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the Exploration of the Sea

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Section contents

6 Megrim and four-spot megrim in divisions 8.c and 9.a

Lepidorhombus whiffiagonis – meg.27.8c9a
(Cantabrian Sea and Atlantic Iberian waters)

Type of assessment in 2021

Update.

Data revisions this year

No revisions this year.

Lepidorhombus boscii – ldb.27.8c9a
(southern Bay of Biscay and Atlantic Iberian waters East)

Type of assessment in 2021

Update.

Data revisions this year

No revisions this year.

ADG issues for *L. boscii*

'Maybe the F-age ranges need to be revised'. This recommendation will be explored in the next benchmark in 2022.

6.1 General

See Stock Annex for general aspects related to megrim assessment.

6.1.1 Ecosystem aspects

See Stock Annex for ecosystem aspects related to megrim assessment.

6.1.2 Fishery description

See Stock Annex for fishery description.

6.2 Summary of ICES advice for 2021 and management for 2020 and 2021

6.2.1.1 ICES advice for 2021 (as extracted from ICES advice on fishing opportunities, catch and effort 2020):

The two megrim species (*L. whiffiagonis* and *L. boscii*) are not completely separated in the landings. A single TAC covers both species and species-specific landings are estimated by ICES (ICES, 2020). ICES considers that management of the two megrim species under a combined TAC prevents effective control of the single-species exploitation rates and could lead to overexploitation of either species. Therefore, the advice since 2016 is based on the single-species F_{MSY}.

A mixed-fisheries analysis covering the stocks in Iberian waters of hake, megrim, four-spot megrim, and white anglerfish is provided in ICES (ICES, 2020; ICES, 2021).

ICES advises that when the EU multiannual plan (MAP; European Parliament and Council Regulation (EU) No. 2019/472) for Western waters and adjacent waters is applied, catches in 2021 that correspond to the F ranges in the MAP are between 312 and 571 t for *L. whiffiagonis* and between 1148 and 2375 t for *L. boscii*. According to the MAP, catches higher than those corresponding to F_{MSY} /468 t for *L. whiffiagonis* and 1690 t for *L. boscii*) can only be taken under conditions specified in the MAP, while the entire range is considered precautionary when applying the ICES advice rule.

6.2.1.2 Management applicable for 2020 and 2021:

The agreed combined TAC for megrim and four-spot megrim in ICES divisions 8.c and 9.a was 2322 t in 2020 and 2158 t in 2021.

6.2.2 References

ICES. 2020. ICES Fisheries Overviews. Bay of Biscay and Iberian Coast ecoregion. ICES Advice 2020. https://doi.org/10.17895/ices.advice.7604.

ICES. 2021. Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE; outputs from 2020 meeting). ICES Scientific Reports. 3:28. 204 pp. https://doi.org/10.17895/ices.pub.7975.

6.3 Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a

6.3.1 General

See general section for both species.

6.3.2 Data

6.3.2.1 Commercial catches and discards

The Working Group estimates of landings, discards, and catches for the period 1986 to 2020 are given in Table 6.3.1. The sampling programs coordinated by the Spanish Institute of Oceanography-IEO (onshore, observers at-sea and biological sampling) were partially suspended in 2020 due to administrative problems and to the COVID-19 disruption. This affected all stocks. From 2011 to 2018, estimates of unallocated or non-reported landings were included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier. These estimates are considered the best information available at this

time. In 2015, data revised for the period 2011–2013 were provided. This revision produced an improvement in the allocation of sampling trips and the revised data are used in the assessment. The total estimated international landings in divisions 8.c and 9.a for 2020 were 315 t. Landings reached a peak of 977 t in 1990, followed by a steady decline until 2002. Some increase in landings has been observed since then, but landings have again decreased annually from 2007 until 2010 to 83 t, the lowest value of the entire time-series. Since 2011, the stock increased again and has then remained stable. Historical landings for both species combined are shown in Figure 6.1.1. The last period shows a decreasing trend since 2014 and in 2020, the international landings were 1026 t.

Discards estimates were available from the Spanish "observers' onboard sampling programme" for the years displayed in Table 6.3.2(a). In 2020, discards data of the first semester were missing for the reasons previously mentioned and were estimated based on the discard per unit of effort of the second semester applied to the exerted effort in the first semester. Discards in number represent between 10–47% of the total catch, with the exception of the years 2007 and 2020 when discards were very low and in 2011 when the value observed was extremely high. Following the recommendations, during the WKSOUTH benchmark in 2014 (ICES, 2014), an effort was made to complete the time-series back until 1986 in years without samplings. Total discards, given in tonnes (Table 6.3.1) and numbers-at-age (Table 6.3.2b), were included in the assessment model.

6.3.2.2 Biological sampling

Annual length compositions of total stock landings are provided in Figure 6.3.2 for the whole period and in Table 6.3.3a for 2020. Due to the lack of samplings in 2020, some length distributions in some quarters were missing. The existing ones were raised to the total catch of the métier. Unallocated/non-reported value was included in the raising of total length distribution in previous years. The bulk of sampled specimens corresponds to individuals of 20–35 cm.

Sampling levels for both species are given in Table 1.4.

Mean lengths and mean weights in landings since 1990 are shown in Table 6.3.3b. The mean length and mean weight values observed in 2013 were the highest in the historic series.

Age compositions of catches are presented in Table 6.3.4 and weights-at-age of catches in Table 6.3.5, from 1986 to 2020. These values were also used as the weights-at-age in the stock.

More biological information, the parameters used in the length-weight relationship, natural mortality and maturity ogive are provided in the Stock Annex.

6.3.2.3 Abundance indices from surveys

Two Portuguese (PtGFS-WIBTS-Q4 (G8899), also called "October" survey, and PT-CTS (UWTV (FU 28–29)), also called "Crustacean" survey) and one Spanish (SP-NSGFS-Q4 (G2784)) survey indices are summarized in Table 6.3.6. In 2012, 2019 and 2020, Portuguese surveys were not conducted.

As noted in the Stock Annex, indices from these Portuguese surveys are not considered representative of the megrim abundance due to the very low catch rates.

The Spanish survey (SP-NSGFS-Q4, G2784) covers the distribution area and depth strata of this species in Spanish waters 8c and 9a. Total biomass and abundance indices from this survey were higher during the period 1988 to 1990, subsequently declining to lower mean levels, which were common throughout the rest of the time-series. There has been an overall declining trend in the abundance index after year 2000, with the values for 2008 and 2009 being the two lowest in the entire series. Since then, there is a general increasing trend with the highest value in 2019 (Figure 6.3.3a, bottom right panel). In 2013, the survey was carried out in a new vessel. This year the abundance indices were high for flatfish and benthic species. Although there was an inter-

calibration exercise performed between both vessels, the results were not consistent with the results of the inter-calibration. Therefore, the WG decided not to include the abundance index value for that year in the assessment model. Since 2014, the gear used was similar to the gear used in the survey before 2013. A new inter-calibration exercise was conducted in 2014 and the index was considered suitable for inclusion in the assessment.

The Spanish survey recruitment index for age 1 (Recruitment age) indicates an extremely weak year-class in 1994, which improved in the following years. From 2000 to 2014, low values of year-classes were observed except in 2010. However, since 2015, there was a considerable increase in age 1 with the highest value of the time-series in 2016. In 2020, the value was within this last period trend (Figure 6.3.3b and Table 6.3.7).

Catch numbers-at-age per unit effort and effort values for the Spanish survey are given in Table 6.3.7. In addition, Figure 6.3.3b displays a bubble plot of log (survey abundance-at-age), with the values for each age standardized by subtracting the mean and dividing by the standard deviation over the years. The size of the bubbles is related to the magnitude of the standardized value, with grey and black bubbles corresponding to positive and negative values, respectively. The figure indicates that the survey is quite good at tracking cohorts through time and highlights the weakness of the last few cohorts.

6.3.2.4   Commercial catch-effort data

The commercial LPUE and effort data of the Portuguese trawlers fishing in Division 9a covers the period 1988–2020 (Table 6.3.8 and Figure 6.3.3a).

It is known that the Northern Spanish coastal bottom otter trawl fleet is a fleet deploying a variety of fishing strategies with different target species. In fact, these fishing strategies are identified under the current Data Collection Framework (DCF; Commission Regulation (EC) No 1639/2001, Council Regulation (EC) No 199/2008) sampling programme, such that they can be then re-aggregated under two DCF métiers: bottom otter trawl targeting demersal species (OTB_DEF_>=55_0_0) and bottom otter trawl targeting pelagic stocks accompanied by some demersal species (OTB_MPD_>55_0_0). Therefore, the LPUE of these métiers was estimated backwards until 1986 and two new time-series of bottom otter trawl targeting demersal species, one per port (A Coruña and Avilés), were provided to the WKSOUTH benchmark in 2014 (ICES, 2014). These tuning fleets (SP-LCGOTBDEF and SP-AVSOTBDEF) were accepted to tune the assessment model instead of the old ones based on A Coruña (SP-CORUTR8c) and Avilés (SP-AVILESTR) trawls. The LPUEs and effort values are given in Table 6.3.8 and Figure 6.3.3a.

Commercial fleets used in the assessment to tune the model

Both Spanish commercial fleets could not be updated because of the problems in samplings that were mentioned in section 6.3.2.1. Before 2003, A Coruña (SP-LCGOTBDEF) effort was generally stable. After that year, the trend was similar but in lower values. The 2011 effort value is the lowest in the series. In 2014, effort reached its highest value and in 2019 decreased again. The LPUE shows a general faintly increasing trend. The 2019 value represented an increase, being the highest value of the time-series.

Avilés (SP-AVSOTBDEF) effort presents a slightly decreasing trend throughout the whole period. The highest value occurred in 1998 and the lowest in 2001. LPUE shows a decreasing trend from 1986 to 2003. Since then, up and down fluctuations were observed, with a peak in 2011.

Landed numbers-at-age per unit effort and effort data for these fleets are given in Table 6.3.7.

Figure 6.3.3c displays bubble plots of standardized log (landed numbers-at-age per unit effort) values for these commercial fleets, with the standardization performed by subtracting the mean and dividing by the standard deviation over the years. The panel corresponding to A Coruña

trawl fleet clearly indicates below-average values from year 2003 to 2010, but since then values above average are frequent. Avilés fleet shows a decreasing trend.

Commercial fleets not used in the assessment to tune the model

Portuguese effort values are quite variable, with a slightly decreasing trend, being the last years the lowest ones in the time-series (Table 6.3.8 and Figure 6.3.3a). The Portuguese LPUE series was revised from 2012 onwards. Further refinement of the algorithms is required to revise the series backwards. The LPUE shows a steep decrease between 1990 and 1992 and has since then remained at low levels, except for a peak in 1997–1998. LPUE for recent years shows an increasing trend.

6.3.3 Assessment

An update assessment was conducted, according to the Stock Annex specifications. Assessment years are 1986–2020 and ages 1–7+.

6.3.3.1 Input data

Following the Stock Annex, discards and landed numbers-at-age were incorporated resulting in catch numbers-at-age as input data from 1986 to 2020 and the year 2020 was added to the index of Spanish survey (G2784). A Coruña (SP-LCGOTBDEF) and Avilés (SP-AVSOTBDEF) tuning fleets were used without the 2020 data..

6.3.3.2 Model

Data screening

Figure 6.3.4a shows catch proportions-at-age where larger proportions can be observed for ages 1 to 3. The top panel of Figure 6.3.4b shows landings proportions at age, indicating that the bulk of the landings consisted of ages 1 and 2 before 1994 then shifted mostly to ages 2 to 4 since the mid-1990s. The bottom panel of the same figure displays standardized (subtracting the mean and dividing by the standard deviation over the years) proportions at age, indicating the same change around the mid 1990's, with proportions-at-age decreasing for ages 1 and 2 and increasing for the older ages. Some weak and strong cohorts can be observed in this figure, particularly around the mid 1990s. In 2010, an increase in landings of older ages, especially ages 5 to 7+ was observed. In the last period, the high abundance of age 1 in the Spanish survey in 2010 can be tracked in the following years. Figure 6.3.4c shows discards proportions-at-age, being more abundant for age 1 from 2000 onwards. Before this year, discarding was higher in age 2. Visual inspection of Figures 6.3.3b and 6.3.3c indicates that all tuning series are good up to age 5 in relation to their internal consistency. Age 6 is harder to track along cohorts, particularly for the Spanish survey and the A Coruña tuning fleet.

Final run

XSA model (Extended Survivor Analysis; Shepherd, 1999) was selected for use in this assessment. Model description and settings are detailed in the Stock Annex.

The retrospective analysis shows a small but consistent pattern of overestimation of SSB and underestimation of F in recent years (Figure 6.3.5).

6.3.3.3 Assessment results

Diagnostics from the XSA run are presented in Table 6.3.9 and log-catchability residuals plotted in Figure 6.3.6. Residuals in A Coruña tuning fleet in the last years present mainly positive

values. No pattern was found in the survey residuals. Several year effects are apparent in all tuning series.

Fishing mortality and population numbers-at-age from the final XSA run are given in Tables 6.3.10 and 6.3.11, respectively. The summary results are presented in Table 6.3.12 and Figure 6.3.7a.

Fishing mortality decreases in the last year. Catches show a small increase and the value is around the last 10 years average. The SSB values in 2007–2010 were the lowest in the series. Since 2011, values were significantly higher and there is an increasing trend especially in the most recent years. Since the high recruitment value (at age 1) in 2015, similar values were observed.

Bubble plots of standardized estimated F-at-age (by subtracting the mean and dividing by the standard deviation over the years) and relative F-at-age (F-at-age divided by F_{bar}) are presented in Figure 6.3.7b. The top panel of the figure indicates that fishing mortality has been lower for all ages in 2000 until 2011, afterwards slightly increasing again. However, since 2017, a decrease in F in all ages was observed. In terms of the relative exploitation pattern-at-age (bottom panel of the figure), the most obvious changes are the reduction of ages 1 and 2 around 1994 and the increase of age 3 soon after that. This might be related to the discarding practices. There is no clear pattern over time in the age 4 selection, whereas for ages 5 and older, there seems to be an increase during the mid to late 1990s, which dropped down to lower values afterwards. Since 2010, there appears to have been an increase of the relative exploitation towards older ages, with high values above the average for ages 5 to 7+ for some years.

6.3.3.4   Year-class strength and recruitment estimations

The 2017 year-class is estimated to have 8.5 million fish at 1 year of age, based on the Spanish survey (SP-NSGFS- Q4, G2784) (96% of the weight and F shrinkage (4%).

The 2018 year-class is estimated to have 8.1 million individuals at 1 year of age based on the information from the Spanish survey (G2784) (72% of weight), P-shrinkage (25% of the weight) and F-shrinkage (4%).

The 2019 year-class is estimated to have 7.4 million fish at 1 year of age, based on the information from the Spanish survey (G2784) (65% of weight), P-shrinkage (29% of the weight) and F-shrinkage (6%).

The working group considered that the XSA last year recruitment value was well estimated. The signal from the survey index is in accordance with the estimated value and age 1 is well represented in the catch data. Working Group estimates of year-class strength used for prediction can be summarized as follows:

Recruitment-at-age 1:

Year-class	Thousands	Basis	Surveys	Commercial	Shrinkage
2017	8530	XSA	96%	0%	4%
2018	8120	XSA	72%	25%	4%
2019	7390	XSA)	65%	29%	6%
2020	3633	GM (98-18)			

6.3.3.5   Historic trends in biomass, fishing mortality, and recruitment

From Table 6.3.12 and Figure 6.3.7a, we see that SSB decreased from 2449 t in 1990 to 950 t in 1995. From 1996 to 2000, it remained relatively stable at low levels with an average value close to 1200 t. Starting from 2001, SSB is estimated to have decreased further. The values for 2001–2010 are the lowest in the series, with SSB in 2008 (616 t) corresponding to the lowest value. Since 2011, SSB values are significantly increasing, being the 2020 value (2498 t), the highest of the recent years.

After a decline from 2006 (0.43) to 2010 (0.08), F showed an increasing trend reaching 0.49 in 2015. In the most recent years, F presents lower values, with 0.12 in 2020.

Recruitment (at age 1) varies substantially throughout the time-series, but shows a general decline from the high levels seen until the 1992 year-class. Since 1998, recruitment has been continuously at low levels (recruitment in 2009 was estimated as the lowest value of the series). In 2010, good recruitment occurred, with a value more similar to those estimated for the previous decade. However, from 2011 to 2014, the values of recruitments decreased again. In the last years, recruitment seems to be very high, with values similar to those of the mid-1990s.

6.3.3.6   Catch options and prognosis

Stock projections were calculated with the settings specified in the Stock Annex.

6.3.3.7   Short-term projections

Short-term projections have been made using MFDP (Multi Fleet Deterministic Projection; Smith, 2000).

The input data for deterministic short-term predictions are shown in Table 6.3.13. Average F_{bar} for the last three years is assumed for the interim year. The exploitation pattern is the scaled F-at-age computed for each of the last five years and then the average of these scaled five years was weighted to the final year. This selection pattern was split into selection-at-age of landings and discards (corresponding to $F_{bar} = 0.175$ for landings and $F_{bar} = 0.024$ for discards, being 0.20 for catches).

According to the Stock Annex, geometric mean (GM) recruitment is computed over years 1998-final assessment year minus 2.

Management options for catch prediction are in Table 6.3.14. Figure 6.3.8 shows the short-term forecast summary. The detailed output by age-group is given in Table 6.3.15 for landings and discards.

Under *status quo* F, landings in 2021 and 2022 are predicted to be 542 and 554 t respectively, and discards 27 and 19 t, respectively. SSB would decrease from the 2782 t estimated for 2021 to 2661 t in 2022 and 2425 t in 2023.

The contributions of recent year-classes to the predicted landings in 2021 and SSB in 2022, assuming GM_{98-18} recruitment, are presented in Table 6.3.16. The assumed GM_{98-18} age 1 recruitment for the 2020 and 2021 year-classes contributes with 6% to landings in 2022 and 19% to the predicted SSB at the beginning of 2023. Megrim starts to contribute strongly to SSB at 2 years of age (see maturity ogive in Table 6.3.13).

6.3.3.8   Yield and biomass per recruit analysis

The results of the yield- and SSB-per-recruit analyses are in Table 6.3.17 (see also left panel of Figure 6.3.8, which plots yield-per-recruit and SSB-per-recruit vs. F_{bar}). Assuming s*tatus quo* exploitation $F_{bar} = 0.175$ for landings and $F_{bar} = 0.024$ for discards and GM_{98-19} for recruitment, the equilibrium yield would be 272 t of landings and 15 t of discards with an SSB of 1383 t.

