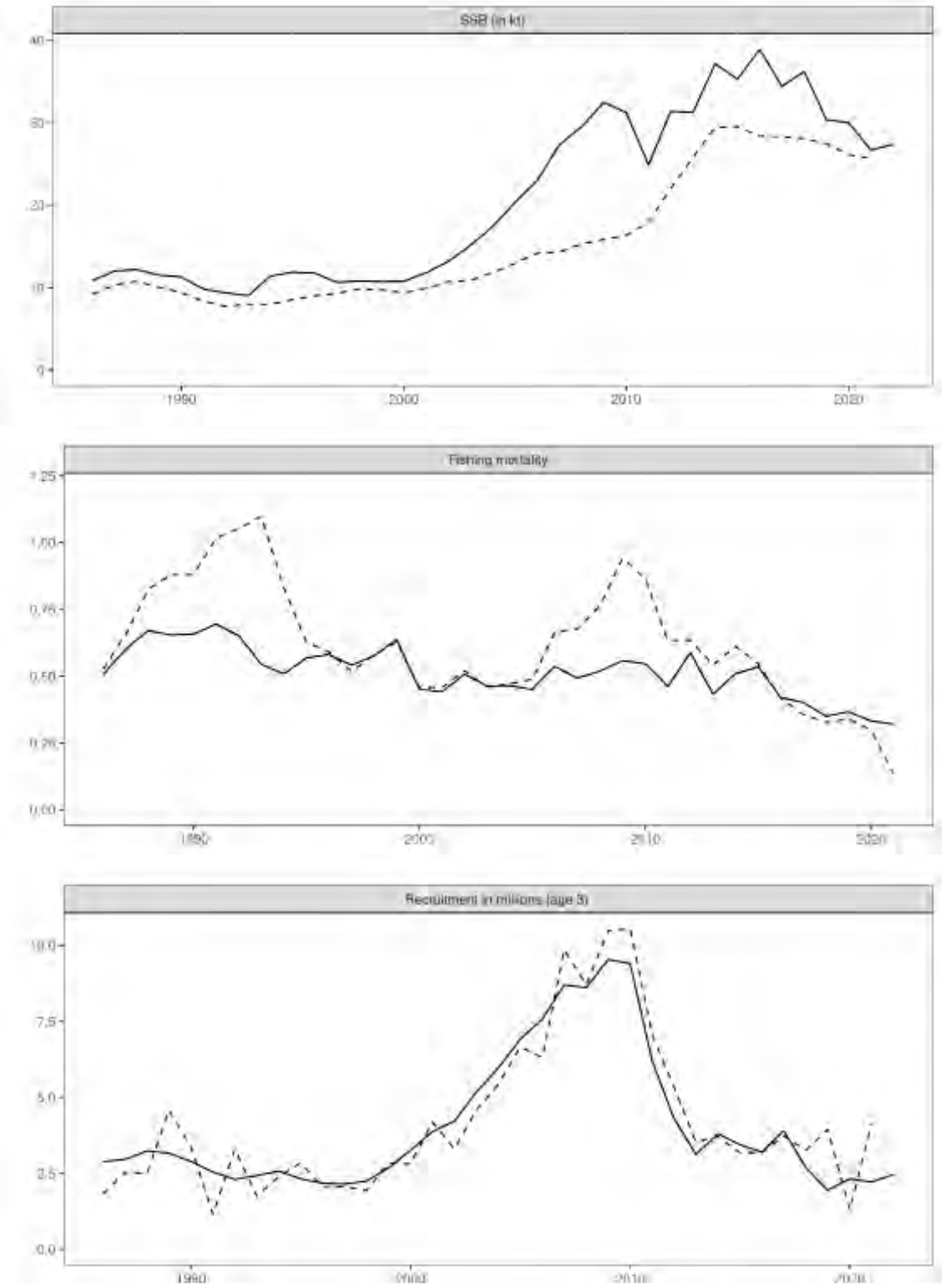

Figure 3.4.14: Ling in 5.a. Comparison of SSB, fishing mortality, and recruitment (age 3) estimates from the previously used Gadget assessment (dashed) to those produced by the SAM model (black line).

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 over the first 2 years of the 5-year peel followed by a

downward revision of biomass (SSB) over the last 3 years, and subsequently a downward then upward revision of F. This period of larger retrospective patterns is the result of rapidly changing biomass levels. 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.

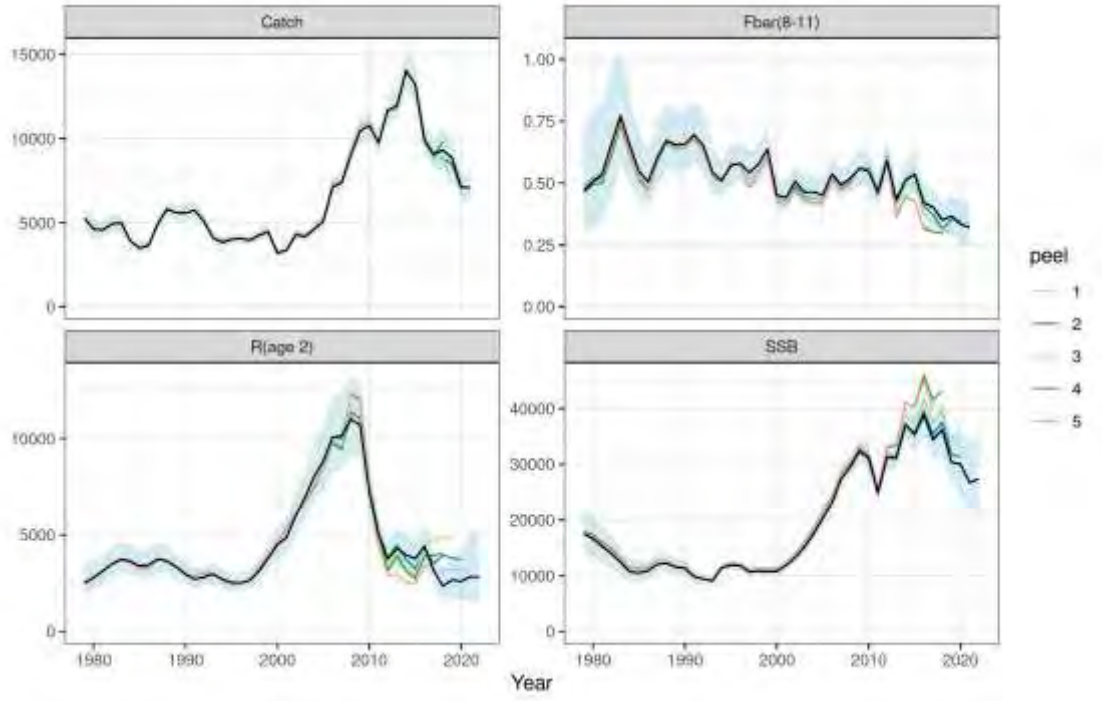

Figure 3.4.15: Ling in 5.a. Retrospective plots illustrating stability in model estimates over a 5-year 'peel' in data. Results of spawning stock biomass, fishing mortality F, and recruitment (age 2) are shown.

Mohn's rho was estimated to be 0.0922019 for SSB, -0.0867184 for F, and 0.4402096 for recruitment.

Neither observation nor process residuals show obvious trends (Figs. 3.4.16 and 3.4.17).

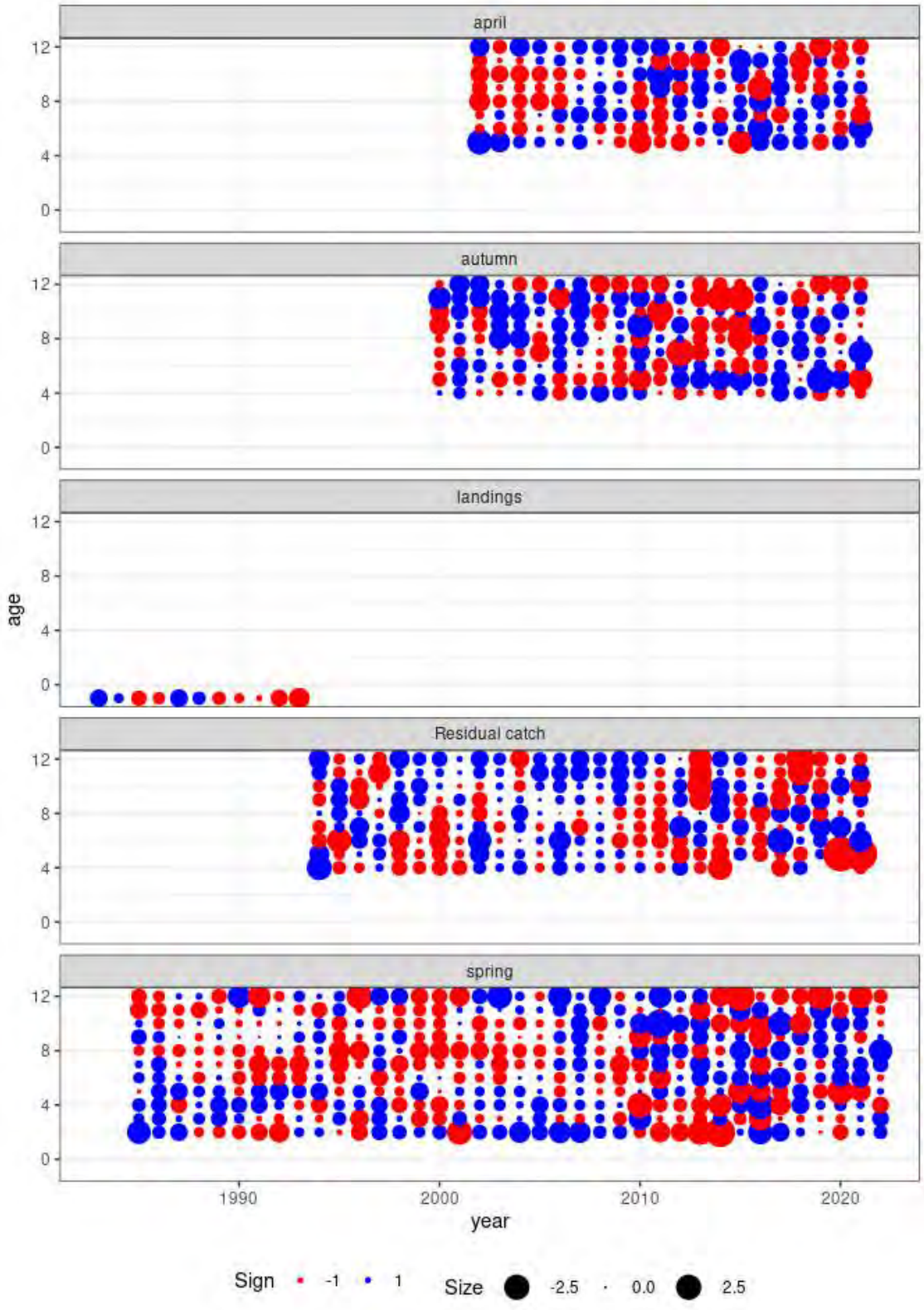

Figure 3.4.16: Ling in 5.a. Observation error residuals of the SAM model.

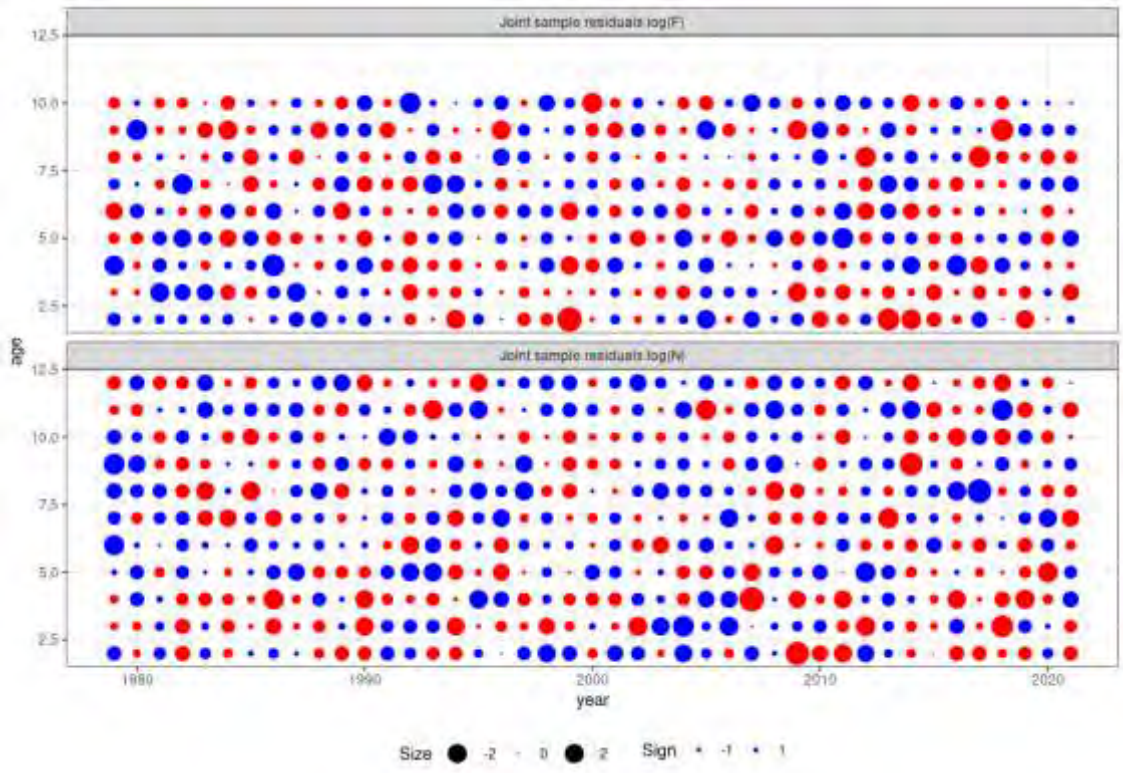

Figure 3.4.17: Ling in 5.a. Process error residuals of the SAM model.

3.4.10.2 Reference points

As part of the WKICEMSE 2022 HCR evaluations, the following reference points were defined for the stock.

Table 1 Previous and revised ICES reference points for ling in Division 5.a following the benchmark. Biomass values in tonnes.

Framework	Reference point	Previous value	Revised value	Revised technical basis
MSY Approach	MSY $B_{trigger}$	9930	11 100	B_{pa}
	F_{MSY}	0.28	0.30	F that produces MSY in the long term
Precautionary Approach	B_{lim}	7090	9000	B_{loss} (SSB in 1993)
	B_{pa}	9930	11 100	$B_{lim} \times e^{1.645 * \sigma B}$, using the default $\sigma_B = 0.2$
	F_{lim}	0.70	0.95	Fishing mortality that in stochastic equilibrium will result in median SSB at B_{lim}.
	F_{pa}	0.41	0.62	F_{p05}, maximum F at which the probability of SSB falling below B_{lim} is <5%
Management plan	MGT $B_{trigger}$	9930	11 100	No lower than MSY $B_{trigger}$
	F_{MGT}	*	0.30	No higher than F_{msy}

* The previously used HCR was based on a harvest rate (HR) relative to a stock reference biomass, so no F_{MGT} was used.

Figure 3.4.18: Ling in 5.a Reference points adopted from ICES 2022

The management plan proposed by Iceland is:

The proposed HCR for the Icelandic Ling fishery, which sets a TAC for the fishing year y/y+1 (September 1 of year y to August 31 of year y+1) based on a fishing mortality F_{MGT} of 0.30 applied to ages 8 to 11 modified by the ratio SSB_y/MGT $B_{trigger}$ when SSB_y < MGT $B_{trigger}$, maintains a high yield while being precautionary as it results in lower than 5% probability of SSB < B_{lim} in the medium and long term. WKICEMSE 2022 concluded that the HCR was precautionary and in conformity with the ICES MSY approach.

3.4.11 Management

The Icelandic Ministry of Food, Agriculture and Fisheries 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 2022).

Table 3.4.4: Ling in 5.a. 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

Fishing Year	MFRI Advice	National TAC	Landings
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	8028
2019/20	6 599	5299	7154
2020/21	5700	5700	7214
2021/22	4735	4735	
2022/23	6098		