6.3.4 Biological reference points

The stock-recruitment time-series is plotted in Figure 6.3.9. See Stock Annex for information about biological reference points. The BRP are:

	Type	Value	Technical basis
MSY Approach	MSY $B_{trigger}$	980 t	B_{pa}
	F_{MSY}	0.191	
	F_{MSY} lower	0.122	based on 5% reduction in yield
	F_{MSY} upper (with advice rule)	0.29	based on 5% reduction in yield
	F_{MSY} upper (without advice rule)	0.24	based on 5% reduction in yield
	$F_{P.05}$	0.40	5% risk to B_{lim} with $B_{trigger}$.
Precautionary Approach	B_{lim}	700 t	B_{loss} estimated in 2015
	B_{pa}	980 t	1.4 B_{lim}
	F_{lim}	0.45	Based on segmented regression simulation of recruitment with B_{lim} as the breakpoint and no error
	F_{pa}	0.40	$F_{pa} = F_{P0.5}$

6.3.5 Comments on the assessment

The behaviour of commercial fleets with regards to landings of age 1 individuals appears to have changed in time. Hence, data from commercial fleets used for tuning are only taken for ages 3 and older, as set in the Stock Annex. However, the Spanish survey (SP-NSGFS-Q4 (G2784)) provides good information on age 1 abundance.

Megrim starts to contribute strongly to SSB at 2 years of age. Around 20% of the predicted SSB in 2023 relies on year-classes for which recruitment has been assumed to be GM_{98-18}.

6.3.5.1 Sensitivity analysis

Some missing data in 2020 had to be estimated due to the data issues in 2020 resulting from the impact of COVID-19 in the data collection from the commercial fishery and research surveys. In the case of discards, the first semester data are missing and were estimated based on the discard per unit of effort of the second semester applied to the exerted effort in the first semester. This estimation showed values that appear to be low. In order to check the impact of a possible underestimation of discards in the assessment and advice, a sensitivity analysis has been carried out. For that, a re-estimation of discards using the average of the last three years proportions of discards at age was done and the estimated values are shown in the next table:

	Landings (tonnes)	Discards (tonnes)	Catch (tonnes)
Duplicate	315	5	320
Average	315	52	366

The assessment and forecast were carried out again with the new discards by age and the impact on the results was negligible. A comparison between both assessments and forecasts are shown in the figure and table below, respectively.

Recruits (Age 1)

SSB

F (2-4)

WGBIE 2021

Biomass	SSB	Catch FMult	FBar	Yield	Discards FBar	Yield
2927	2782	1	0.1747	542	0.0243	27

Sensitivity_analysis 2021

Biomass	SSB	Catch FMult	FBar	Yield	Discards FBar	Yield
2921	2775	1	0.1777	545	0.0315	35

WGBIE

2022 Biomass	SSB	Catch FMult	Landings FBar	Yield	Discards FBar	Yield	2023 Biomass	SSB
2780	2661	0	0.0000	0	0.0000	0	3218	3099
.	2661	0.1	0.0175	63	0.0024	2	3142	3022
.	2661	0.2	0.0349	123	0.0049	4	3068	2948
.	2661	0.3	0.0524	183	0.0073	6	2996	2876
.	2661	0.4	0.0699	240	0.0097	8	2926	2806
.	2661	0.5	0.0874	296	0.0122	10	2857	2738
.	2661	0.6	0.1048	351	0.0146	12	2791	2672
.	2661	0.7	0.1223	404	0.0170	13	2726	2607
.	2661	0.8	0.1398	455	0.0195	15	2664	2545
.	2661	0.9	0.1573	506	0.0219	17	2603	2484
.	2661	1	0.1747	554	0.0243	19	2543	2425
.	2661	1.1	0.1922	602	0.0268	21	2485	2367
.	2661	1.2	0.2097	648	0.0292	22	2429	2311
.	2661	1.3	0.2272	693	0.0316	24	2375	2256
.	2661	1.4	0.2446	737	0.0341	26	2321	2203
.	2661	1.5	0.2621	779	0.0365	27	2270	2152
.	2661	1.6	0.2796	821	0.0389	29	2219	2101
.	2661	1.7	0.2970	861	0.0414	31	2170	2053
.	2661	1.8	0.3145	900	0.0438	32	2123	2005
.	2661	1.9	0.3320	939	0.0462	34	2076	1959
.	2661	2	0.3495	976	0.0487	35	2031	1914

Input units are thousands and kg - output in tonnes

Sensitivity_analysis

2022 Biomass	SSB	Catch FMult	Landings FBar	Yield	Discards FBar	Yield	2023 Biomass	SSB
2777	2660	0	0.0000	0	0.0000	0	3216	3097
.	2660	0.1	0.0178	63	0.0032	3	3138	3020
.	2660	0.2	0.0355	124	0.0063	5	3063	2945
.	2660	0.3	0.0533	183	0.0095	7	2990	2872
.	2660	0.4	0.0711	241	0.0126	10	2919	2801
.	2660	0.5	0.0889	297	0.0158	12	2850	2732
.	2660	0.6	0.1066	351	0.0189	14	2783	2665
.	2660	0.7	0.1244	405	0.0221	17	2717	2600
.	2660	0.8	0.1422	456	0.0252	19	2653	2536
.	2660	0.9	0.1599	507	0.0284	21	2592	2474
.	2660	1	0.1777	555	0.0315	23	2531	2414
.	2660	1.1	0.1955	603	0.0347	26	2473	2356
.	2660	1.2	0.2132	649	0.0378	28	2416	2299
.	2660	1.3	0.2310	695	0.0410	30	2360	2243
.	2660	1.4	0.2488	738	0.0441	32	2306	2190
.	2660	1.5	0.2666	781	0.0473	34	2254	2137
.	2660	1.6	0.2843	823	0.0505	36	2202	2086
.	2660	1.7	0.3021	863	0.0536	38	2153	2037
.	2660	1.8	0.3199	903	0.0568	40	2104	1988
.	2660	1.9	0.3376	941	0.0599	42	2057	1941
.	2660	2	0.3554	978	0.0631	44	2011	1896

Input units are thousands and kg - output in tonnes

6.3.6   Management considerations

It should be taken into account that megrim, *L. whiffiagonis*, is caught in mixed fisheries. There is a common TAC for both megrim species (*L. whiffiagonis* and *L. boscii*), so the status of both stocks should be taken into consideration when formulating management advice. Megrims are bycatch in mixed fisheries generally directed to white fish. Therefore, fishing mortality of megrims could be influenced by restrictions imposed on demersal mixed fisheries, aimed at preserving and re-building the overexploited stocks of southern hake and *Nephrops*.

This is a small stock (average stock SSB since 1986 is 1258 t). Managing according to a very low F for megrim could cause serious difficulties for the exploitation of other stocks in the mixed fishery (choke species effect). Both Iberian megrim stocks are assessed separately but managed together, a situation that may produce inconsistencies when these stocks are considered in a mixed fisheries approach. This effect was observed in the results of the mixed fisheries analysis developed for Iberian stocks by the WGMIXFISH-ADVICE (ICES, 2021). Of course, any F to be applied for the management of megrim must conform with the precautionary approach.

The WG considered that this stock could be just "the tail" of the much larger stock of megrim in ICES Subarea 7 and divisions 8.a, 8.b, and 8.d and suggested reconsidering the stock limits and the inclusion in the Northern megrim stock. This option was studied during the Stock Identification Methods Working Group (SIMWG) in 2015 and the conclusion was that SIMWG did not find strong evidence to support combining the northern and southern stock areas and recommends that the current stock definition stands until more studies are developed (ICES, 2015).

6.3.7   References

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6.3.8   Tables and Figures

Table. 6.3.1. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Landings, discards and catch in tonnes.

Year	Spain landings 8c	Spain landings 9a*	Spain landings Total	Portugal landings 9a	Unallocated	Total landings	Discards	Total catch
1986	508	98	606	53		659	46	705
1987	404	46	450	47		497	40	537
1988	657	59	716	101		817	42	859
1989	533	45	578	136		714	47	761
1990	841	25	866	111		977	45	1022
1991	494	16	510	104		614	41	655
1992	474	5	479	37		516	42	558
1993	338	7	345	38		383	38	421
1994	440	8	448	31		479	13	492
1995	173	20	193	25		218	40	258
1996	283	21	305	24		329	44	373
1997	298	12	310	46		356	52	408
1998	372	8	380	66		446	36	482
1999	332	4	336	7		343	43	386
2000	238	5	243	10		253	35	288
2001	167	2	169	5		175	19	193
2002	112	3	115	3		117	19	137
2003	113	3	116	17		134	15	148
2004	142	1	144	5		149	11	159
2005	120	1	121	26		147	19	166
2006	173	2	175	35		210	16	226
2007	139	2	141	14		155	0.4	155
**2008	114	2	116	17		133	11	144
2009	74	2	77	7		84	11	94
2010	66	8	74	10		83	5	88
^2011	242	0	242	34	26	302	69	371
^2012	151	11	161	18	83	262	31	293
^2013	128	3	131	11	90	231	18	250
2014	225	5	231	30	116	377	23	399
2015	188	2	190	23	63	276	21	297
2016	171	1	172	15	48	235	63	298
2017	189	4	193	16	39	247	41	288
2018	227	8	234	7	74	315	37	352
2019	226	7	233	6		239	51	289
2020	278	26	305	10		315	5	320

^Data revised in WG2015

*9a is without Gulf of Cádiz till 2016

** Data revised in WG2010

*** Official data by country and unallocated landings

Table. 6.3.2a. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Discard/Total Catch ratio and estimated CV for Spain from on-board sampling.

Year	1994	1997	1999	2000	2003	2004	2005	2006	2007
Weight Ratio	0.03	0.14	0.12	0.13	0.11	0.07	0.14	0.08	0.00
CV	50.83	32.23	33.4	48.41	19.93	29.24	43.17	31.62	55.01
Number Ratio	0.10	0.38	0.34	0.45	0.26	0.16	0.28	0.21	0.01

Year	2008	2009	2010	2011*	2012	2013	2014	2015	2016
Weight Ratio	0.08	0.13	0.06	0.23	0.12	0.07	0.06	0.07	0.21
CV	58.8	52.9	61.6	23.7	28.8	30.3	44.7	49.8	57.1
Number Ratio	0.20	0.36	0.27	0.57	0.37	0.24	0.20	0.29	0.47

Year	2017	2018	2019	2020
Weight Ratio	0.14	0.10	0.17	0.02
CV	28.9			
Number Ratio	0.34	0.26	0.37	0.05

All discard data revised in WG2011

*Data revised in WG2013

Table. 6.3.2b. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Discards in numbers-at-age (thousands) for Spanish trawlers.

	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	138	138	138	138	138	138	138	138	104
2	339	339	339	339	339	339	339	339	93
3	425	425	425	425	425	425	425	425	136
4	130	130	130	130	130	130	130	130	51
5	10	10	10	10	10	10	10	10	3
6	4	4	4	4	4	4	4	4	1
7	1	1	1	1	1	1	1	1	0

	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	138	138	41	138	270	27	10	10	0
2	339	339	453	339	471	611	338	338	239
3	425	425	857	425	284	160	82	82	57
4	130	130	142	130	197	73	31	31	12
5	10	10	1	10	26	19	9	9	4
6	4	4	5	4	6	0	1	1	0
7	1	1	3	1	0	0	1	1	0

	2004	2005	2006	2007	2008	2009	2010	2011*	2012
1	4	20	0	0	0	96	16	12	8
2	164	223	19	11	126	142	119	2044	808
3	28	61	108	0	86	21	6	346	85
4	6	38	115	0	8	15	1	1	41
5	5	11	28	0	5	7	2	2	2
6	3	4	13	0	2	7	0	0	1
7	2	1	4	0	0	3	1	0	1

	2013	2014	2015	2016	2017	2018	2019	2020
1	330	442	624	1074	492	203	487	42
2	53	94	10	373	410	387	337	54
3	13	16	4	3	43	110	135	3
4	5	2	1	1	0	28	40	0
5	0	0	0	0	0	1	6	0
6	0	0	0	0	0	1	0	0
7	0	0	0	0	0	0	0	0

Table 6.3.3a. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Annual length distribution of landings in 2020.

Length (cm)	Total
10	
11	
12	
13	
14	
15	
16	12954
17	0
18	12954
19	12954
20	28130
21	15485
22	36510
23	83932
24	98918
25	158785
26	286746
27	238866
28	197180
29	133145
30	96688
31	103651
32	89401
33	60162
34	53024
35	31098
36	25190
37	16762
38	8311
39	7696
40	17389
41	4751
42	9560
43	4524
44	4860
45	2587
46	3816
47	3652
48	0
49	0
50+	1067
Total	1860750

Table 6.3.3b. Mean lengths and mean weights in landings since 1990.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Mean length (cm)	22.3	23.5	24.6	23.4	25.1	24.7	24.6	24.6	24.7	25.3	25.8	25.1
Mean weight (g)	105	108	129	108	124	121	120	118	119	127	134	124

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Mean length (cm)	26.15	26.68	26.64	27.58	29.4	27.63	28.2	29.39	28.6	28.72	26.81	26.41
Mean weight (g)	137	148	146.8	163.2	187.4	159.5	163.2	187.5	170.7	172.3	145.7	134.1

Table 6.3.4. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Catch numbers-at-age.

Catch numbers at age   Numbers*10**-3

YEAR	1986	1987	1988	1989	1990
AGE					
1	1352	2359	3316	1099	4569
2	2377	2728	3769	2328	2560
3	798	882	1168	808	905
4	649	404	748	641	878
5	505	293	534	505	333
6	202	81	182	191	377
+gp	194	71	130	253	558
TOTALNUM	6077	6818	9847	5825	10180
TONSLAND	705	537	858	761	1022
SOPCOF %	95	95	95	99	99

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
1	1357	1401	858	133	848	537	535	416	491	620
2	2777	817	2128	568	461	1911	1919	1307	524	282
3	931	807	442	1835	384	167	1153	1335	1157	671
4	700	1130	536	552	630	289	77	891	719	526
5	647	595	361	625	245	506	367	218	448	361
6	142	78	103	330	70	148	308	329	105	83
+gp	59	68	36	119	72	81	116	149	207	161
TOTALNUM	6613	4896	4464	4162	2710	3639	4475	4645	3651	2704
TONSLAND	655	558	421	492	258	373	408	482	386	288
SOPCOF %	100	100	101	100	101	101	100	100	101	101

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE										
1	378	369	368	210	346	110	90	133	170	149
2	387	233	299	264	276	526	161	370	111	39
3	331	341	277	211	438	582	232	215	159	53
4	253	95	179	247	171	276	297	153	102	112
5	221	165	80	187	156	183	142	168	80	97
6	161	81	54	102	87	110	81	60	60	81
+gp	118	37	48	72	41	36	56	35	29	43
TOTALNUM	1849	1321	1305	1293	1515	1823	1059	1134	711	574
TONSLAND	194	136	149	160	166	226	155	144	95	88
SOPCOF %	100	99	101	100	98	100	100	100	101	100

YEAR	2011**	2012**	2013**	2014	2015	2016	2017	2018	2019	2020
AGE										
1	2054	812	359	469	712	1187	530	206	554	77
2	1087	275	152	705	224	1275	1160	782	716	396
3	156	834	320	420	536	218	877	668	658	540
4	220	157	612	432	239	116	64	912	553	384
5	266	192	81	518	257	87	81	141	197	338
6	209	106	61	74	191	85	35	74	14	165
+gp	184	139	89	144	82	96	41	78	20	62
TOTALNUM	4176	2515	1674	2762	2241	3064	2788	2861	2712	1962
TONSLAND	371	293	250	399	297	298	288	352	289	320

Table 6.3.5. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Catch weights-at-age (kg).

Mean weight at age

YEAR	1986	1987	1988	1989	1990
AGE					
1	0.041	0.046	0.043	0.045	0.04
2	0.095	0.079	0.086	0.094	0.091
3	0.113	0.086	0.098	0.114	0.121
4	0.163	0.142	0.149	0.163	0.165
5	0.215	0.175	0.191	0.223	0.206
6	0.315	0.311	0.289	0.292	0.24
+gp	0.477	0.415	0.424	0.52	0.369
SOPCOFAC	0.9502	0.9535	0.9509	0.995	0.9874

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
1	0.035	0.031	0.031	0.039	0.051	0.041	0.033	0.032	0.033	0.037
2	0.085	0.075	0.073	0.063	0.044	0.08	0.062	0.061	0.058	0.057
3	0.102	0.116	0.102	0.099	0.087	0.081	0.095	0.095	0.084	0.089
4	0.145	0.155	0.146	0.13	0.126	0.127	0.126	0.13	0.118	0.119
5	0.173	0.209	0.194	0.15	0.164	0.164	0.14	0.154	0.159	0.161
6	0.251	0.318	0.235	0.19	0.21	0.21	0.198	0.189	0.216	0.215
+gp	0.42	0.534	0.538	0.344	0.34	0.354	0.341	0.324	0.296	0.296
SOPCOFAC	1.0041	0.9983	1.005	1.0004	1.0091	1.014	1.0005	1.0047	1.0057	1.0107

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE										
1	0.039	0.038	0.047	0.048	0.0510	0.0570	0.061	0.033	0.031	0.037
2	0.078	0.07	0.083	0.082	0.0770	0.0820	0.088	0.084	0.088	0.091
3	0.085	0.111	0.115	0.109	0.1080	0.1100	0.11	0.118	0.135	0.116
4	0.117	0.115	0.149	0.13	0.1400	0.1500	0.144	0.145	0.16	0.168
5	0.148	0.162	0.194	0.157	0.1640	0.1740	0.197	0.187	0.189	0.203
6	0.171	0.205	0.252	0.203	0.1990	0.2230	0.236	0.246	0.246	0.228
+gp	0.256	0.387	0.382	0.319	0.3790	0.3900	0.366	0.409	0.404	0.37
SOPCOFAC	1.0046	0.9944	1.0061	1.0008	0.9847	1.0034	0.9966	1.0034	1.0062	0.9989

YEAR	2011**	2012**	2013**	2014	2015	2016	2017	2018	2019	2020
AGE										
1	0.026	0.027	0.039	0.035	0.037	0.041	0.038	0.035	0.041	0.044
2	0.088	0.089	0.079	0.097	0.102	0.086	0.081	0.073	0.076	0.096
3	0.135	0.138	0.127	0.13	0.133	0.147	0.131	0.107	0.112	0.134
4	0.134	0.164	0.179	0.166	0.174	0.198	0.184	0.144	0.146	0.155
5	0.201	0.172	0.232	0.22	0.197	0.244	0.217	0.224	0.209	0.219
6	0.242	0.228	0.281	0.264	0.277	0.304	0.295	0.243	0.414	0.29
+gp	0.371	0.343	0.391	0.381	0.388	0.388	0.43	0.438	0.496	0.405
SOPCOFAC	0.9976	1.0031	1.0124	0.9988	0.9986	1.0012	1.006	1.0033	1.0019	0.9992

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

Table 6.3.6. Megrim (*L. whiffiagonis*) divisions 8.c and 9.a. Biomass, Abundance and Recruitment indices from Portuguese and Spanish surveys.

| | Biomass Index | | | | | | Abundance index | | | | | Recruitment index | | |
| | Portugal (k/h) | | | Spain (k/30 min) | | | Portugal (n/h) | | Spain (n/30 min) | | | At age 1 Portugal (n) | At age 0 Spain (n/30 min) | At age 1 Spain (n/30 min) |
	October	Crustaceans	s.e	Mean	s.e.		Crustaceans	s.e.	Mean	s.e.		October		
1983				0.96	0.14	1983			14.0	2.45	1983		1.88	7.72
1984				1.92	0.34	1984			28.0	4.57	1984		0.32	16.08
1985				0.89	0.15	1985			9.0	1.34	1985		0.10	2.74
1986				1.65	0.2	1986			33.0	6.22	1986		13.78	11.19
1987				ns		1987			ns		1987		ns	ns
1988				3.52	0.64	1988			43.0	8.82	1988		0.65	16.60
1989				3.13	0.5332	1989			42.0	7.04	1989		2.90	13.96
1990	0.08			3.08	0.86	1990			28.0	5.5	1990	5	0.11	9.13
1991	0.11			1.22	0.17	1991			10.0	1.67	1991	5	1.26	1.38
1992	0.11			1.39	0.2	1992			18.0	3.35	1992	8	0.01	12.03
1993	0.04			1.46	0.24	1993			15.0	3.23	1993	1	0.00	2.76
1994	0.05			1.02	0.2	1994			8.0	1.87	1994 +		0.60	0.05
1995	0.01			1.03	0.16	1995			11.0	1.86	1995 +		0.41	7.38
A,1996 +				1.64	0.22	A,1996			21.0	3.6	A,1996 +		0.45	11.26
1997 +		1.41	1.04	1.79	0.25	1997	7.22	4.82	20.0	3.26	1997 +		0.15	5.91
1998	0.01	0.20	0.09	1.47	0.23	1998	1.09	0.51	14.8	2.64	1998 +		0.02	2.56
,B,1999 +		0.11	0.11	1.59	0.29	A,B,1999	0.57	0.53	15.5	3.05	A,B,1999 +		0.56	1.26
2000 +		0.06	0.05	1.8	0.35	2000	0.27	0.17	19.4	4.46	2000 +		0.05	6.92
2001	0	0.04	0.03	1.45	0.28	2001	0.07	0.04	12.8	2.77	2001 +		0.19	1.97
2002	0.04	0.07	0.04	1.26	0.24	2002	0.21	0.10	12.1	2.65	2002 +		0.08	2.53
A,2003	0.01	0.07	0.05	0.82	0.16	A,2003	0.16	0.08	7.2	1.26	A,2003	0.05	0.05	1.91
A,2004	0.01	ns		1.08	0.2	A,2004	ns		8.44	1.39	A,2004 +		0.14	1.83
2005	0.01	0.37	0.20	1.29	0.21	2005	0.71	0.35	9.76	1.73	2005 +		0.08	2.21
2006	0.02	0.29	0.18	1.03	0.18	2006	0.43	0.24	6.38	1.16	2006		0.00	0.89
2007	0	0.15	0.09	1.13	0.24	2007	0.49	0.37	6.87	1.52	2007		0.01	1.87
2008	0	0.25	0.11	0.68	0.15	2008	1.49	0.71	4.33	1.07	2008		0.00	0.23
2009	0.00	*0.05	0.03	0.80	0.12	2009	*0.19	0.10	4.17	0.59	2009		0.19	0.20
2010	0.01	0.20	0.10	0.89	0.16	2010	0.56	0.23	10.15	1.97	2010		0.01	7.63
2011	0.00	0.84	0.67	1.83	0.35	2011	1.75	1.30	17.45	3.86	2011		0.00	1.94
2012	ns	ns	ns	1.38	0.19	2012	ns	ns	9.07	1.29	2012		0.03	0.58
**2013	0	0.20	0.13	2.44	0.39	2013	0.43	0.22	15.89	2.58	2013		0.02	3.24
2014	0.02	0.30	0.18	1.34	0.21	2014	0.81	0.41	9.04	1.26	2014		0.40	1.32
2015	0.06	0.27	0.14	1.86	0.26	2015	0.89	0.39	30.75	5.64	2015		0.28	25.46
2016	0.06	0.26	0.13	2.71	0.28	2016	0.90	0.35	43.10	5.35	2016		0.02	26.31
2017	0.06	0.21	0.09	3.75	0.39	2017	2.04	1.37	50.23	6.04	2017		0.00	15.42
2018	0.04	0.18	0.11	3.42	0.30	2018	1.49	1.01	41.45	4.37	2018		0.05	7.62
2019	ns	ns	ns	3.93	0.43	2019	ns	ns	46.19	5.86	2019		0.09	14.58
2020	ns	ns	ns	3.79	0.49	2020	ns	ns	51.00	6.34	2020		0.04	19.20

+ less than 0.04

ns no survey

A Portuguese October Survey with different vessel and gear (Capricórnio and CAR net)

B Portuguese Crustacean Survey covers partial area only with a different Vessel (Mestre Costeiro)

* Revised in WG2011

** Since 2013 new vessel for Spanish survey (Miguel Oliver)

Table 6.3.7. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Tuning data.

FLT01: SP-LCGOTBDEF 1000 Days by 100 HP (thousand)

1986	2019							
1	1	0	1					
1	7						Eff.	
10	13.0	32.1	24.9	24.3	21.5	11.1	6.7	7.1	1986
10	105.5	114.2	46.8	22.4	15.1	7.5	5.8	12.7	1987
10	18.5	55.0	41.2	32.3	22.9	10.2	5.5	11.3	1988
10	4.6	24.4	23.6	25.7	20.8	9.8	5.7	11.9	1989
10	6.1	23.7	25.3	34.1	32.9	17.6	10.5	8.8	1990
10	6.8	31.1	30.5	36.8	32.3	16.0	9.0	9.6	1991
10	1.2	16.6	21.3	31.1	31.1	16.9	13.5	10.2	1992
10	0.2	12.0	15.1	20.7	17.8	8.2	3.9	7.1	1993
10	0.0	4.9	72.9	40.0	58.6	41.7	8.8	8.5	1994
10	65.1	4.1	19.6	42.9	15.4	4.2	2.9	13.4	1995
10	1.4	64.0	3.2	20.6	54.7	17.2	10.1	11.0	1996
10	1.1	37.2	56.8	5.7	29.0	27.0	9.3	12.5	1997
10	0.7	20.1	56.1	69.8	19.8	40.8	18.4	8.2	1998
10	0.8	8.6	44.3	46.5	38.3	10.7	21.4	8.8	1999
10	1.5	7.0	46.7	64.3	61.6	15.6	18.2	10.5	2000
10	2.6	25.7	25.8	31.0	33.4	27.1	19.0	12.1	2001
10	2.0	12.8	43.6	12.1	32.9	17.3	6.9	11.0	2002
10	25.9	19.2	20.0	20.1	12.2	10.0	8.5	10.2	2003
10	2.2	12.0	13.5	20.4	19.2	14.3	13.5	7.0	2004
10	5.7	12.4	27.6	12.6	13.5	8.3	5.6	7.1	2005
10	3.4	17.9	24.8	17.5	13.3	9.5	3.8	7.8	2006
10	12.9	19.2	21.7	27.7	16.7	10.0	8.0	7.3	2007
10	0.2	21.9	20.2	14.9	16.3	5.5	3.8	9.0	2008
10	6.0	17.2	22.6	12.7	8.8	5.9	2.8	8.0	2009
10	1.6	7.0	12.1	25.4	24.5	18.1	10.3	5.8	2010
10	2.3	134.6	27.5	38.0	31.8	15.8	9.3	5.1	2011
10	2.3	108.1	392.9	68.3	76.2	27.9	18.2	7.6	2012
10	1.6	19.9	54.6	89.3	9.8	7.2	6.8	10.8	2013
10	2.8	33.7	17.9	16.2	17.0	2.6	5.3	13.4	2014
10	16.4	32.2	64.7	25.3	26.3	19.8	7.1	9.8	2015
10	69.4	254.4	24.7	11.1	8.2	7.1	7.3	10.6	2016
10	10.0	178.8	193.9	15.9	19.0	7.0	4.7	8.7	2017
10	1.6	66.4	74.9	108.4	14.5	7.6	4.3	8.1	2018
10	28.7	120.0	153.1	137.0	48.2	1.8	2.8	7.8	2019

FLT02: SP-AVSOTBDEF 1000 Days by 100 HP (thousand) (*)

1986	2019							
1	1	0	1					
1	7						Eff.	
10	408.3	516.4	427.9	208.7	181.7	153.1	91.6	3.9	1986
10	589.9	470.6	510.4	242.2	145.3	167.8	55.4	3.0	1987
10	1458.2	905.1	749.0	357.4	154.7	193.1	84.9	3.4	1988
10	835.9	513.9	538.8	252.8	145.1	174.1	67.7	3.3	1989
10	4366.2	949.0	224.8	173.4	45.8	49.9	70.8	3.2	1990
10	980.1	855.3	228.9	99.8	83.6	14.7	7.3	3.5	1991
10								10.2	1992
10	1149.0	1489.5	91.4	99.7	52.6	24.9	19.4	2.4	1993
10	19.0	175.6	547.0	135.3	132.9	51.0	23.7	4.5	1994
10	40.5	2.4	43.0	139.5	69.5	25.9	14.3	3.5	1995
10	135.0	796.8	14.0	116.8	258.6	74.2	62.5	2.3	1996
10	96.0	880.4	621.3	34.1	153.4	127.8	46.3	2.6	1997
10	16.0	308.5	374.9	233.1	51.9	69.5	38.1	5.1	1998
10	10.3	109.8	397.8	262.9	162.2	38.0	69.7	4.9	1999
10	28.7	54.3	238.7	229.5	146.0	35.7	52.8	2.5	2000
10	36.6	199.6	192.6	121.6	115.1	83.5	85.2	1.3	2001
10	54.5	157.6	238.5	64.6	92.9	53.5	46.8	2.0	2002
10	26.1	84.5	105.0	70.5	31.4	24.1	28.1	2.2	2003
10	52.5	231.5	208.5	248.0	193.4	102.9	59.9	1.6	2004
10	118.2	181.5	309.0	117.1	106.9	58.6	26.1	3.0	2005
10	42.8	181.8	235.7	120.5	83.2	45.5	12.4	2.8	2006
10	24.6	48.0	72.4	93.0	40.7	24.5	19.9	2.2	2007
10	5.0	153.3	85.0	50.6	48.7	18.1	15.7	2.0	2008
10	12.4	41.2	66.8	49.6	39.1	38.7	21.2	2.3	2009
10	49.8	45.0	66.0	160.3	135.6	120.9	61.5	2.0	2010
10	6.4	483.1	95.2	133.1	167.6	133.8	109.7	2.2	2011
10	0.4	27.8	117.6	22.7	29.1	17.7	27.9	2.6	2012
10	10.6	35.1	128.7	279.4	38.4	31.1	62.1	1.5	2013
10	7.2	116.4	64.5	72.8	116.6	21.5	53.2	3.0	2014
10	32.8	42.3	100.0	52.4	62.9	62.9	33.0	1.8	2015
10	37.6	261.5	65.3	47.3	43.4	48.0	55.6	1.6	2016
10	40.1	416.5	352.2	21.5	33.9	22.4	45.0	2.0	2017
10	2.0	113.8	149.9	245.6	53.6	29.5	58.2	1.5	2018
10	8.2	86.7	161.8	197.3	104.0	17.5	25.6	2.0	2019

FLTO3: SPGFS-WIBTS-Q4 (n/30 min)

1988	2020							
1	1	0.75	0.83					
1	7							
1	16.60	12.48	5.18	4.54	2.66	0.74	0.53	101	1988
1	13.96	11.20	5.38	5.64	1.47	0.48	0.43	91	1989
1	9.13	7.69	3.04	3.61	1.26	1.36	1.57	120	1990
1	1.38	3.23	1.45	1.84	0.87	0.23	0.03	107	1991
1	12.03	1.07	1.57	2.24	1.14	0.21	0.15	116	1992
1	2.76	8.79	0.66	1.69	0.85	0.17	0.01	109	1993
1	0.05	0.65	4.24	1.30	0.71	0.27	0.04	118	1994
1	7.38	0.20	0.55	1.65	0.70	0.17	0.10	116	1995
1	11.26	6.45	0.25	1.03	1.00	0.35	0.27	114	1996
1	5.91	7.54	3.44	0.46	0.99	0.39	0.06	116	1997
1	2.56	4.30	4.33	2.08	0.41	0.60	0.15	114	1998
1	1.26	4.47	4.36	2.50	1.46	0.46	0.77	116	1999
1	6.92	2.46	2.84	3.42	2.14	0.70	0.39	113	2000
1	1.97	4.60	1.14	2.31	1.58	0.61	0.40	113	2001
1	2.53	3.15	3.74	0.44	1.38	0.51	0.29	110	2002
1	1.91	1.44	1.66	1.14	0.52	0.26	0.16	112	2003
1	1.83	1.94	1.31	1.30	0.80	0.66	0.47	114	2004
1	2.21	1.58	2.04	1.43	1.57	0.60	0.25	116	2005
1	0.89	1.40	1.57	0.82	0.88	0.61	0.22	115	2006
1	1.87	0.94	1.27	1.24	0.68	0.44	0.42	117	2007
1	0.23	1.54	1.23	0.56	0.52	0.18	0.08	115	2008
1	0.20	0.44	1.52	0.91	0.40	0.30	0.22	117	2009
1	7.63	0.26	0.28	0.75	0.52	0.50	0.21	114	2010
1	1.94	12.47	1.32	0.30	0.63	0.40	0.39	111	2011
1	0.58	2.22	4.81	0.41	0.16	0.30	0.56	115	2012
0	3.24	1.63	3.29	5.63	0.67	0.35	0.87	114	2013
1	1.32	2.80	1.30	1.38	1.21	0.20	0.42	116	2014
1	25.46	1.24	1.45	0.75	0.73	0.46	0.38	114	2015
1	26.31	14.54	0.88	0.57	0.30	0.30	0.18	114	2016
1	15.42	25.02	8.71	0.33	0.35	0.21	0.15	112	2017
1	7.62	19.01	9.75	4.10	0.33	0.18	0.40	113	2018
1	14.58	18.46	9.50	2.40	0.68	0.13	0.35	113	2019
1	19.20	20.53	6.12	2.16	1.65	0.96	0.34	109	2020

Table 6.3.8. Megrim (*L. whiffiagonis*). LPUE data by fleet in divisions 8.c and 9.a.

Year	SP-LCGOTBDEF			SP-AVSOTBDEF			Portugal trawl in 9a		
	Landings (t)	Effort	LPUE[1]	Landings (t)	Effort	LPUE[1]	Landings (t)	Effort	LPUE[2]
1986	16	7.1	2.24	83	3.9	21.17			
1987	36	12.7	2.85	52	3.0	17.65			
1988	29	11.3	2.59	83	3.4	24.65	74.9	38.5	1.95
1989	24	11.9	2.03	65	3.3	19.76	92.2	44.7	2.06
1990	27	8.8	3.05	120	3.2	36.91	86.0	39.0	2.20
1991	29	9.6	3.05	52	3.5	14.96	85.5	45.0	1.90
1992	32	10.2	3.10	35	2.3	15.46	32.6	50.9	0.64
1993	11	7.1	1.53	45	2.4	18.55	31.7	44.2	0.72
1994	32	8.5	3.79	52	4.5	11.39	25.8	45.8	0.56
1995	12	13.4	0.86	34	3.5	9.72	21.4	37.0	0.58
1996	26	11.0	2.36	39	2.3	17.13	22.2	46.5	0.48
1997	30	12.5	2.43	51	2.6	19.16	41.5	33.4	1.24
1998	30	8.2	3.65	62	5.1	12.19	60.1	43.1	1.39
1999	23	8.8	2.65	63	4.9	12.67	4.3	25.3	0.17
2000	35	10.5	3.33	26	2.5	10.49	6.9	27.0	0.25
2001	28	12.1	2.30	15	1.3	11.15	1.3	43.1	0.03
2002*	22	11.0	2.01	18	2.0	9.14	1.0	31.2	0.03
2003*	18	10.2	1.73	12	2.2	5.72	15.3	40.5	0.38
2004	12	7.0	1.66	23	1.6	14.77	3.4	35.4	0.10
2005	9	7.1	1.29	33	3.0	11.10	19.0	42.6	0.45
2006	11	7.8	1.44	27	2.8	9.62	26.3	40.3	0.65
2007**	13	7.3	1.78	11	2.2	4.85	10.5	43.8	0.24
2008**	12	9.0	1.30	11	2.0	5.27	14.4	38.4	0.37
2009	9	8.0	1.06	11	2.3	5.05	6.0	49.3	0.12
2010	12	5.8	2.02	24	2.0	11.74	7.3	48.0	0.15
2011	17	5.1	3.43	41	2.2	18.67	24.8	49.4	0.50
2012	43	7.6	5.58	11	2.6	4.40	14.5	30.9	0.47
2013***	33	10.8	3.02	16	1.5	11.07	8.1	28.0	0.29
2014	20	13.4	1.47	26	3.0	8.80	25.7	49.2	0.52
2015	29	9.8	3.00	14	1.8	7.54	18.0	17.7	1.02
2016	40	10.6	3.77	15	1.6	9.55	12.3	16.4	0.75
2017	47	8.7	5.43	25	2.0	12.52	12.7	15.4	0.83
2018	29	8.1	3.53	18	1.5	11.51	5.5	7.9	0.70
2019	48	7.8	6.19	23	2.0	11.39	5.2	7.1	0.73
2020	ns	ns	ns	ns	ns	ns	8.7	7.9	1.10

[1] LPUE as catch (kg) per fishing day per 100 HP.

[2] LPUE as catch (kg) per hour.

* Effort from Portuguese trawl revised from original value presented

** Effort from Portuguese trawl revised in WG2010 from original value presented

*** Effort from SP-LCGOTBDEF and SP-AVSOTBDEF revised in WG2015 from original value presented

Table 6.3.9. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Tuning diagnostics.