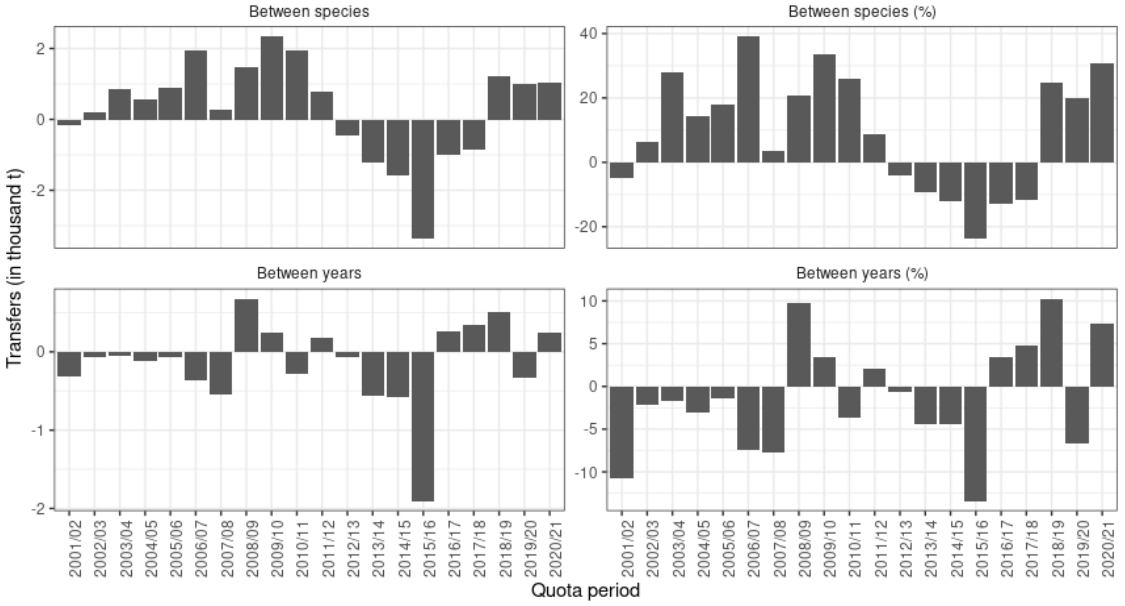

Figure 3.4.19: Ling in 5.a. Net transfer of quota in the Icelandic ITQ system by fishing year. Between species (upper): Positive values indicate a transfer of other species to ling, but negative values indicate a transfer of ling quota to other species. Between years (lower): Net transfer of quota for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

3.4.12 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 SAM 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. 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
2021	926	0	6110	91	0

Table 3.4.6. Ling in 5.a. Estimates of spawning–stock biomass (SSB) in thousands of tonnes, recruitment at age 2 (thousands), fishing mortality over ages 8 - 11 (Fbar) and catch from SAM.

Year	Recruitment			SSB			Total	F		
	Age 2	97.5%	2.5%		97.5%	2.5%	Catch	Ages 8-11	97.5%	2.5%
	thousands			tonnes			tonnes			
1979	2531	3505	1827	17538	22057	13946	5315	0.46	0.72	0.30
1980	2790	3618	2152	16669	20838	13335	4645	0.51	0.79	0.32
1981	3142	3951	2499	15276	19031	12263	4520	0.54	0.83	0.35
1982	3496	4350	2810	13958	17265	11284	4990	0.66	0.97	0.45

Year	Recruitment			SSB			Total	F		
1983	3734	4631	3010	12384	15160	10117	5123	0.77	1.03	0.57
1984	3654	4530	2947	10693	12996	8799	3880	0.65	0.85	0.51
1985	3379	4185	2728	10499	12563	8775	3450	0.55	0.70	0.43
1986	3458	4287	2789	10845	12717	9248	3596	0.51	0.64	0.40
1987	3753	4650	3029	12038	13911	10418	4974	0.60	0.75	0.48
1988	3655	4502	2967	12207	13964	10672	5846	0.67	0.82	0.55
1989	3344	4075	2744	11535	13159	10111	5547	0.65	0.79	0.54
1990	2959	3574	2449	11329	12937	9920	5560	0.66	0.79	0.55
1991	2699	3265	2231	9839	11185	8655	5780	0.70	0.83	0.58
1992	2813	3405	2324	9385	10390	8478	5086	0.65	0.79	0.54
1993	2967	3579	2459	9054	9807	8358	4046	0.55	0.65	0.45
1994	2711	3285	2237	11420	12245	10651	4115	0.51	0.59	0.44
1995	2535	3077	2088	11881	12728	11091	4015	0.57	0.66	0.49
1996	2513	3048	2072	11789	12622	11011	4125	0.58	0.66	0.51
1997	2642	3196	2183	10655	11435	9928	3906	0.54	0.63	0.47
1998	3128	3783	2586	10822	11651	10051	4394	0.58	0.66	0.50
1999	3795	4582	3144	10760	11590	9989	4625	0.64	0.73	0.56
2000	4490	5418	3721	10786	11638	9996	3284	0.45	0.52	0.39
2001	4876	5910	4023	11826	12739	10978	3362	0.44	0.50	0.39
2002	5994	7213	4981	13190	14203	12249	4519	0.51	0.58	0.44
2003	6935	8346	5762	15144	16318	14055	4270	0.46	0.53	0.40
2004	8032	9727	6633	17446	18755	16228	4606	0.46	0.53	0.41
2005	8829	10686	7294	20357	21849	18967	5198	0.45	0.51	0.40
2006	10077	12210	8316	23032	24644	21526	7405	0.54	0.61	0.47
2007	10139	12336	8334	27359	29239	25599	7591	0.49	0.56	0.44
2008	11005	13278	9121	29572	31640	27640	9283	0.52	0.59	0.46
2009	10697	12991	8808	32494	34765	30372	10945	0.56	0.63	0.49
2010	7201	8710	5953	31249	33514	29137	11131	0.55	0.62	0.48
2011	5024	6120	4125	24921	26865	23118	9626	0.46	0.53	0.40

Year	Recruitment			SSB			Total	F		
2012	3751	4629	3040	31376	33843	29089	11817	0.59	0.68	0.51
2013	4316	5381	3462	31302	33942	28867	11581	0.43	0.50	0.38
2014	3961	4955	3167	37169	40433	34169	14246	0.51	0.58	0.44
2015	3781	4785	2988	35300	38695	32203	13035	0.54	0.62	0.46
2016	4430	5735	3421	38903	43189	35042	9884	0.42	0.50	0.36
2017	3158	4190	2380	34432	38714	30624	8766	0.40	0.48	0.34
2018	2355	3298	1681	36224	41318	31759	8062	0.35	0.43	0.29
2019	2668	3929	1812	30387	35445	26050	8269	0.37	0.45	0.30
2020	2602	4187	1617	30032	36361	24804	7061	0.33	0.43	0.26
2021	2840	5073	1590	26688	33760	21097	7128	0.32	0.43	0.24
2022	2810	5507	1434	27405	36698	20464				

3.4.13 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.

3.4.14 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 is Area 4.a. There Norwegian longliners fished around Shetland and in the Norwegian Deep. There are little catches 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.

Catches from Norwegian vessels in subareas 4 and 6 dropped from 5854 tonnes in 2020 to 1276 tonnes in 2021 as a consequence of a reduction in their access to British waters.

When subareas 3–4 and 6–14 are summed over 1988–2020, 43% of the total landings were in Subarea 4, 30% in Subarea 6, and 23% in Subarea 7. In 2021, 54%, 37 % and 6% of the landings were from subareas 4, 6 and 7 respectively, as aconsequence of the continuous reduction of landings coming from 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).

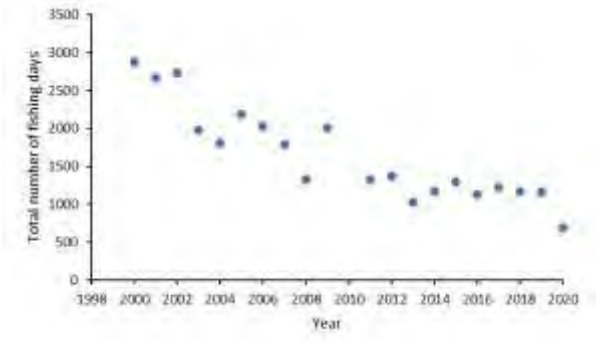

Figure 3.5.1. Total fishing days by the Norwegian longliners (20002020).

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 bulk of Spanish landings since 2012 are from Division 6.a. 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 1988–2021 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 landings have been stable and slightly increasing until 2019, a marked decreased occurred in the two last years, 2020 and 2021. 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 2021 is 12 482 t.

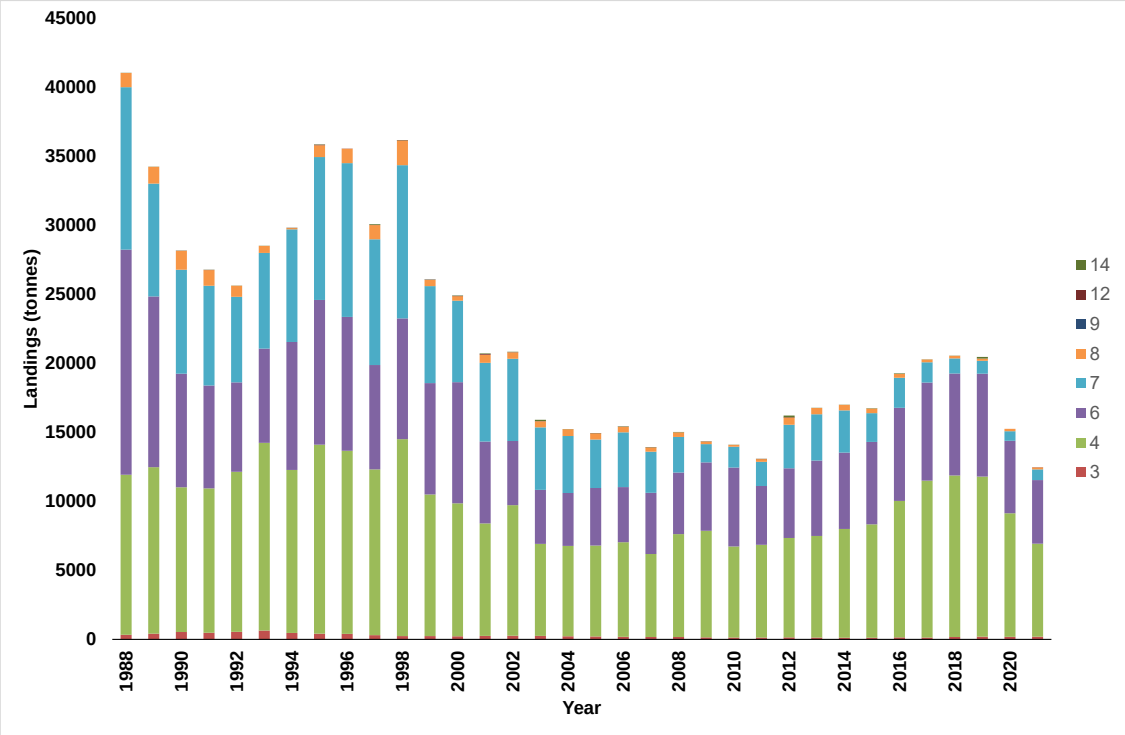

Figure 3.5.2. International landings of ling in subareas 3,4, 6–9, 12, and 14 from 1988 to 2021.

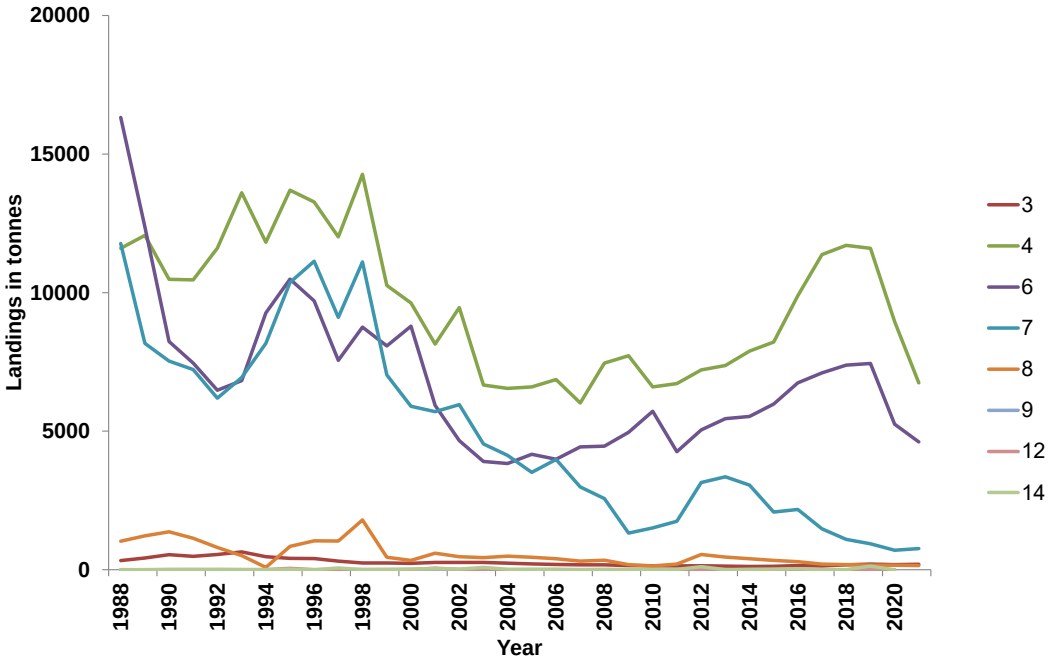

Figure 3.5.3. International landings of ling in subareas 3,4, 6–9, 12, and 14 from 1988 to 2021.

3.5.3 ICES Advice

Advice for 2022 to 2023: "ICES advises that when the precautionary approach is applied, catches should be no more than 15 092 tonnes in each of the years 2022 and 2023".

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

The Norwegian quota in EU waters decreases in 2021 and 2022 as a consequence of UK waters between separated from EU waters following the Brexit.

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)	2022
Division 3a	87 t	87	87	170	179	175	144
Subarea 4 (UK and EU waters)	2912 t	3494	3843	4035	4237	3813	3127
Subarea 4 (Norwegian waters)	950	1350	1350	1350	1350	900	700
Subarea 6, 7,8, 9 and 10, international waters of 12 and 14	16 997 t.	20 396	20 396	20 396	20 396	18356	15052

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 2021, 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 2021.

	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	15664	2.6

	Denmark	Spain	Ireland	France	Sweden	UK (Scotland)	UK (England)	Total discard	Total catches	%discard
2021	1	15	36	4	5	213	0	274	12541	2.18

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 $W=0.0055*TL^{3.0120}$.

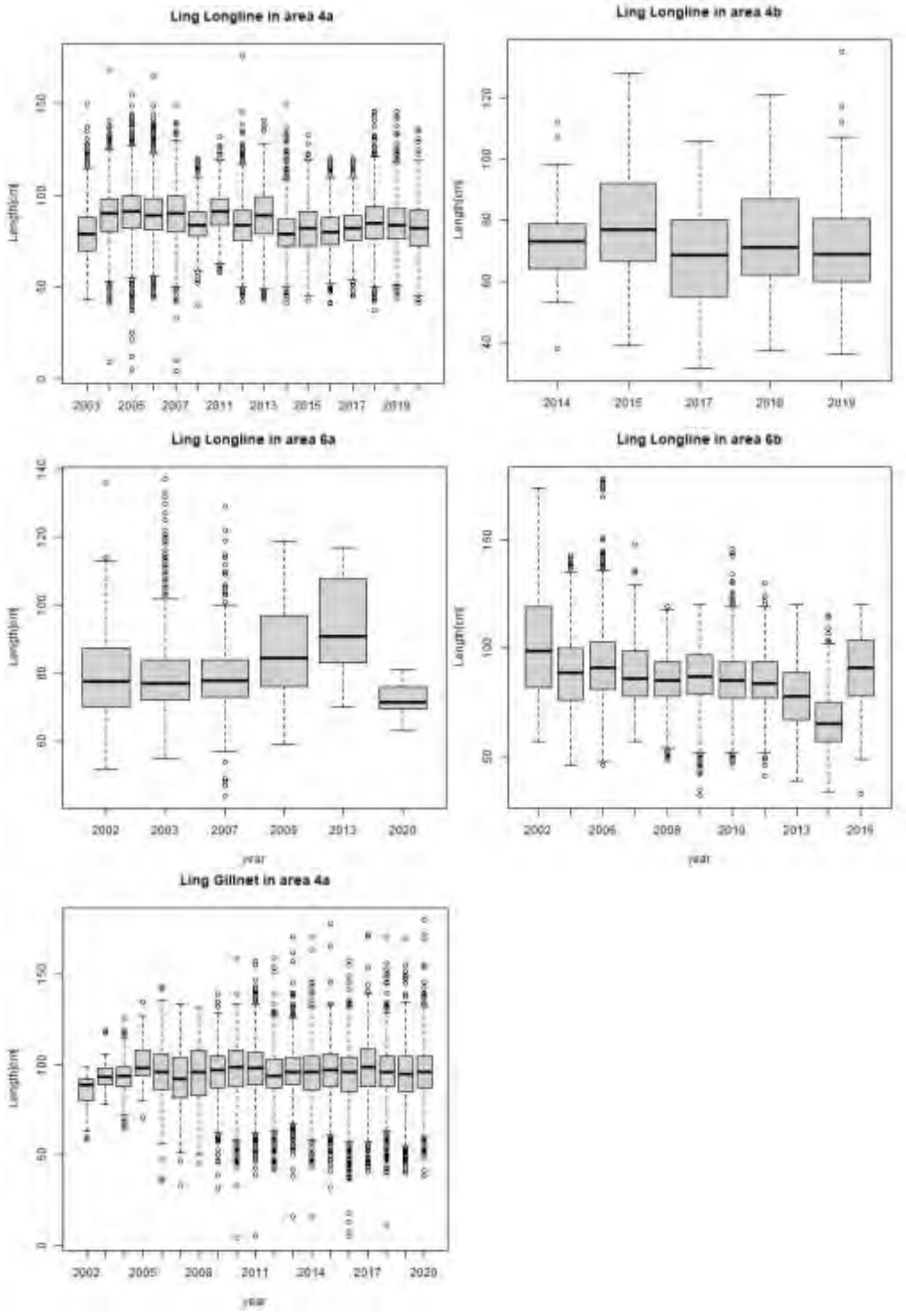

Figure 3.5.4. Time-series of mean length of ling caught by the Norwegian longline reference fleet in divisions 4.a, 4.b, 6.a and 6.b (note that some years are missing in some divisions).