Lowestoft VPA Version 3.1

29/04/2021 12:05

Extended Survivors Analysis

Megrim (L. whiffiagonis.) in Divisions 27.7.8c and 27.7.9a

CPUE data from file fleetw.txt

Catch data for 35 years. 1986 to 2020. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF	1986	2020	3	6	0	1
SP-AVSOTBDEF	1986	2020	3	6	0	1
SP-GFS	1990	2020	1	6	0.75	0.83

Time series weights :

 Tapered time weighting not applied

Catchability analysis :

 Catchability dependent on stock size for ages <   3

  Regression type = C
  Minimum of   5 points used for regression
  Survivor estimates shrunk to the population mean for ages < 3

 Catchability independent of age for ages >=   5

Terminal population estimation :

 Survivor estimates shrunk towards the mean F
 of the final   5 years or the   3 oldest ages.

 S.E. of the mean to which the estimates are shrunk =   1.500

 Minimum standard error for population
 estimates derived from each fleet =   .200

 Prior weighting not applied

Tuning had not converged after 90 iterations

Total absolute residual between iterations
89 and 90 =   .00017

Final year F values

Age	1	2	3	4	5	6
Iteration 89	0.0116	0.0739	0.1293	0.1456	0.2391	0.2832
Iteration 90	0.0116	0.0739	0.1293	0.1456	0.239	0.2831

      1

Regression weights

1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1	1	1	1

Fishing mortalities

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	1	0	0	0	0	0	0.072	0.027	0.078	0.012
2	0	0	0	0	0	0	0.228	0.144	0.124	0.074
3	0	0	0	0	1	0	0.288	0.198	0.174	0.129
4	0	0	0	0	1	0	0.194	0.552	0.251	0.146
5	1	1	0	1	1	0	0.329	0.862	0.216	0.239
6	1	0	1	1	1	0	0.275	0.569	0.181	0.283

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2011	5390	5440	840	752	671	431
2012	2930	2550	3470	547	416	308
2013	3180	1660	1840	2080	305	167
2014	1910	2280	1220	1220	1150	177
2015	8290	1140	1230	622	605	475
2016	9000	6140	730	519	293	263
2017	8430	6300	3870	400	320	161
2018	8530	6430	4110	2380	270	188
2019	8120	6800	4550	2760	1120	93.3
2020	7390	6150	4920	3130	1760	740

Estimated population abundance at 1st Jan 2021

	0	5980	4680	3540	2220	1130

Taper weighted geometric mean of the VPA populations:

	5060	3560	2210	1300	721	338

Standard error of the weighted Log(VPA populations) :

	0.6464	0.6552	0.5697	0.5533	0.4949	0.5241
1						

Log catchability residuals.

Fleet : SP-LCGOTBDEF

Age	1986	1987	1988	1989	1990
1	No data for this fleet at this age				
2	No data for this fleet at this age				
3	-0.71	-0.44	-0.1	-0.86	-0.71
4	-0.54	-0.74	-0.72	-0.22	-0.24
5	-0.53	-0.84	-0.54	-1.04	0.44
6	-0.63	-0.86	-0.56	-0.6	-0.57

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.75	-0.74	-0.86	0.09	-0.76	-1.64	-0.09	-0.07	-0.02	0.58
4	-0.07	-0.4	-0.55	0.29	-0.15	-0.67	-1.23	0.4	0.02	0.68
5	0.33	0.35	-0.59	1.06	-0.39	0.3	-0.3	0.08	0.13	0.49
6	0.66	0.86	0.32	1.32	-0.2	0.47	0.51	0.89	0.21	-0.17

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.22	0.45	-0.37	-0.56	0.29	-0.06	0.13	-0.09	0	-0.35
4	0.46	-0.49	-0.3	-0.3	-0.53	0.12	0.34	-0.22	-0.56	0.11
5	0.17	0.65	-0.6	-0.37	-0.65	-0.47	0.29	0.04	-0.76	-0.01
6	0.28	0.02	0	0.04	-0.67	-0.61	-0.19	-0.09	-0.32	0.46

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.7	1.98	0.6	0.01	1.36	0.8	1.16	0.11	0.71	99.99
4	0.82	1.74	0.67	-0.44	0.7	-0.05	0.52	0.81	0.75	99.99
5	0.37	1.8	-0.16	-0.72	0.33	-0.18	0.53	0.66	0.14	99.99
6	0.2	0.98	0.29	-0.63	0.24	-0.17	0.15	0.2	-1.03	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-6.215	-5.8414	-5.3753	-5.3753
S.E(Log q)	0.7278	0.6112	0.6002	0.5639

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.13	-0.519	6.02	0.32	34	0.84	-6.21
4	1.28	-1.113	5.48	0.33	34	0.78	-5.84
5	1.75	-2.05	4.49	0.19	34	1	-5.38
6	0.98	0.096	5.36	0.46	34	0.56	-5.35

Fleet : SP-AVSOTBDEF

Age	1986	1987	1988	1989	1990
1	No data for this fleet at this age				
2	No data for this fleet at this age				
3	0.51	0.32	1.17	0.66	-0.11
4	0.21	0.22	0.26	0.66	-0.03
5	0.33	0.12	0.05	-0.41	-0.52
6	0.68	0.89	1.03	0.96	-0.79

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.35	99.99	-0.7	0.5	-1.58	-1.97	0.71	0.21	0.57	0.59
4	-0.49	99.99	-0.42	0.1	-0.39	-0.37	-0.84	0.18	0.33	0.51
5	-0.03	99.99	-0.8	0.58	-0.21	0.54	0.1	-0.27	0.26	0.04
6	-0.73	99.99	0.1	0.21	0.24	0.62	0.78	0.12	0.24	-0.61

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.62	0.52	-0.31	0.61	1.05	0.6	-0.29	-0.25	-0.55	-0.28
4	0.4	-0.22	-0.49	0.77	0.26	0.6	0.16	-0.41	-0.65	0.5
5	0.12	0.36	-0.91	0.67	0.08	0.08	-0.1	-0.16	-0.57	0.41
6	0.11	-0.12	-0.46	0.69	-0.07	-0.27	-0.63	-0.11	0.21	1.01

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.33	-0.86	-0.18	-0.34	0.19	0.13	0.12	-0.8	-0.84	99.99
4	0.65	-0.78	0.36	-0.37	0.05	0	-0.7	0.22	-0.3	99.99
5	0.75	-0.55	0	-0.11	-0.05	0.15	-0.19	0.63	-0.4	99.99
6	1.03	-0.68	0.49	-0.03	0.18	0.41	-0.09	0.4	0.41	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-4.602	-4.4118	-4.0727	-4.0727
S.E(Log q)	0.7103	0.4563	0.4138	0.5733

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	0.92	0.38	4.84	0.43	33	0.66	-4.6
4	0.84	1.232	4.83	0.67	33	0.38	-4.41
5	0.98	0.114	4.12	0.58	33	0.41	-4.07
6	0.94	0.349	4	0.51	33	0.51	-3.88
1							

Fleet : SP-GFS

Age	1986	1987	1988	1989	1990
1	99.99	99.99	99.99	99.99	-0.36
2	99.99	99.99	99.99	99.99	-0.21
3	99.99	99.99	99.99	99.99	0.02
4	99.99	99.99	99.99	99.99	0.71
5	99.99	99.99	99.99	99.99	0.63
6	99.99	99.99	99.99	99.99	0.31

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	-0.59	-0.22	-0.19	-1.45	-0.3	-0.07	-0.11	0.08	0.05	0.64
2	-0.49	-0.69	-0.23	-1.03	-0.99	-0.27	-0.18	-0.23	0.38	0.39
3	-0.97	-0.53	-1.22	0.14	-1.55	-1.54	-0.06	0.23	0.55	0.67
4	0.11	0.19	0.06	0.04	-0.29	-0.62	-0.7	0.06	0.24	0.89
5	0.41	0.7	-0.27	0.39	-0.12	-0.3	-0.31	-0.39	0.27	0.49
6	-0.06	-0.13	-0.11	-0.02	-0.06	0	-0.21	0.22	0.51	0.03

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0.12	0.41	0.25	0.08	0.32	0.05	0.3	-0.34	-0.23	0.03
2	0.48	0.3	0.05	0.19	-0.13	0.08	-0.13	0.09	-0.27	-0.4
3	-0.08	0.78	-0.07	-0.06	0.51	0.07	0.07	-0.1	0.07	-1.38
4	0.97	-0.74	-0.09	0.05	0.35	0.2	0.38	-0.4	-0.14	-0.39
5	0.46	0.84	-0.46	-0.2	0.46	0.19	0.5	-0.07	-0.57	-0.58
6	-0.19	-0.22	-0.33	0.29	-0.02	0.02	0.04	-0.15	-0.04	0.14

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	-0.21	-0.28	99.99	0.54	0.47	0.42	0.19	-0.19	0.2	0.41
2	0.34	0.03	99.99	0.41	0.55	0.31	0.59	0.37	0.28	0.42
3 0.45		0.39	99.99	0.26	0.51	0.32	0.86	0.84	0.69	0.14
4	-0.89	-0.26	99.99	0.24	0.35	0.04	-0.32	0.7	-0.22	-0.53
5	-0.13	-0.92	99.99	0.07	0.16	-0.18	-0.17	0.36	-0.85	-0.4
6	0.01	-0.17	99.99	0.09	-0.09	-0.04	-0.04	-0.12	-0.05	-0.04

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-6.5688	-6.4732	-6.2258	-6.2258
S.E(Log q)	0.6915	0.472	0.4637	0.175

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.5	3.986	7.75	0.69	30	0.42	-7.07
2	0.58	3.226	7.25	0.68	30	0.44	-6.65

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	0.86	0.761	6.72	0.5	30	0.6	-6.57
4	0.86	1.07	6.56	0.66	30	0.4	-6.47
5	1.01	-0.046	6.22	0.49	30	0.48	-6.23
6	0.94	0.991	6.21	0.91	30	0.16	-6.24
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2019

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1	0	0	0	0	0	0
SP-AVSOTBDEF	1	0	0	0	0	0	0
SP-GFS	8971	0.434	0	0	1	0.654	0.008
P shrinkage mea	3556	0.66				0.291	0.019
F shrinkage mea	765	1.5				0.055	0.087

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5979	0.35	0.54	3	1.537	0.012

1

Age 2 Catchability dependent on age and year class strength

Year class = 2018

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1	0	0	0	0	0	0
SP-AVSOTBDEF	1	0	0	0	0	0	0
SP-GFS	6368	0.315	0.112	0.35	2	0.719	0.055
P shrinkage mea	2210	0.57				0.246	0.15
F shrinkage mea	1607	1.5				0.035	0.201

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4675	0.27	0.34	4	1.261	0.074

Age 3   Catchability constant w.r.t. time and dependent on age

Year class = 2017

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1	0	0	0	0	0	0
SP-AVSOTBDEF 1		0	0	0	0	0	0
SP-GFS	3723	0.286	0.155	0.54	3	0.956	0.123
F shrinkage mea	1180	1.5				0.044	0.346

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3539	0.28	0.19	4	0.663	0.129

Age 4   Catchability constant w.r.t. time and dependent on age

Year class = 2016

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	4492	0.738	0	0	1	0.092	0.075
SP-AVSOTBDEF	960	0.721	0	0	1	0.096	0.309
SP-GFS	2358	0.25	0.257	1.03	4	0.781	0.137
F shrinkage mea	778	1.5				0.031	0.369

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2218	0.22	0.23	7	1.013	0.146

Age 5   Catchability constant w.r.t. time and dependent on age

Year class = 2015

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1900	0.477	0.313	0.66	2	0.143	0.149
SP-AVSOTBDEF	742	0.391	0.216	0.55	2	0.217	0.345
SP-GFS	1209	0.231	0.231	1	5	0.615	0.226
F shrinkage mea	482	1.5				0.025	0.491

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1133	0.18	0.17	10	0.918	0.239

Age 6   Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2014

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	753	0.396	0.29	0.73	3	0.088	0.181
SP-AVSOTBDEF	385	0.3	0.205	0.69	3	0.161	0.328
SP-GFS	442	0.161	0.164	1.02	6	0.738	0.291
F shrinkage mea	795	1.5				0.013	0.172

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
456	0.13	0.12	13	0.857	0.283

Table 6.3.10. Megrim (*L. whiffiagonis*) divisions 8.c and 9.a. Estimates of fishing mortality-at-age.

Run title : Megrim (L. whiffiagonis.) in Divisions 27.7.8c and 27.7.9a

At 29/04/2021 12:08

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AGE													
	1	0.1624	0.2245	0.3742	0.1206	0.4816	0.2886	0.1442	0.191	0.062	0.1026	0.066	0.0872
	2	0.389	0.57	0.6757	0.4928	0.4535	0.6148	0.2823	0.3394	0.1865	0.3161	0.3531	0.3532
	3	0.3104	0.2427	0.5137	0.2914	0.3601	0.2943	0.3587	0.2428	0.5544	0.1855	0.1797	0.374
	4	0.4649	0.255	0.3348	0.5981	0.596	0.5269	0.7076	0.4309	0.5433	0.372	0.2075	0.1175
	5	0.6621	0.395	0.6327	0.3973	0.7328	1.3218	1.2736	0.5135	1.457	0.4963	0.5836	0.4426
	6	0.4449	0.2033	0.4581	0.4871	0.5884	0.8277	0.5191	0.7856	1.3836	0.5988	0.6426	0.8895
+gp		0.4449	0.2033	0.4581	0.4871	0.5884	0.8277	0.5191	0.7856	1.3836	0.5988	0.6426	0.8895
FBAR 2- 4		0.3881	0.3559	0.5081	0.4608	0.4699	0.4786	0.4496	0.3377	0.4281	0.2912	0.2468	0.2816

Table 8 Fishing mortality (F) at age

YEAR		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE													
	1	0.1253	0.2072	0.1994	0.1351	0.1556	0.1524	0.0747	0.1426	0.0541	0.0393	0.0875	0.1344
	2	0.3171	0.23	0.1762	0.1843	0.1153	0.1823	0.1558	0.1329	0.335	0.1046	0.2249	0.0979
	3	0.4462	0.5167	0.5182	0.3232	0.2456	0.1953	0.1892	0.418	0.456	0.2413	0.1983	0.142
	4	0.5589	0.462	0.471	0.375	0.1436	0.1966	0.2678	0.2308	0.5099	0.4465	0.2483	0.136
	5	0.5642	0.6158	0.4465	0.3692	0.4501	0.1729	0.3246	0.2704	0.4146	0.5411	0.4924	0.1984
	6	0.9407	0.5905	0.2139	0.3661	0.2231	0.2578	0.3481	0.2458	0.3111	0.3254	0.4629	0.3251
+gp		0.9407	0.5905	0.2139	0.3661	0.2231	0.2578	0.3481	0.2458	0.3111	0.3254	0.4629	0.3251
FBAR 2- 4		0.4407	0.4029	0.3885	0.2941	0.1681	0.1914	0.2043	0.2606	0.4336	0.2641	0.2238	0.1253

Table 8 Fishing mortality (F) at age

YEAR		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	FBAR 18-20
AGE													
	1	0.0245	0.5473	0.366	0.1334	0.3167	0.0998	0.1575	0.072	0.027	0.0784	0.0116	0.0390
	2	0.0412	0.2498	0.1269	0.1065	0.4189	0.2451	0.2607	0.2276	0.1444	0.1237	0.0739	0.1140
	3	0.0618	0.2297	0.3091	0.2135	0.4771	0.6601	0.4007	0.288	0.1982	0.174	0.1293	0.1672
	4	0.1407	0.3907	0.382	0.3925	0.4984	0.5532	0.2839	0.1945	0.5516	0.2506	0.1456	0.3159
	5	0.1853	0.577	0.7125	0.3469	0.687	0.6338	0.3982	0.3285	0.8619	0.2159	0.239	0.4390
	6	0.3166	0.7675	0.478	0.5161	0.6212	0.5885	0.4422	0.2749	0.5691	0.1814	0.2831	0.3445
+gp		0.3166	0.7675	0.478	0.5161	0.6212	0.5885	0.4422	0.2749	0.5691	0.1814	0.2831	
FBAR 2- 4		0.0812	0.2901	0.2726	0.2375	0.4648	0.4861	0.3151	0.2367	0.2981	0.1828	0.1162	

Table 6.3.11. Megrim (*L. whiffiagonis*) divisions 8.c and 9.a. Estimates of stocks numbers-at-age.

Run title : Megrim (L. whiffiagonis.) in Divisions 27.7.8c and 27.7.9a

At 29/04/2021 12:08

Terminal Fs derived using XSA (With F shrinkage)

Table 10   Stock number at age (start of year)   Numbers*10**-3

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AGE												
1	9970	12965	11741	10692	13212	5983	11530	5454	2443	9609	9298	7083
2	8152	6939	8480	6612	7759	6683	3671	8172	3689	1880	7100	7127
3	3305	4524	3213	3533	3307	4036	2959	2266	4765	2506	1122	4083
4	1929	1984	2906	1574	2161	1889	2462	1692	1455	2241	1705	768
5	1153	992	1259	1702	709	975	913	993	900	692	1265	1134
6	622	487	547	547	937	279	213	209	487	172	345	578
+gp	592	424	387	718	1371	114	184	72	171	175	187	214
TOTAL	25723	28316	28534	25378	29456	19959	21932	18859	13912	17275	21021	20987

Table 10   Stock number at age (start of year)   Numbers*10**-3

YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE												
1	3903	2899	3790	3306	2830	2877	3225	2876	2309	2579	1754	1494
2	5315	2819	1930	2542	2365	1983	2022	2450	2042	1791	2030	1316
3	4099	3169	1834	1325	1731	1725	1353	1417	1756	1196	1321	1327
4	2300	2148	1548	894	785	1108	1162	917	764	911	769	887
5	559	1077	1108	791	503	557	746	728	596	376	478	491
6	596	260	476	580	448	263	383	441	455	322	179	239
+gp	266	507	919	422	203	232	269	207	148	221	103	115
TOTAL	17037	12879	11604	9860	8865	8745	9160	9036	8070	7396	6634	5868

Table 10   Stock number at age (start of year)   Numbers*10**-3

YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	GM 98-18
AGE													
1	6803	5385	2928	3177	1909	8285	9003	8435	8533	8121	7387	0	3633
2	1069	5435	2551	1662	2276	1139	6139	6297	6426	6800	6148	5979	
3	977	840	3467	1839	1223	1226	730	3873	4106	4554	4919	4675	
4	943	752	547	2084	1216	622	519	400	2377	2757	3133	3539	
5	634	671	416	305	1152	605	293	320	270	1121	1757	2218	
6	330	431	308	167	177	475	263	161	188	93	740	1133	
+gp	174	374	400	241	340	201	294	187	196	133	276	627	
TOTAL	10929	13888	10617	9477	8294	12553	17241	19673	22097	23579	24360	18171	

Table 6.3.12. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Summary of landings and XSA results.

Run title : Megrim (L. whiffiagonis.) in Divisions 27.7.8c and 27.7.9a

At 29/04/2021 12:08

Table 16   Summary   (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2-4
1986	9970	2597	2250	705	0.3134	0.3881
1987	12965	2317	1868	537	0.2875	0.3559
1988	11741	2545	2139	858	0.4012	0.5081
1989	10692	2675	2295	761	0.3316	0.4608
1990	13212	2868	2449	1022	0.4174	0.4699
1991	5983	1750	1555	655	0.4213	0.4786
1992	11530	1714	1451	558	0.3846	0.4496
1993	5454	1525	1353	421	0.3111	0.3377
1994	2443	1275	1189	492	0.4138	0.4281
1995	9609	1282	950	258	0.2715	0.2912
1996	9298	1602	1294	373	0.2882	0.2468
1997	7083	1506	1308	408	0.3119	0.2816
1998	3903	1422	1307	482	0.3687	0.4407
1999	2899	1156	1077	386	0.3585	0.4029
2000	3790	1150	1047	288	0.2751	0.3885
2001	3306	869	764	194	0.254	0.2941
2002	2830	807	720	136	0.1889	0.1681
2003	2877	926	821	149	0.1816	0.1914
2004	3225	900	781	160	0.2049	0.2043
2005	2876	902	787	166	0.211	0.2606
2006	2309	870	766	226	0.2951	0.4336
2007	2579	809	689	155	0.2249	0.2641
2008	1754	671	616	144	0.2337	0.2238
2009	1494	681	639	95	0.1487	0.1253
2010	6803	889	713	88	0.1234	0.0812
2011	5385	1210	1070	371	0.3467	0.2901
2012	2928	1153	1078	293	0.2717	0.2726
2013	3177	1074	979	250	0.2553	0.2375
2014	1909	1078	1012	399	0.3942	0.4648
2015	8285	1023	809	297	0.3672	0.4861
2016	9003	1373	1076	298	0.2769	0.3151
2017	8435	1609	1346	288	0.2139	0.2367
2018	8533	1742	1498	352	0.235	0.2981
2019	8121	2101	1830	289	0.158	0.1828
2020	7387	2771	2498	320	0.1281	0.1162
Arith. Mean	6108	1453	1258	368	0.282	0.3164
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 6.3.13. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Prediction with management option table: Input data.

MFDP version 1a
Run: meg
Time and date: 13:19 29/04/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2021 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
1	3633	0.2	0.34	0	0	0.040	0.0058	0.055	0.0508	0.039
2	5979	0.2	0.9	0	0	0.082	0.0918	0.098	0.0510	0.053
3	4675	0.2	1	0	0	0.126	0.1922	0.131	0.0155	0.079
4	3539	0.2	1	0	0	0.165	0.2402	0.167	0.0065	0.102
5	2218	0.2	1	0	0	0.223	0.3473	0.223	0.0022	0.041
6	1133	0.2	1	0	0	0.309	0.3132	0.310	0.0014	0.017
7	627	0.2	1	0	0	0.431	0.3146	0.432	0.0000	0.038

2022 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
1	3633	0.2	0.34	0	0	0.040	0.0058	0.055	0.0508	0.039
2	.	0.2	0.9	0	0	0.082	0.0918	0.098	0.0510	0.053
3	.	0.2	1	0	0	0.126	0.1922	0.131	0.0155	0.079
4	.	0.2	1	0	0	0.165	0.2402	0.167	0.0065	0.102
5	.	0.2	1	0	0	0.223	0.3473	0.223	0.0022	0.041
6	.	0.2	1	0	0	0.309	0.3132	0.310	0.0014	0.017
7	.	0.2	1	0	0	0.431	0.3146	0.432	0.0000	0.038

2023 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
1	3633	0.2	0.34	0	0	0.040	0.006	0.055	0.051	0.039
2	.	0.2	0.9	0	0	0.082	0.092	0.098	0.051	0.053
3	.	0.2	1	0	0	0.126	0.192	0.131	0.016	0.079
4	.	0.2	1	0	0	0.165	0.240	0.167	0.007	0.102
5	.	0.2	1	0	0	0.223	0.347	0.223	0.002	0.041
6	.	0.2	1	0	0	0.309	0.313	0.310	0.001	0.017
7	.	0.2	1	0	0	0.431	0.315	0.432	0.000	0.038

Input units are thousands and kg - output in tonnes

Table 6.3.14. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a catch forecast: management options table.

MFDP version 1a
Run: meg
Time and date: 13:19 29/04/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2021 Biomass	SSB	Catch FMult	Landings FBar	Yield	Discards FBar	Yield
2927	2782	1	0.1747	542	0.0243	27

2022 Biomass	SSB	Catch FMult	Landings FBar	Yield	Discards FBar	Yield	2023 Biomass	SSB
2780	2661	0	0.0000	0	0.0000	0	3218	3099
.	2661	0.1	0.0175	63	0.0024	2	3142	3022
.	2661	0.2	0.0349	123	0.0049	4	3068	2948
.	2661	0.3	0.0524	183	0.0073	6	2996	2876
.	2661	0.4	0.0699	240	0.0097	8	2926	2806
.	2661	0.5	0.0874	296	0.0122	10	2857	2738
.	2661	0.6	0.1048	351	0.0146	12	2791	2672
.	2661	0.7	0.1223	404	0.0170	13	2726	2607
.	2661	0.8	0.1398	455	0.0195	15	2664	2545
.	2661	0.9	0.1573	506	0.0219	17	2603	2484
.	2661	1	0.1747	554	0.0243	19	2543	2425
.	2661	1.1	0.1922	602	0.0268	21	2485	2367
.	2661	1.2	0.2097	648	0.0292	22	2429	2311
.	2661	1.3	0.2272	693	0.0316	24	2375	2256
.	2661	1.4	0.2446	737	0.0341	26	2321	2203
.	2661	1.5	0.2621	779	0.0365	27	2270	2152
.	2661	1.6	0.2796	821	0.0389	29	2219	2101
.	2661	1.7	0.2970	861	0.0414	31	2170	2053
.	2661	1.8	0.3145	900	0.0438	32	2123	2005
.	2661	1.9	0.3320	939	0.0462	34	2076	1959
.	2661	2	0.3495	976	0.0487	35	2031	1914

Input units are thousands and kg - output in tonnes

Table 6.3.15. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Single option prediction. Detailed tables.

MFDP version 1a
Run: meg
Time and date: 13:19 29/04/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2021   F multiplier: 1   Fleet1 HCFbar: 0.1747 Fleet1 DFbar: 0.0243

Age		Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	1	0.0058	19	1	0.0508	163	6	3633	145	1235	49	1235	49
	2	0.0918	465	45	0.051	258	14	5979	493	5381	443	5381	443
	3	0.1922	738	97	0.0155	60	5	4675	590	4675	590	4675	590
	4	0.2402	686	114	0.0065	19	2	3539	585	3539	585	3539	585
	5	0.3473	593	132	0.0022	4	0	2218	494	2218	494	2218	494
	6	0.3132	277	86	0.0014	1	0	1133	350	1133	350	1133	350
	7	0.3146	154	67	0	0	0	627	270	627	270	627	270
Total			2931	542		504	27	21804	2927	18808	2782	18808	2782

Year: 2022   F multiplier: 1   Fleet1 HCFbar: 0.1747 Fleet1 DFbar: 0.0243

Age		Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	1	0.0058	19	1	0.0508	163	6	3633	145	1235	49	1235	49
	2	0.0918	218	21	0.051	121	6	2811	232	2530	208	2530	208
	3	0.1922	670	88	0.0155	54	4	4244	536	4244	536	4244	536
	4	0.2402	602	100	0.0065	16	2	3110	514	3110	514	3110	514
	5	0.3473	605	135	0.0022	4	0	2264	504	2264	504	2264	504
	6	0.3132	313	97	0.0014	1	0	1280	396	1280	396	1280	396
	7	0.3146	259	112	0	0	0	1052	454	1052	454	1052	454
Total			2686	554		360	19	18394	2780	15715	2661	15715	2661

Year: 2023   F multiplier: 1   Fleet1 HCFbar: 0.1747 Fleet1 DFbar: 0.0243

Age		Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	1	0.0058	19	1	0.0508	163	6	3633	145	1235	49	1235	49
	2	0.0918	218	21	0.051	121	6	2811	232	2530	208	2530	208
	3	0.1922	315	41	0.0155	25	2	1995	252	1995	252	1995	252
	4	0.2402	547	91	0.0065	15	2	2823	467	2823	467	2823	467
	5	0.3473	532	119	0.0022	3	0	1989	443	1989	443	1989	443
	6	0.3132	320	99	0.0014	1	0	1307	404	1307	404	1307	404
	7	0.3146	343	148	0	0	0	1394	601	1394	601	1394	601
Total			2293	521		329	16	15952	2543	13273	2425	13273	2425

Input units are thousands and kg - output in tonnes

Table.6.3.16. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Stock numbers of recruits and their source for recent year-classes used in predictions, and the relative (%) contributions to catches and SSB (by weight) of these year-classes.

Year-class	2017	2018	2019	2020	2021
Stock No. (thousands) of 1 year-olds	8533	8121	7387	3633	3633
Source	XSA	XSA	XSA	GM98-18	GM98-18
Status Quo F:					
% in 2021 catch	20.4	17.9	10.4	1.2	-
% in 2022	23.6	17.8	16.1	4.7	1.2
% in 2021 SSB	21.0	21.2	15.9	1.8	-
% in 2022 SSB	18.9	19.3	20.1	7.8	1.8
% in 2023 SSB	16.7	18.3	19.3	10.4	8.6

GM : geometric mean recruitment

Megrim (L. whiffiagonis) in Divisions 8c and 9a : Year-class % contribution to


a)   2022 catches

b)   2023 SSB
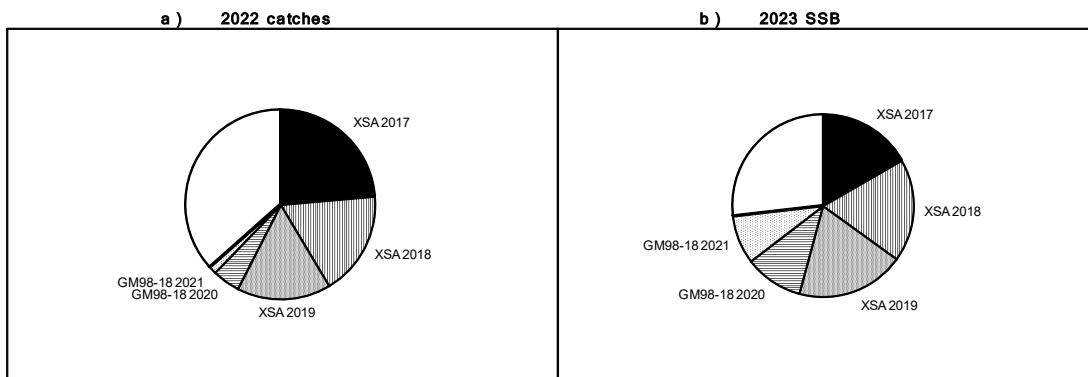
Table 6.3.17. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a, yield-per-recruit results.

MFYPR version 2a
Run: meg
Time and date: 13:27 29/04/2021
Yield per results

Catch FMult	Landings Fbar	CatchNos	Yield	Discards Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	1.2132	4.7748	1.1802	4.7748	1.1802
0.1	0.0175	0.0881	0.0253	0.0024	0.0097	0.0005	5.0295	1.0247	4.2881	0.9918	4.2881	0.9918
0.2	0.0349	0.1538	0.0422	0.0049	0.0191	0.001	4.6557	0.8841	3.9147	0.8511	3.9147	0.8511
0.3	0.0524	0.2042	0.0536	0.0073	0.0284	0.0014	4.359	0.7757	3.6185	0.7428	3.6185	0.7428
0.4	0.0699	0.2439	0.0614	0.0097	0.0374	0.0018	4.1172	0.69	3.3772	0.6571	3.3772	0.6571
0.5	0.0874	0.2757	0.0667	0.0122	0.0462	0.0023	3.9158	0.6208	3.1762	0.588	3.1762	0.588
0.6	0.1048	0.3015	0.0702	0.0146	0.0548	0.0027	3.7451	0.564	3.006	0.5312	3.006	0.5312
0.7	0.1223	0.3227	0.0725	0.017	0.0633	0.0031	3.5982	0.5167	2.8595	0.4839	2.8595	0.4839
0.8	0.1398	0.3403	0.0738	0.0195	0.0716	0.0035	3.4702	0.4768	2.7319	0.4441	2.7319	0.4441
0.9	0.1573	0.3551	0.07	0.0219	0.0797	0.0039	3.36	0.4427	2.6196	0.4101	2.6196	0.4101
1	0.1747	0.3674	0.0748	0.0243	0.0877	0.0043	3.2571	0.4135	2.5197	0.3808	2.5197	0.3808
1.1	0.1922	0.3779	0.0746	0.0268	0.0955	0.0046	3.1672	0.388	2.4302	0.3554	2.4302	0.3554
1.2	0.2097	0.3868	0.0743	0.0292	0.1031	0.005	3.086	0.3658	2.3495	0.3332	2.3495	0.3332
1.3	0.2272	0.3943	0.0737	0.0316	0.1106	0.0053	3.0121	0.3462	2.2761	0.3137	2.2761	0.3137
1.4	0.2446	0.4007	0.0731	0.0341	0.118	0.0057	2.9446	0.3288	2.209	0.2963	2.209	0.2963
1.5	0.2621	0.4061	0.0723	0.0365	0.1252	0.006	2.8826	0.3133	2.1474	0.2809	2.1474	0.2809
1.6	0.2796	0.4107	0.0715	0.0389	0.1323	0.0063	2.8253	0.2994	2.0905	0.267	2.0905	0.267
1.7	0.297	0.4146	0.0706	0.0414	0.1393	0.0066	2.7722	0.2869	2.0378	0.2545	2.0378	0.2545
1.8	0.3145	0.4178	0.0697	0.0438	0.1461	0.007	2.7228	0.2756	1.9888	0.2432	1.9888	0.2432
1.9	0.332	0.4205	0.0688	0.0462	0.1528	0.0073	2.6766	0.2653	1.9431	0.233	1.9431	0.233
2.0	0.3495	0.4228	0.0679	0.0487	0.1594	0.0076	2.6334	0.2559	1.9003	0.2236	1.9003	0.2236

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.1747
FMax	1.0119	0.1768
F0.1	0.5775	0.1009
F35%SPR	0.8905	0.1556