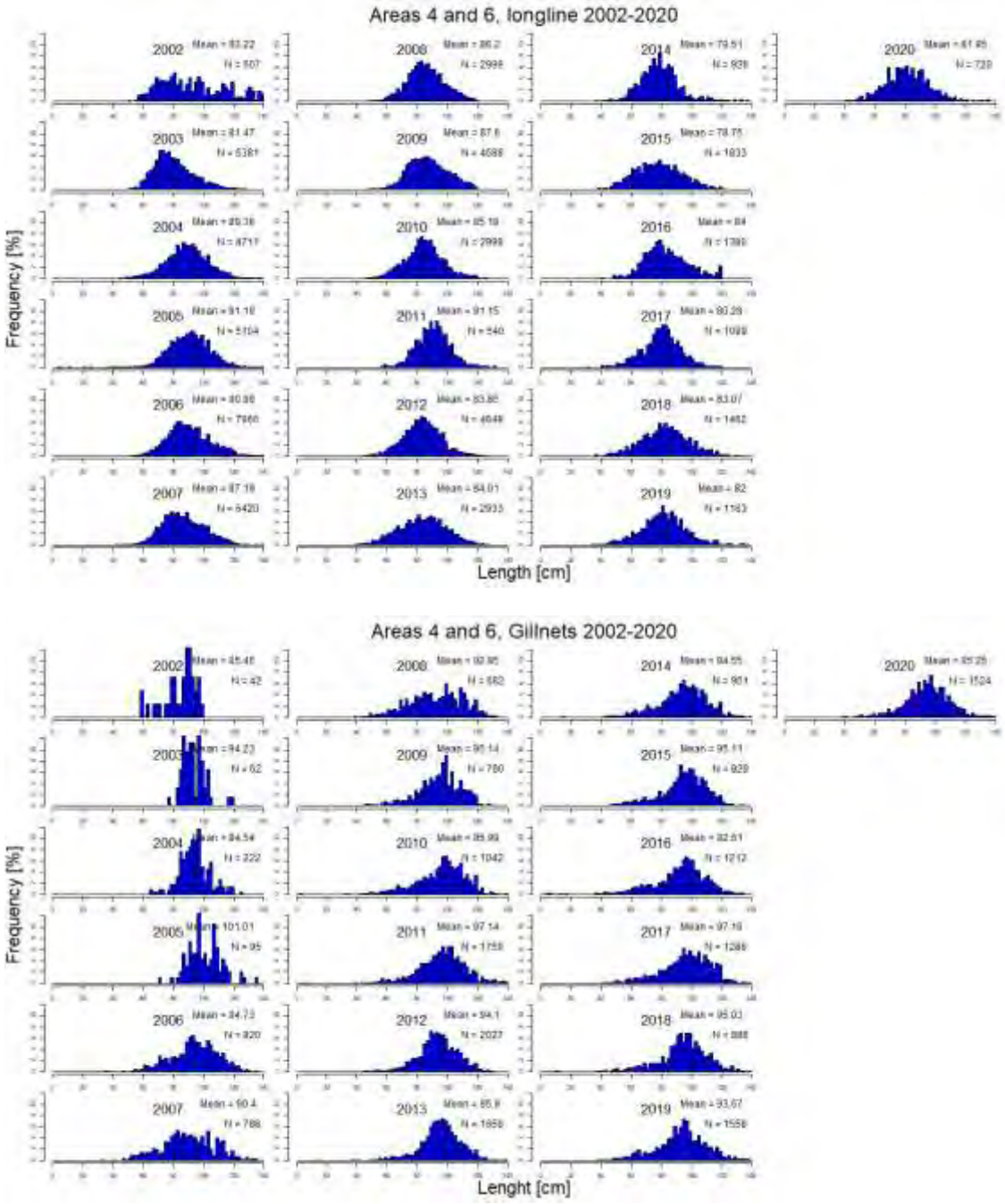

Figure 3.5.5. Length distributions of ling in Areas 3a, 4.a, 6.a and 6.b based on data from the Norwegian reference fleet.

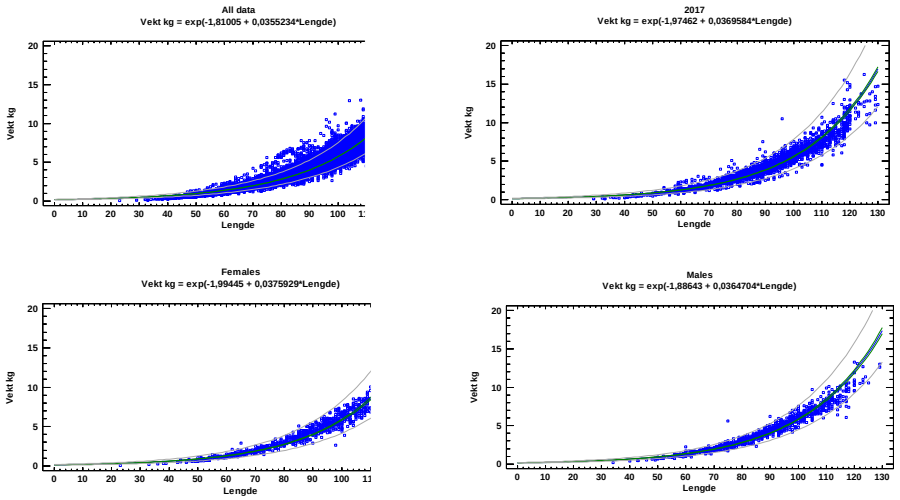

Figure 3.5.6. Weight as a function of length for ling based on all available Norwegian data.

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).

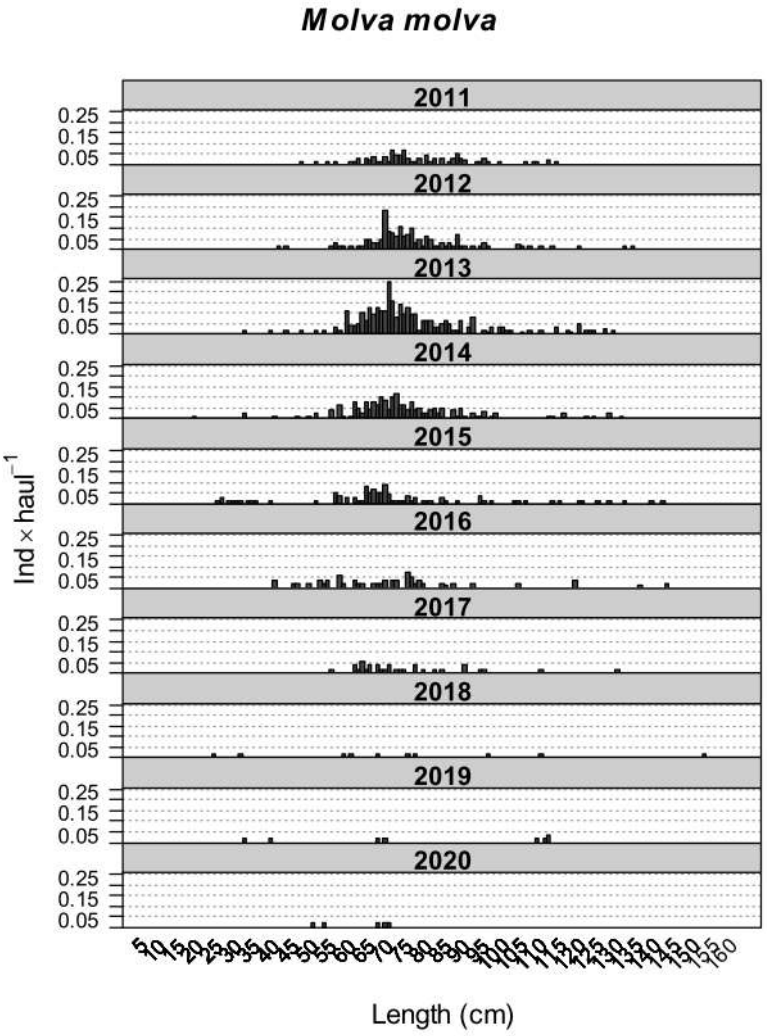

Figure 3.57. Estimated length distributions of ling (*M. molva*) based on the Porcupine Bank Spanish survey in the period 2011–2020.

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).