Weights in kilograms
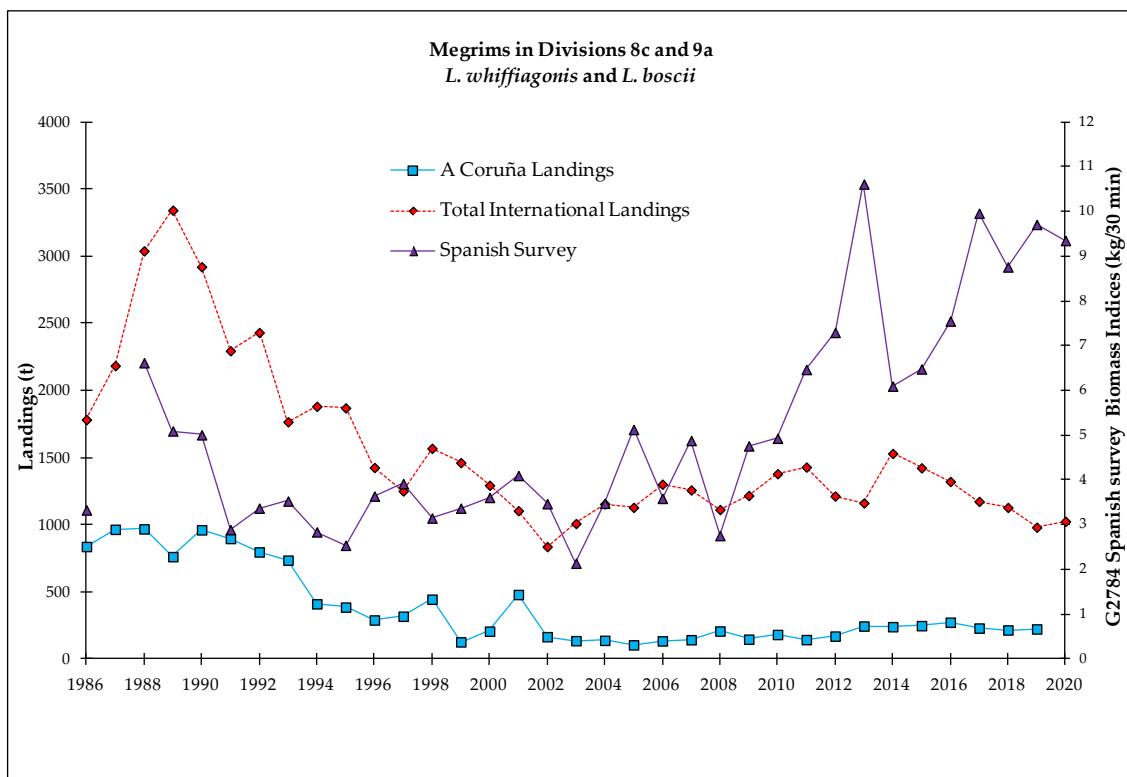
Figure 6.3.1. Historical landings and biomass indices of Spanish survey of megrims (both species combined).
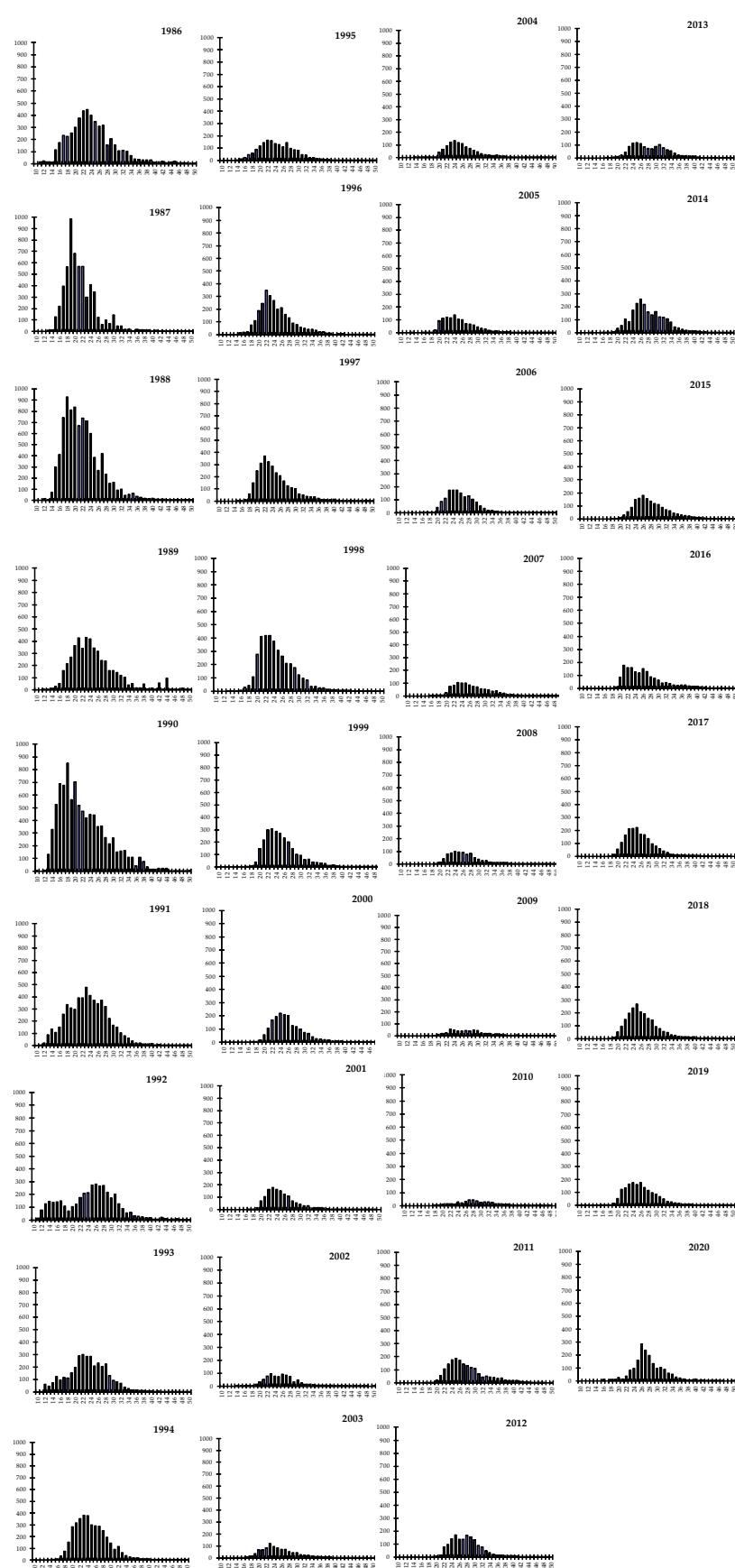
Figure 6.3.2. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Annual length compositions of landings ('000).
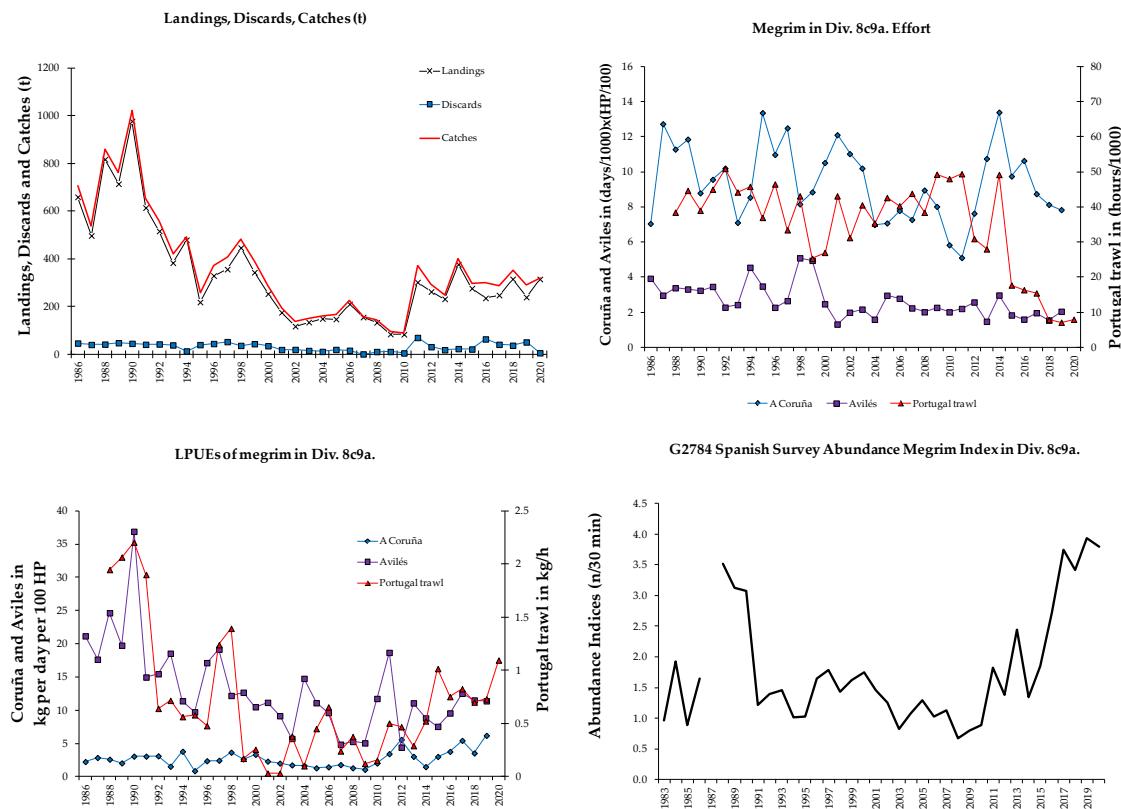
Figure 6.3.3a. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Catches (t), Efforts, LPUEs and Abundance Indices.
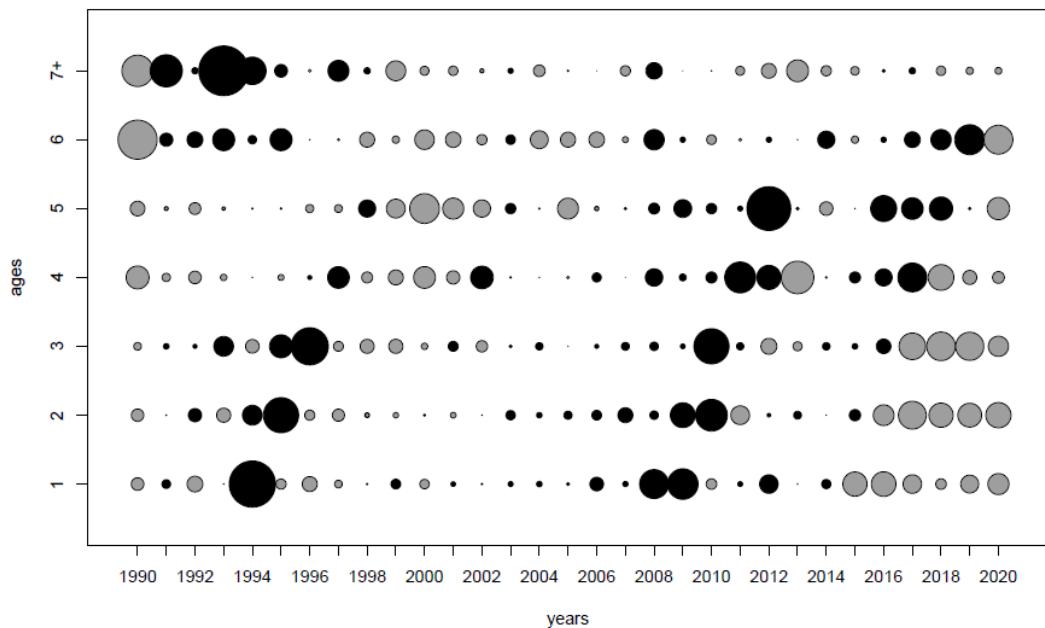
Figure 6.3.3b. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Standardized log (abundance index at age) from survey SP-NSGFS-Q4 (G2784) (Bubbles colour scale: black – negative, grey – positive).

Standardized log (abundance index at age) from A Coruña fleet (SP-LCGOTBDEF).
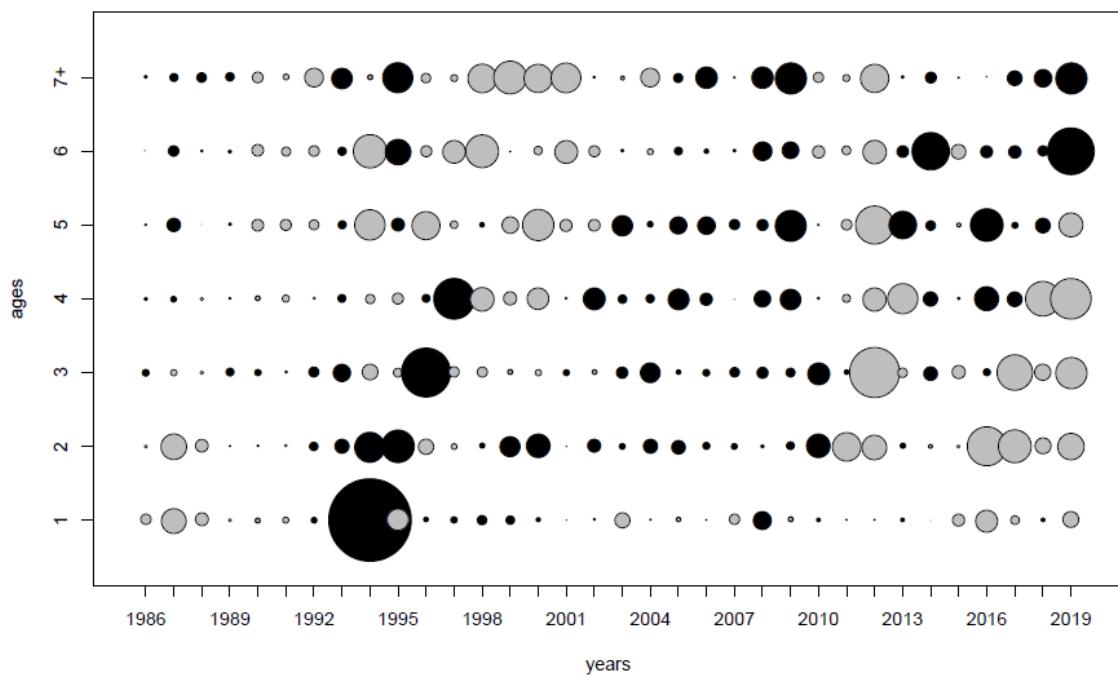
Standardized log (abundance index at age) from Avilés fleet (SP-AVSOTBDEF).
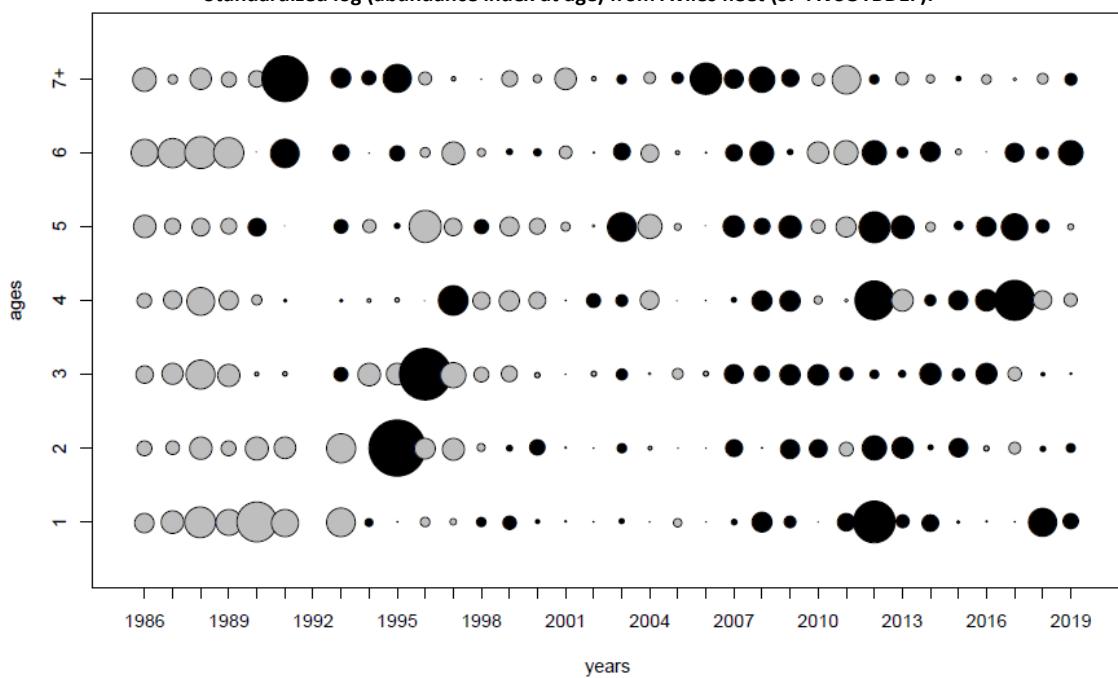
Figure 6.3.3c. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Standardized log (abundance index at age) from A Coruña SP-LCGOTBDEF) and Avilés (SP-AVSOTBDEF) fleets. Bubbles colour scale: black – negative, grey – positive.

Catches proportions at age

Standardized catches proportions-at-age (Bubbles colour scale: black – negative, grey – positive)
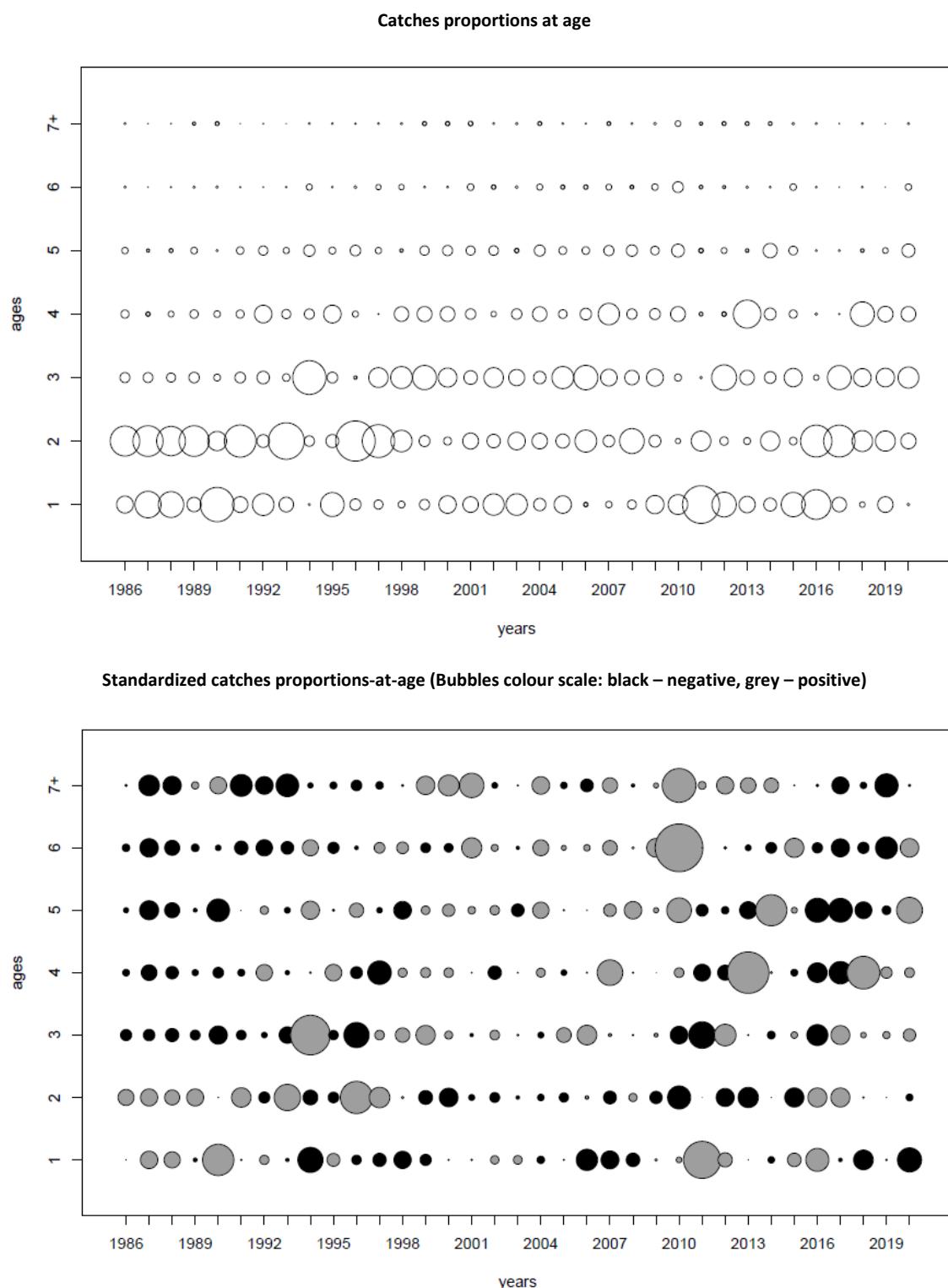
Figure 6.3.4a. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Catch proportions-at-age.