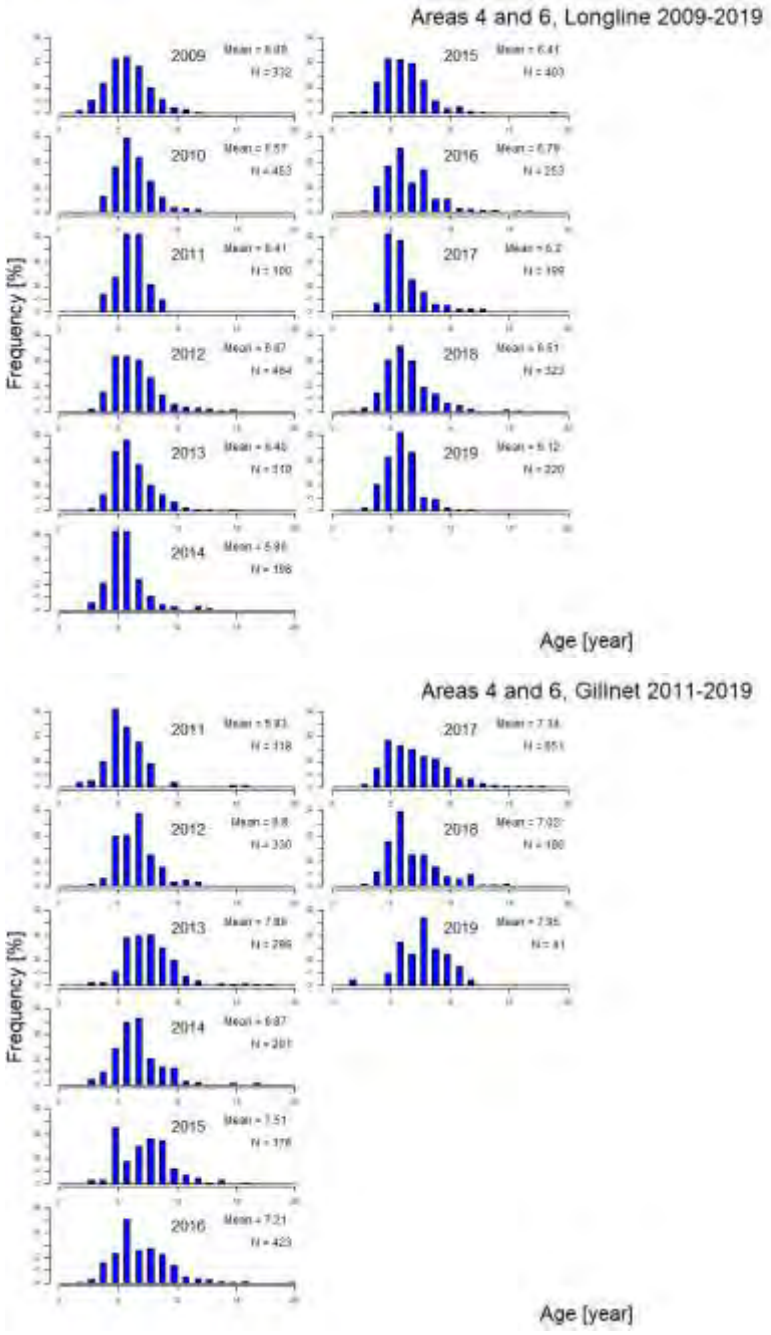

Figure 3.5.8. Age distributions for ling areas combined for all catches taken by longliners and by gillnetters.

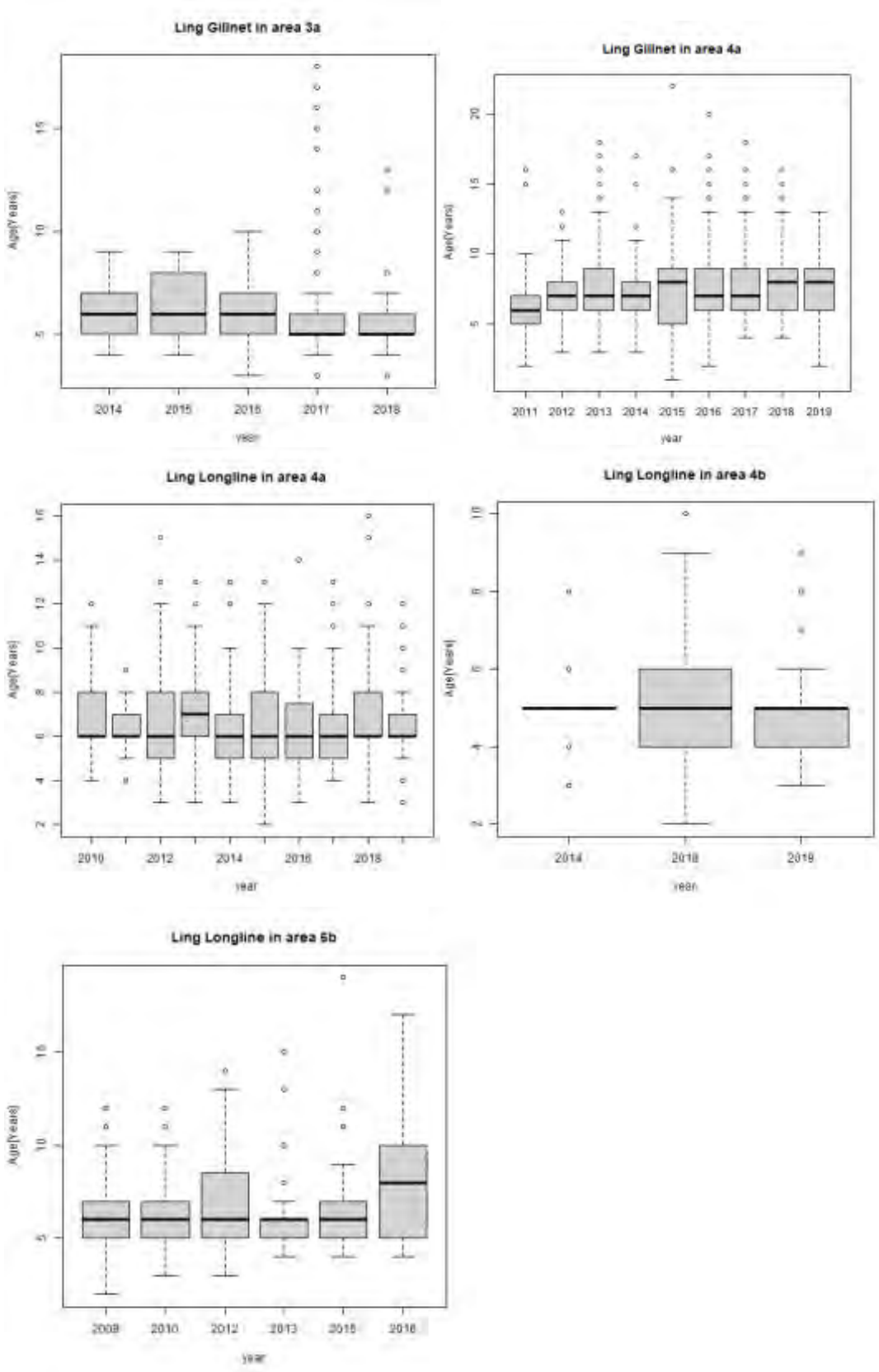

Figure 3.5.9. Average age of ling catches by longliners and gillnetters by area.

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).

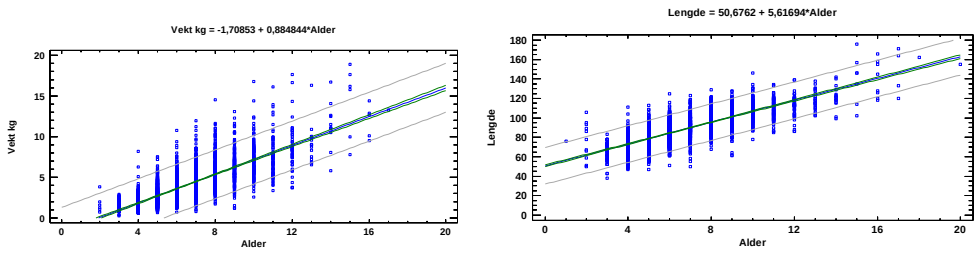

Figure 3.5.10. Weight versus age and length versus age for ling (combined data from 2009 to 2017) for divisions 4.a and 6.a based on the Norwegian longliner reference fleet.

3.5.5.5 Maturity and natural mortality

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).

See stock annex, no new data in 2021.

3.5.5.6 Growth

In 2021, 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 are compiled in the stock annex.

Table 3.5.7. Growth estimated of ling

L_∞	K	t_0	Sex	Area	Data from the stock area	Reference
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.

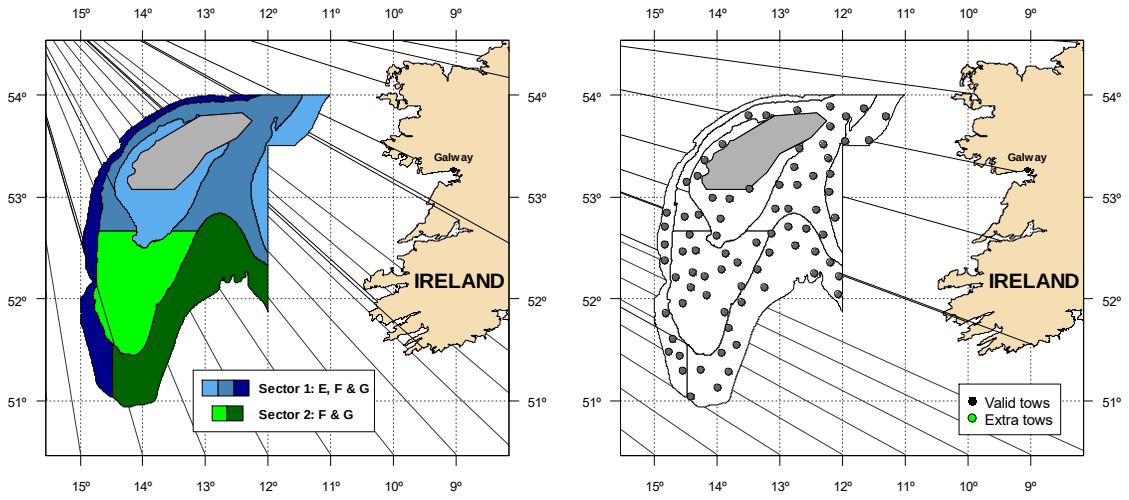

Figure 3.5.11. Left: Stratification design used in the Porcupine surveys starting in 2003: Previous years were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank denotes a large non-trawl able area. Right: distribution 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 until 2019 and has not been further updated.

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. As the Norwegian fleet had no access to UK waters in 2021, there is no data for Subarea 6 in 2021.

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 3.5.4). When all data for these areas are combined for longliners and for gill netters the average length is about 10 cm higher for gill netters than for longliners (Figure 3.5.4)

Ling smaller than 50 cm are not caught in significant number in Surveys. The length distributions of ling caught in surveys suggest a disappearance of large fish both on the Porcupine bank (Figure 3.5.7) and in the area covered by the EVHOE survey, divisions 7g-j and 8abd (Figure 3.5.12). 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 clear decline of ling in the survey area.

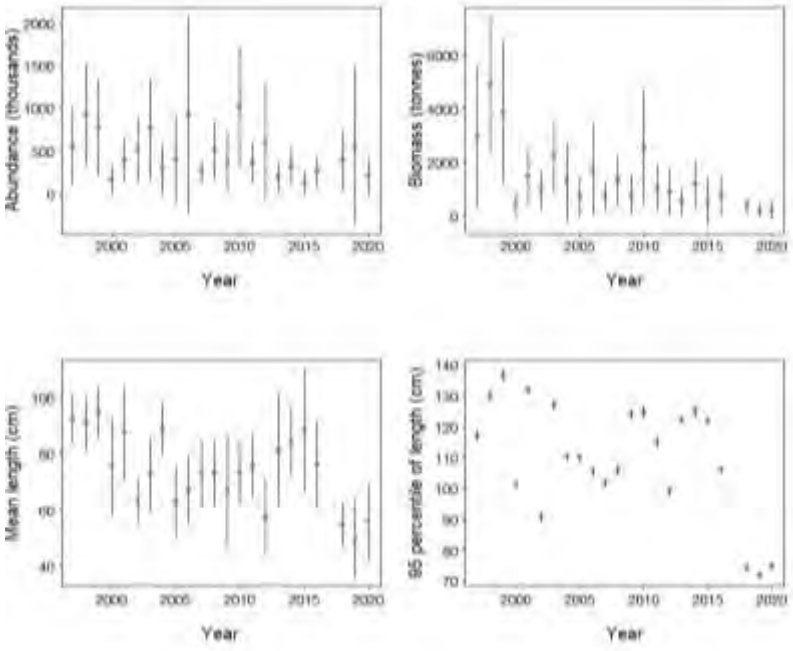

Figure 3.5.12. Population indices (swept area raised abundance and biomass, mean length and 95 percentile of the length distribution) of ling in the Bay and Biscay and Celtic Sea (ICES divisions 7.g,hjk and 8a,b,d) from the French EVHOE survey (W-IBTS-Q4), 1997–2020 (except 2017).

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.

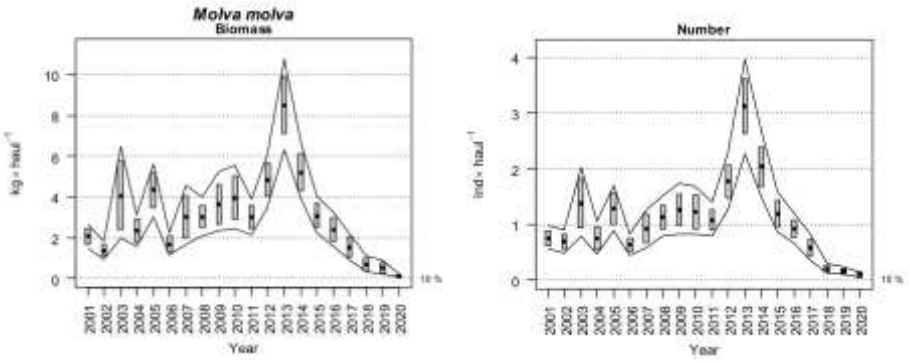

Figure 3.5.13. Estimated biomass and abundance indices based on the Porcupine Survey for the years 2001–2020. Boxes mark the parametric, based standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000).

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.

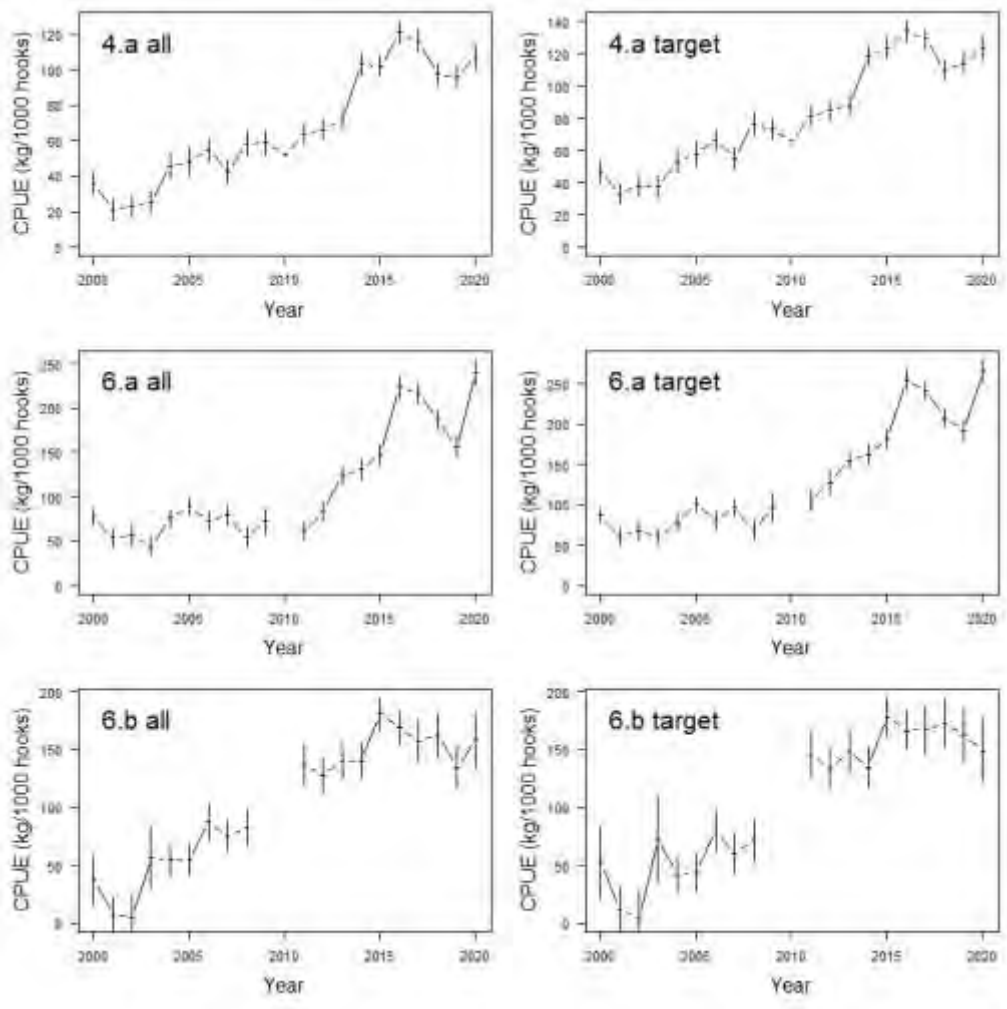

Figure 3.5.14. Cpue series for ling for the period 2000–2020 based on all available data and when ling was targeted. The bars denote the 95% confidence intervals.