Landings proportions-at-age

Standardized landings proportions-at-age (Bubbles colour scale: black – negative, grey – positive)
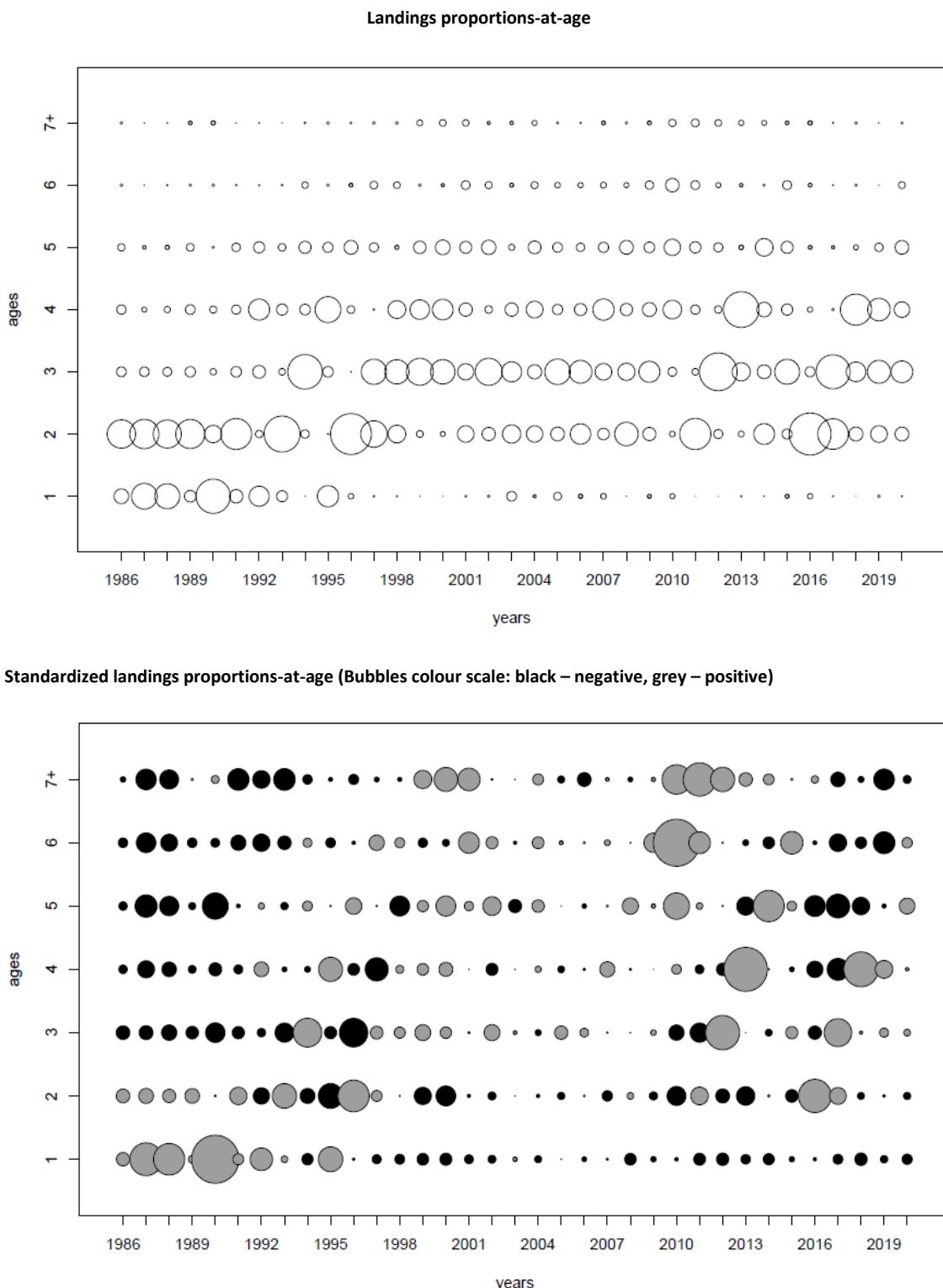
Figure 6.3.4b. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Landings proportions-at-age.

Discards proportions-at-age

Standardized discards proportions-at-age (Bubbles colour scale: black – negative, grey – positive)
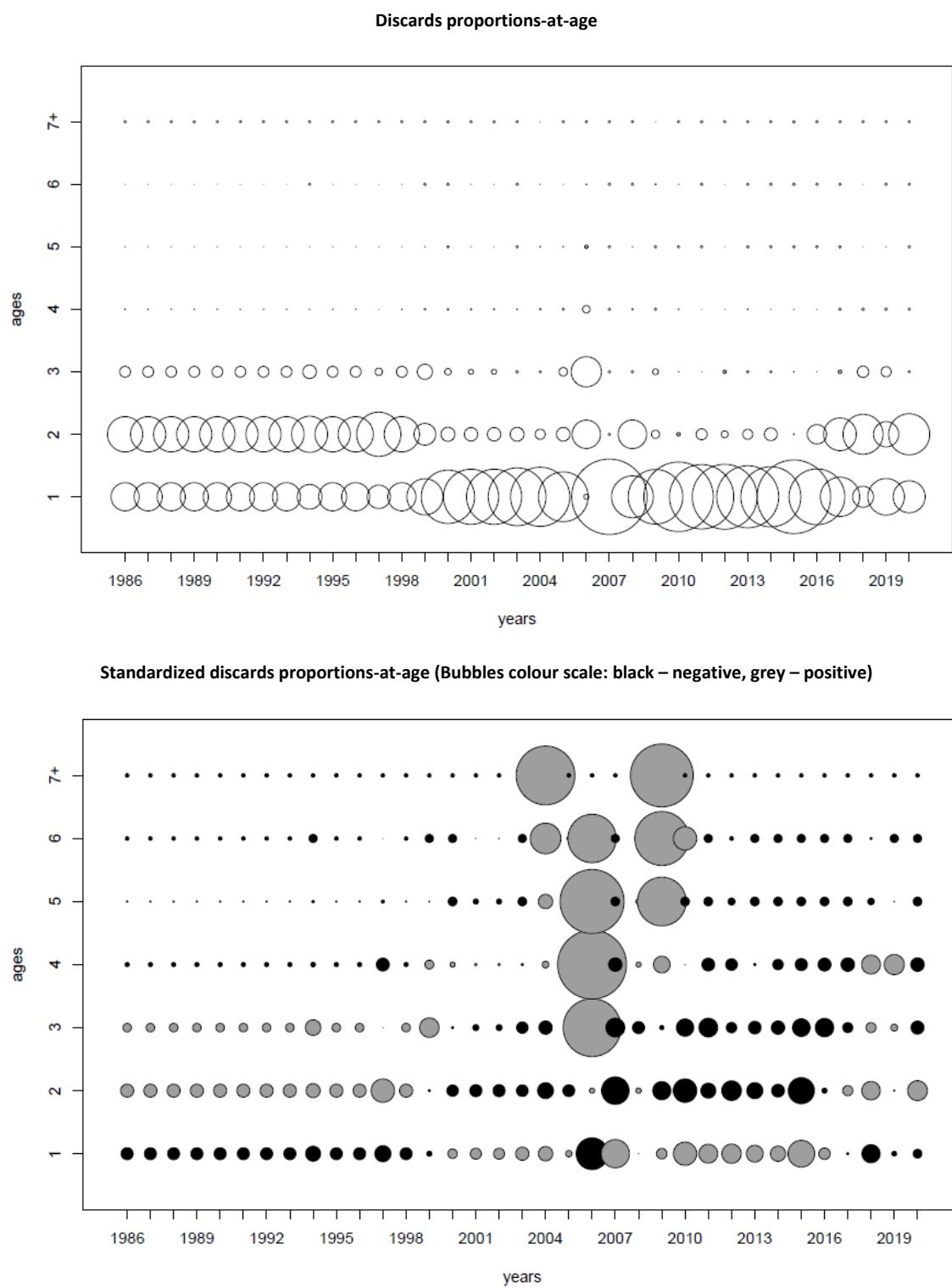
Figure 6.3.4c. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Discards proportions-at-age.
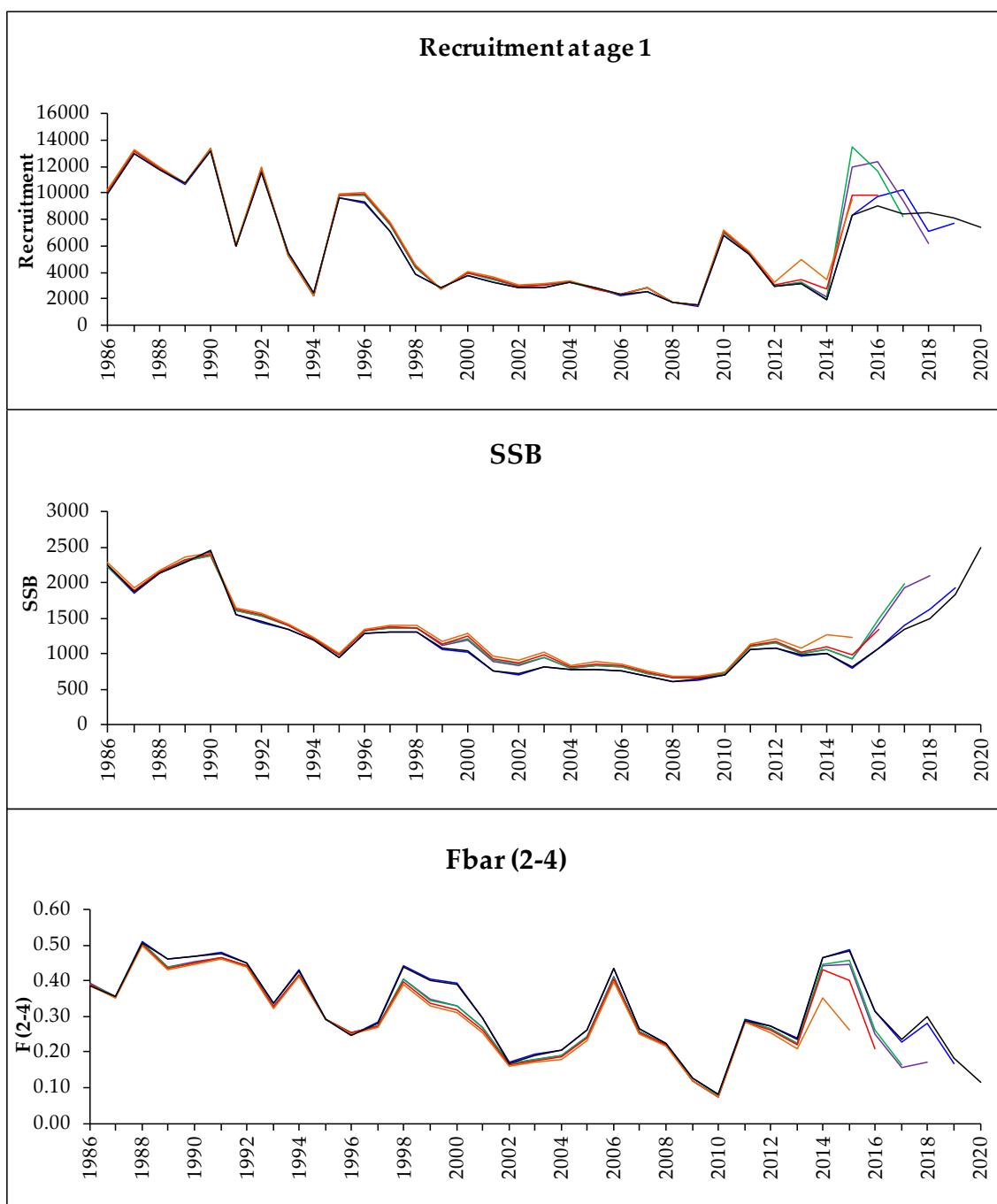
Figure 6.3.5. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Retrospective XSA.
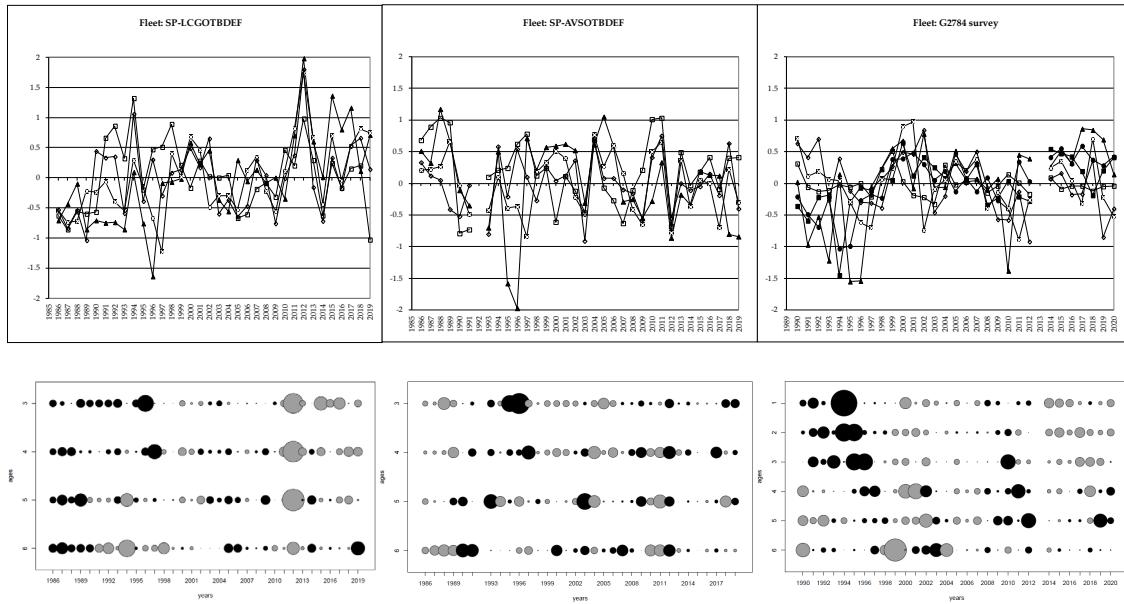
Figure 6.3.6. Megrim in divisions 8.c and 9.a. Log-catchability residual plots (XSA).
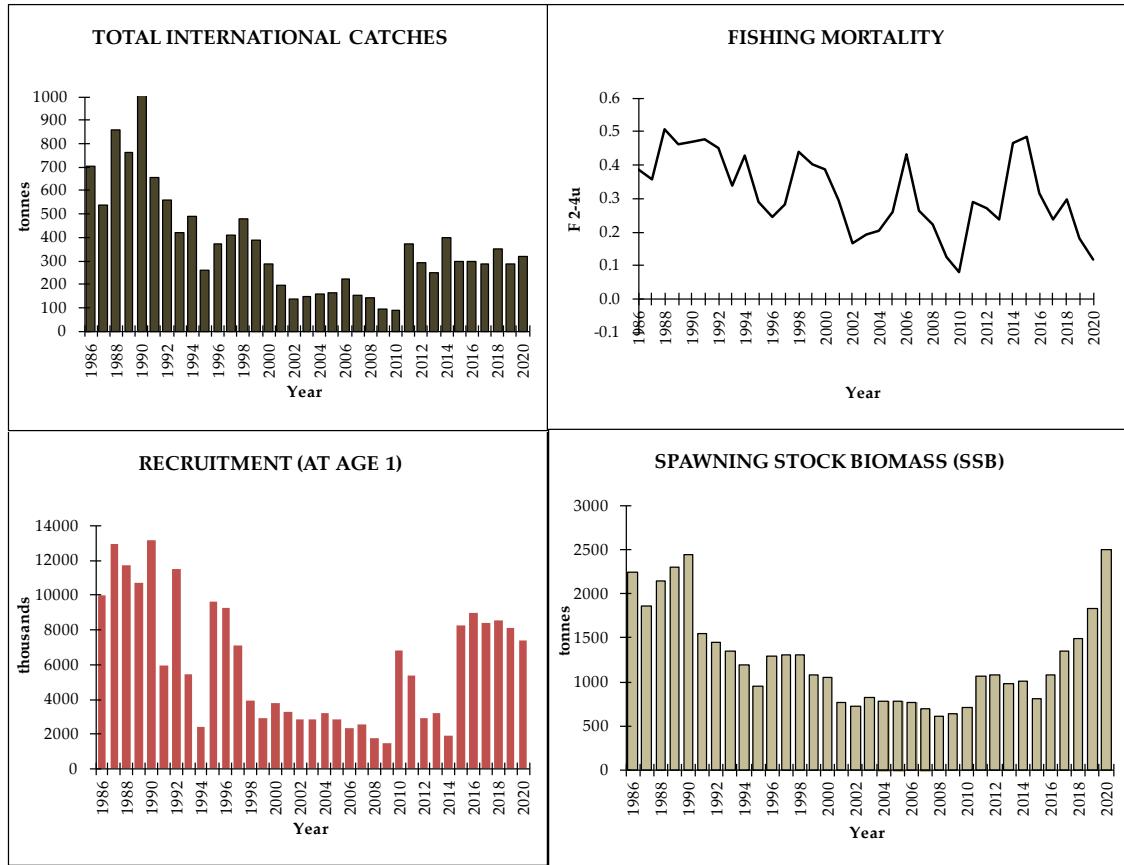
Figure 6.3.7a. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. Stock Summary.

Standardized F-at-age (Bubbles colour scale: black – negative, grey – positive)

Standardized relative F-at-age (Bubbles colour scale: black – negative, grey – positive)
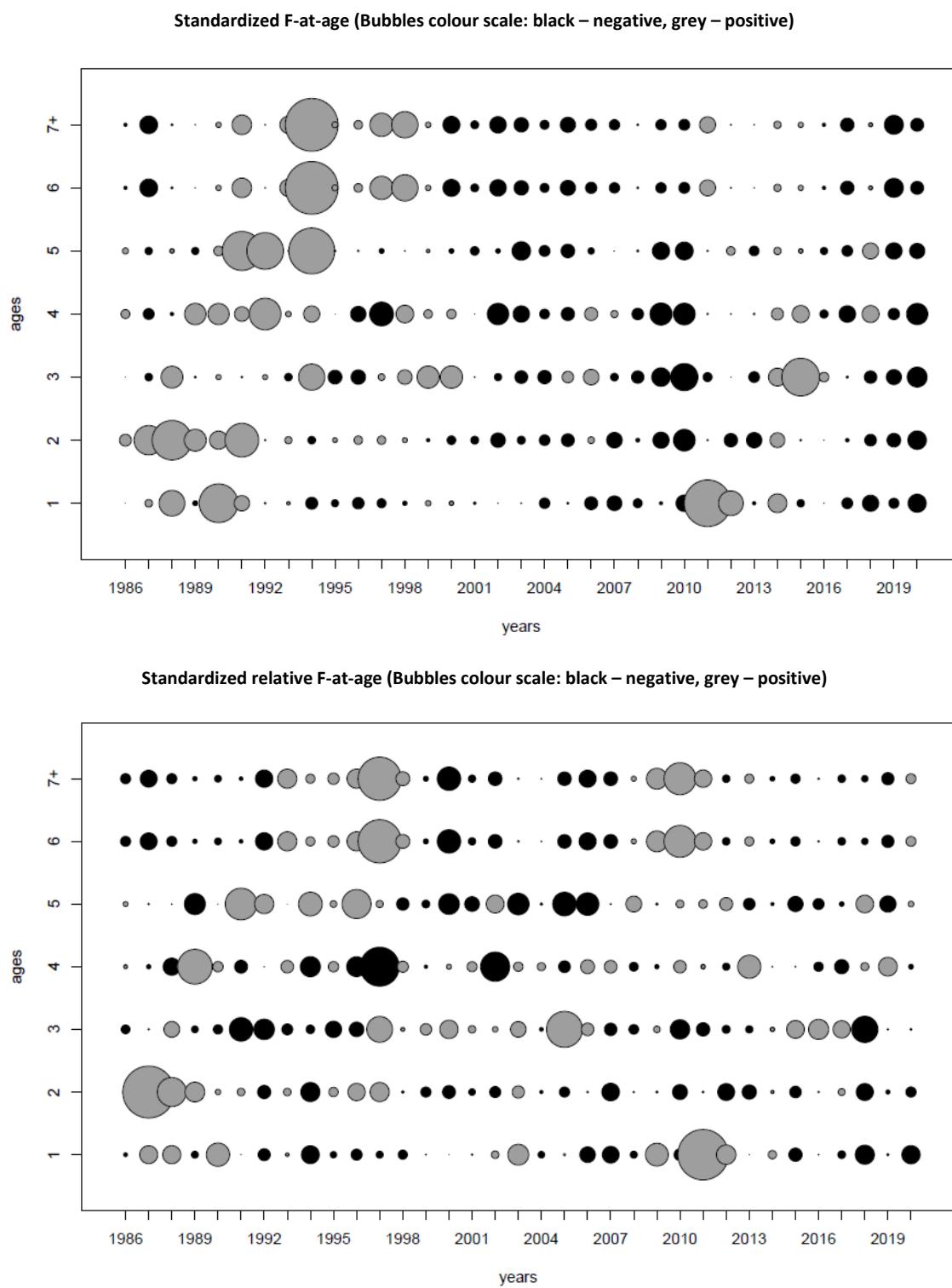
Figure 6.3.7b. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a. F-at-age.
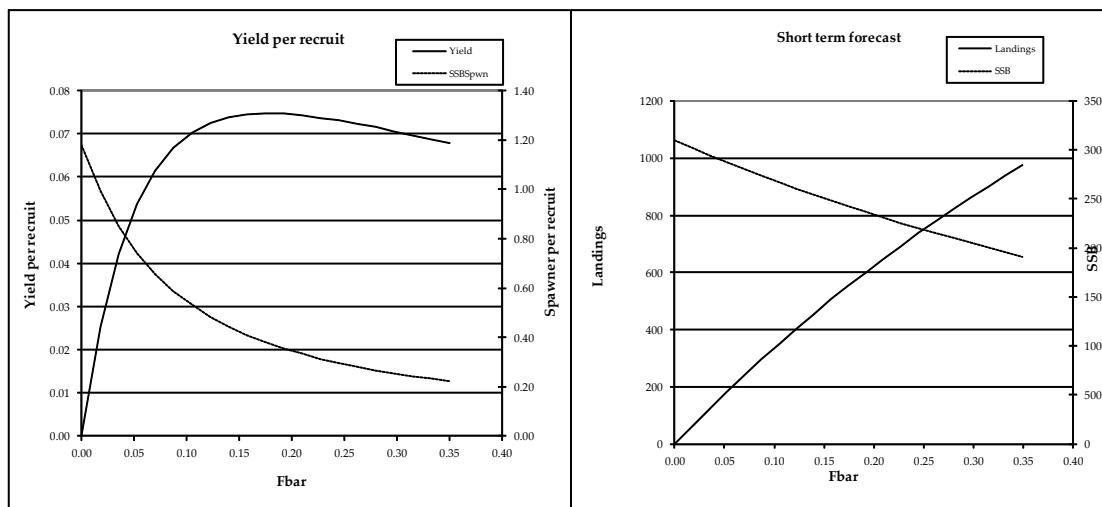
MFYPR version 2a
Run: meg
Time and date: 13:27 29/04/2021