The index used for advice on the stock is the combination of all data for the 3 divisions (4.a,6.a and 6.b). The index used since 2015 is the cpue when ling was targeted (Figure 3.5.15 right). Nevertheless, the time-series is similar when targeted fishing and all fishing for ling are considered (Figure 3.5.15).

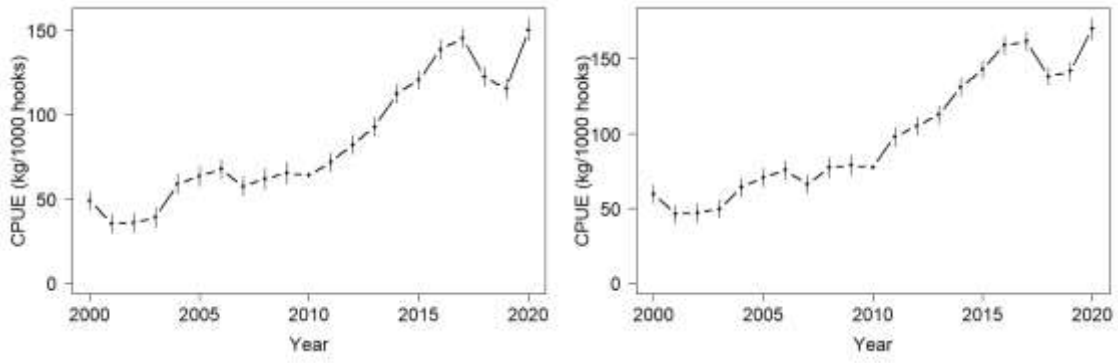

Figure 3.5.15. Cpue series for ling, areas 4a, 4b, 6a and 6b combined, for the period 2000–2020 for all data available (left) and for target fishing (right). The bars depict the 95% confidence intervals.

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

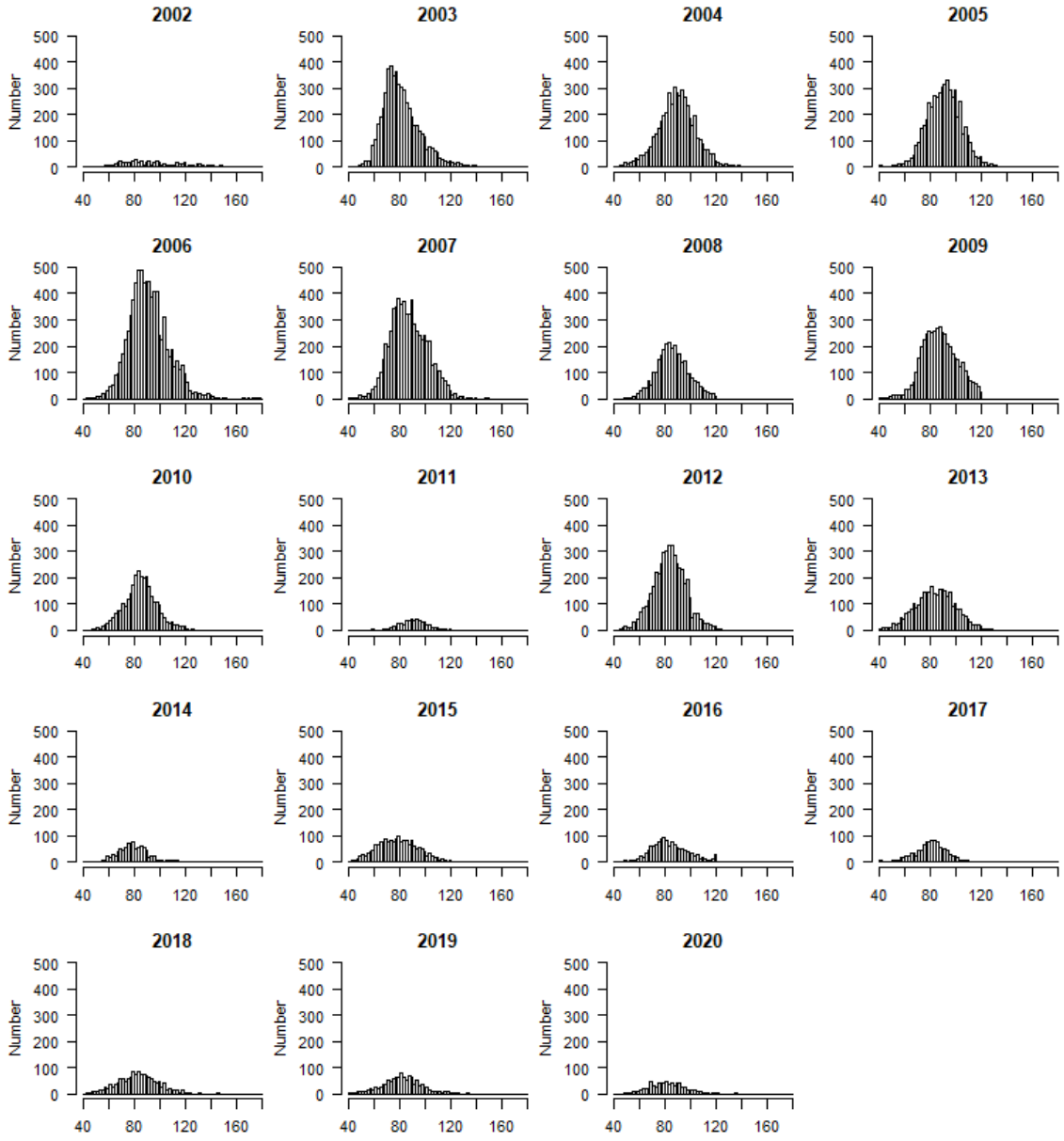

Figure 3.5.16 Ling in other areas (3.a, 4.a, 4.b, 6.a, 6.b, 7). Length composition of the catch from the Norwegian longliner fleet, for the period 2002–2020 by 2 cm length classes (sex combined).

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. 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. The Norwegian data do not include Subarea 7, were Norwegian vessels do not operate. 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 1990s to under 1000 tons in 2019. For other areas, the landings have been stable or increasing.

Overall, the length-based indicator, derived from the Norwegian longline fishery data, indicates that ling has probably been fished over possible MSY reference points, expect with the most optimistic combination of parameters (smaller L_∞ and higher k).

3.5.9 Management considerations

LBI estimated in 2020 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).

A 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
2021		144	0	42	14	0	0	200

***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
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**
2021*	0	604	0	896	117	8	1250	35	83	1	3516	**6510**

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**
2021*	0	27	0	8	16	2	0	0	4	**57**

***Preliminary.**

Table 3.5.1. (continued).

Ling 6.a.

Year	Bel-gium	Den-mark	Fa-roes	Franc e	Ger-many	Ire-land	Nor-way	Spain)	E& W	IO M	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**
2021 *	0	0	9	878	0	189	0	1007	3	0	0	2220	**4306**

***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**
2021*	2	6	0	76	0	4	3	3	241	0	**335**

***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**
2021*	0	0	0	0	0	5	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**
2021*	24	0	0	0	94	10	1	**129**

***Preliminary. .**

Table 3.5.1. (continued).

Ling 7.d, e.

Year	Belgium	Denmark	France	Ireland	E & W	Scotland	Ch. Islands	Netherlands	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**
2021*	0	0	49	0	46	0	0	1	0	**96**

***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**
2021*	0	17	0	14	0	**31**

***Preliminary.**

Table 3.5.1. (continued).

Ling 7.g–k.

Year	Belgium	Denmark	France	Germany	Ireland	Norway	Spain [(1)]	E&W	UK(N.I.)	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		44	51		2	**427**
2021*	0	0	133	0	268	0	51	51	1	1	**505**

***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**
2021*		133	18					**151**

Ling 9.

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

Year	Spain	Total
2005		
2006		
2007	1	**1**
2008		
2009		
2010		
2011		
2012(*)	1	**1**

(*) there was no reported landings after 2012

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**

Year	Faroes	France	Norway	E & W	Scotland	Germany	Ireland	Total
2018								**0**
2019								**0**
2020								
2021	0	0	11	0	0	0	0	**11**

Table 3.5.1. (continued).

Ling 14.

Year	Faroes	Germany	Iceland	Norway	E & W	Scotland	Russia	GREENLAND	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	183	8848	110	4563	687		5	154	85	33	427	162				15257
2021	200	6510	57	4306	335		5	129	96	31	505	151	0	11	0	12336

***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