MFDP version 1a
Run: meg
Time and date: 13:19 29/04/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

| Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar	1.0000	0.1747
FMax	1.0119	0.1768
F0.1	0.5775	0.1009
F35%SPR	0.8905	0.1556

Figure 6.3.8. Megrim (*L. whiffiagonis*) in divisions 8.c and 9.a, forecast summary.
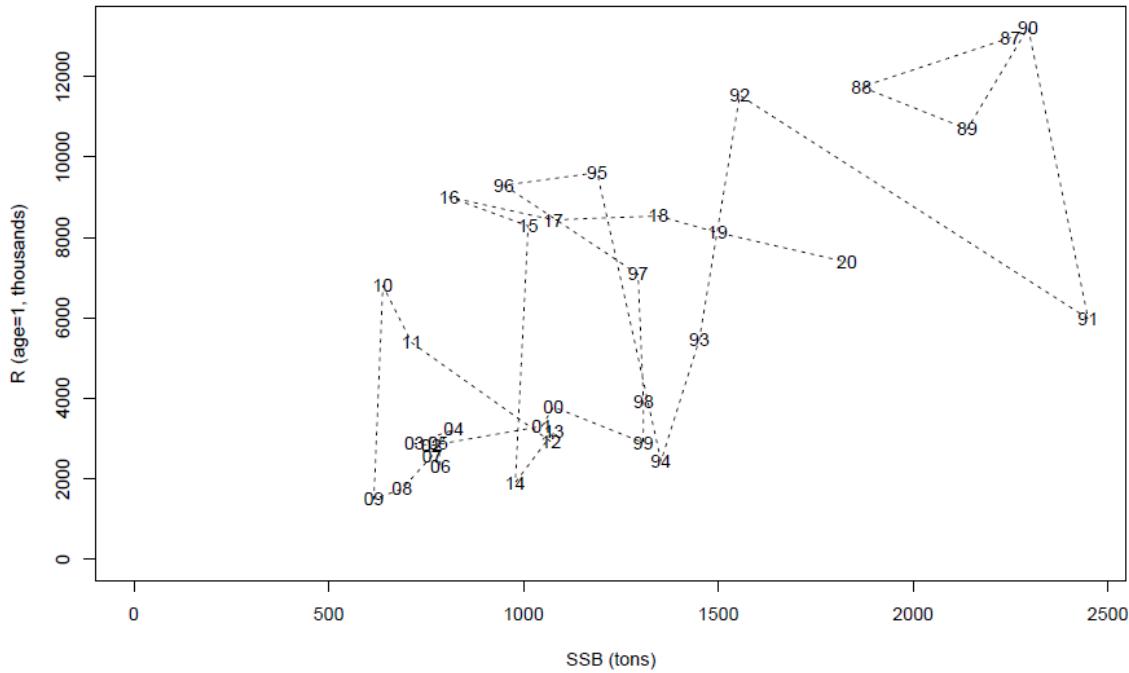
**Figure 6.3.9. Megrim (*L.whiffiagonis*) in divisions 8.c and 9.a. SSB-Recruitment plot (numbers in graph, 1987–2020, are recruitment years).**

6.4 Four-spot megrim (*Lepidorhombus boscii*) in divisions 8.c and 9.a

6.4.1 General

See general section for both species.

6.4.2 Data

6.4.2.1 Commercial catches and discards

The WG estimates of four-spot megrim international landings, discards, and catches for the period 1986 to 2020 are given in Table 6.4.1. The sampling programs coordinated by the Spanish Institute of Oceanography-IEO (onshore, observers at-sea and biological sampling) were suspended partially of 2020 due to administrative problems and to the COVID-19 disruption. This affected all stocks. From 2011 to 2018, estimates of unallocated or non-reported landings were included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier. These estimates are considered the best information available at this time. In 2015, data revised for the period 2011–2013 were provided. This revision produced an improvement in the allocation of sampling trips and the data revised are used in the assessment. Landings reached a peak of 2629 t in 1989 and have generally declined since then to their lowest value of 720 t in 2002. There has been some increase again in the last few years. Landings in 2010 are 1297 t, the highest value after 1995. In 2020, the landings value of 711 t is one of the lowest of the time-series.

Discards estimates were available from the "observers' onboard sampling programme" for Spain in the years displayed in Table 6.4.2a. In 2020, discards data of the first semester were missing for the reasons previously mentioned and were estimated based on the discard per unit of effort of the second semester applied to the exerted effort in the first semester. Discard / Total Catch ratio and CV are also presented, where discards in number represent between 21–67% of the total catch. Following the ICES recommendations in the advice sheet and using the same methodology described for *L. whiffiagonis* in section 6.1.2.1, discards missing data were also estimated for *L. boscii* in the WKSOUTH benchmark in 2014 (ICES, 2014). Spanish discards in numbers-at-age are shown in Table 6.4.2b, indicating that the bulk of discards (in numbers) is for ages 1 to 3. Total discards are given in tons in Table 6.4.1

6.4.2.2 Biological sampling

Annual length compositions of total stock landings are provided in Figure 6.4.1 for the period 1986–2020 and in Table 6.4.3a for the year 2020. Due to the lack of samplings in 2020, some length distributions in some quarters were missing. The existing ones were raised to the total catch of the métier.

Mean length and mean weight in landings since 1990 are shown in Table 6.4.3b.

Age compositions of catches are presented in Table 6.4.4. Weights-at-age of catches (given in Table 6.4.5) were also used as weights-at-age in the stock. There is some variability of the weights-at-age through the historical time-series.

For more information about biological data see Stock Annex.

6.4.2.3 Abundance indices from surveys

Portuguese and Spanish survey indices are summarized in Table 6.4.6.

Two Portuguese surveys, named "Crustacean" (PT-CTS (UWTV(FU28–29))) and "October" (PtGFS-WIBTS-Q4 (G8899)), provide biomass and abundance indices. The October survey was conducted with a different vessel and gear in 2003 and 2004. Excluding these two years, the biomass index from this survey in 2017 was the highest observed since 1994, whereas the value in 2010 is the second-lowest in the series. In 2011, both the biomass and abundance indices from the Crustacean survey are the highest in the time-series. In 2012 and the last two years, 2019 and 2020, the Portuguese Surveys were not carried out. Total biomass, abundance and recruitment indices from the Spanish Groundfish Survey (SP-NSGFS-Q4 (G2784)) are also presented in Table 6.4.6. Total biomass indices from this survey generally remained stable after a maximum level in 1988 until 2003, when a very low value was obtained (as done in previous years, the 2003 index has been excluded from the assessment, as it was felt to be too much in contradiction with the rest of the time-series). Since then, this was followed by a period of higher values until the present days, with the only exception of 2008. In 2013, the biomass and the abundance indices were the highest of the series. For the same reason that for *L. whiffiagonis*, i.e. the survey carried out in a new vessel, the abundance value of 2013 was not included in the assessment model. In 2017, the survey presented the second-highest value in both biomass and abundance indices, remaining high in 2019 and 2020.

The recruitment index for age 0 in 2005 was very high and also in 2009 and 2014. A medium value was estimated for the year 2020. The high index in 2009 applies to all ages and not just the recruitment (see Table 6.4.7, which gives abundance indices by age, and Figure 6.4.2, which is a bubble plot of log(abundance index at age) standardized by subtracting the mean and dividing by the standard deviation over the years). Since 2009, almost all ages appear to be above average. From Figure 6.4.2, the survey appears to have been quite good in tracking cohorts in the last ten years, the stronger cohorts of 2005, 2009 and 2014 can be followed, especially the last two.

6.4.2.4   Commercial catch-effort data

Two new commercial tuning indices were also provided for this stock as in the case of *L. whiffiagonis*. The LPUEs of the métiers of bottom otter trawl targeting demersal species, previously described in section 6.1.2.4, one per port (A Coruña and Avilés), was made available for the WKSOUTH benchmark in 2014 (ICES, 2014). From these new tuning fleets, SP-LCGOTBDEF and SP-AVSOTBDEF, only the first one was accepted to tune the assessment model. The LPUE and effort values and landed numbers-at-age are given in Table 6.4.7 and Figure 6.4.3a.

These fleets operate in different areas, each covering only a small part of the distribution of the stock, which may partly explain differences between patterns from these fleets and those from the Spanish survey in some years. Furthermore, commercial catches are mostly composed of ages 3 and 4, while the Spanish survey catches mostly fish of ages 1 and 2.

Table 6.4.8 displays landings (in tonnes), fishing effort and LPUE for the Spanish trawl fleet SP-LCGOTBDEF for the period 1986–2019, SP-AVSOTBDEF for the period 1986–2015 and for the Portuguese trawl fleet fishing in Division 9a for the period 1988–2020 (see also Figure 6.4.3). As SP-AVSOTBDEF is not used in the assessment, the sampling for this species in this port has been suspended since 2015. After a very high value in 2010 and a drop in the two following years, the LPUE of Coruña (SP-LCGOTBDEF) shows in 2019 a small decrease relative to the previous year. The Portuguese LPUE series was revised from 2012 onwards. To revise the series backwards, further refinement of the algorithms is required.

6.4.2.4.1.1   Commercial fleets used in the assessment to tune the model

Both Spanish commercial fleets could not be updated because of the problems in samplings that were mentioned in section 6.4.2.1. Because of the trend in the residuals, A Coruña fleet (SP-LCGOTBDEF) was split in two (SP-LCGOTBDEF-1 and SP-LCGOTBDEF-2) for tuning, considering values until 1999 and from 2000 onwards, as indicated in the Stock Annex. In Figure 6.4.3b,

the bubble plots of log (abundance index at age) standardized by subtracting the mean and dividing by the standard deviation over the years) of these two fleets are presented. Some cohorts can be followed in the time-series. The effort of the SP-LCGOTBDEF fleet had been generally stable until year 2009, when effort is declining to its lowest value in the series, reached in 2011. After this year, the effort began to increase until 2014 when the highest value of the time-series was observed.

6.4.2.4.1.2   Commercial fleets not used in the assessment to tune the model

The effort of the Avilés fleet (SP-AVSOTBDEF) presents two periods, the first one with a mean value of 3.2 and the second with 2.2 (days/1000) x (HP/100). The value in 2013 is one of the lowest of the series and was similar in 2015. The effort of the Portuguese trawl fleet shows a slightly declining trend until last year, one of the lowest of the time-series.

The LPUE series from the Avilés trawl fleet (SP-AVSOTBDEF) shows a generally upwards trend during all the series. The LPUE of the Portuguese trawl fleet has generally declined from 1992 to 2001, followed by an increase until 2010, when the values started a decreasing trend. Since 2014, there is an increasing trend and the 2020 value is the highest observed over the years.

6.4.3   Assessment

An update assessment was conducted, according to the Stock Annex specifications. Assessment years are 1986–2020 and ages 0–7+.

6.4.4   Model

Data screening

Figures 6.4.4a, b and c are bubble plots representing catch, landings and discards proportions-at-age, respectively. These plots clearly indicate that the bulk of the landings generally corresponds to ages 2 to 4 and the discards to ages 1–2, although in the last years, it seems to be an increase in age 5 and a decrease in age 2. The bottom panel of Figures 6.4.4a, b and c also present bubble plots corresponding to standardized catch, landings and discards proportions-at-age, respectively, showing that the one corresponding to landings is the best to follow cohorts.

Very weak cohorts corresponding to year-classes of 1993 and 1998 can be clearly identified from the standardized landing proportions-at-age matrix and stronger cohorts corresponding to year-classes of 1991, 1992, 1995, 2005 and 2009 can also be tracked.

Final XSA run

Settings for the assessment are those detailed in the Stock Annex.

The retrospective analysis shows no particular worrying features (Figure 6.4.5). The model tends to underestimate F and overestimate SSB in the last years.

6.4.4.1   Assessment results

Diagnostics from the XSA final run are presented in Table 6.4.9 and log-catchability residuals plotted in Figure 6.4.6. Diagnostics and residuals are similar to those found in the previous assessment. Many of the survey residuals are negative until the 2000s. After that, positive survey residuals are more abundant in this period.

Table 6.4.10 presents the fishing mortality-at-age estimates. F_{bar} ($= F_{2-4}$) is estimated to be 0.108 in 2020.

Population numbers-at-age estimates are presented in Table 6.4.11.

6.4.4.2   Year-class strength and recruitment estimations

The 2018 year-class estimate is 47 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (97% of weight) and F-shrinkage (3% weight).

The 2019 year-class estimate is 37 million individuals, estimated from the Spanish survey (95% of weight) and F-shrinkage (5% weight).

The 2020 year-class estimate is 46 million individuals, obtained a value from the Spanish survey (100% weight).

The working group considered that the XSA last year recruitment is poorly estimated. Following the procedure stated in the Stock Annex, the geometric mean of estimated recruitment over the years 1990–2018 has been used for the computation of 2020 and subsequent year-classes, for prediction purposes. Working Group estimates of year-class strength used for prediction are:

Recruitment-at-age 0:

Year-class	Thousand	Basis	Survey	Commercial	Shrinkage
2018	46800	XSA	97%	-	3%
2019	36800	XSA	95%	-	5%
2020	43194	GM_{90-18}		-	
2021	43194	GM_{90-18}			

6.4.4.3   Historic trends in biomass, fishing mortality, and recruitment

Estimated fishing mortality and population numbers-at-age from the XSA run are given in Tables 6.4.10 and 6.4.11. Further results, including SSB estimates, are summarized in Table 6.4.12 and Figure 6.4.7a.

SSB decreased gradually from 6698 t in 1988 to 3133 t in 2001, the lowest value in the series, and has since increased. In 2020, the SSB was estimated at 7353 t, the highest of the time-series.

Recruitment has fluctuated around 47 million fish during all the series. Very weak year-classes are found in 1993 and 1998. The second highest value occurred in 2012, while the 2014 value is the third one in the series. Last year value is considered in the average.

Estimates of fishing mortality values show two different periods: an initial one with higher values from 1986 to 1996 and, following a decrease in 1997, a second period at a lower level, with small ups and downs. From 2007, the F has been decreasing until 2013. After two years of increasing values, the last five years show a decline in F, with the lowest values of the time-series observed in 2020.

There seems to be interannual variability of the relative fishing exploitation pattern at age (F over F_{bar} (Figure 6.4.7b), bottom panel), with alternating periods of time with higher and lower relative exploitation patterns on older ages.

6.4.5   Catch options and prognosis

Stock projections were calculated according to the settings specified in the Stock Annex.

6.4.5.1   Short-term projections

Short-term projections have been made using MFDP software (Multi Fleet Deterministic Projection; Smith, 2000). The input data for deterministic short-term projections are given in Table

6.4.13. Average F_{bar} for the last three years is assumed for the interim year. The exploitation pattern was the scaled F-at-age computed for each of the last five years and then the average of these scaled five years was weighted to the final year. This selection pattern was split into selection-at-age of landings and discards (corresponding to F_{bar} = 0.09 for landings and F_{bar} = 0.04 for discards, being 0.13 for catches). The recruitment in 2020 (age 0) has been replaced by the geometric mean (in accordance with the Stock Annex, GM is computed over years 1990-final assessment year minus 2), age 1 in 2021 has been recalculated from GM reduced by total estimated mortality obtained from the fishing mortality of age 0 of the last year and the natural mortality.

Table 6.4.14 gives the management options for 2022, and their consequences in terms of projected landings and stock biomass. Figure 6.4.8 (right panel) plots short-term yield and SSB vs. F_{bar}. The detailed output by age-group, assuming F *status quo*, is given in Table 6.4.15 for landings and discards. Under this scenario, projected landings for 2021 and 2022 are 1145 and 1185 t, respectively. Projected discards for the same years are 129 and 128 t.

Under F *status quo*, projected SSB values for 2022 and 2023 are about 8954 t and 9337 t, respectively.

The contributions of recent year-classes to the projected landings and SSB are presented in Table 6.4.16. GM_{90-18} recruitment is assumed to contribute with 6% to catches in 2022 and with 27% to SSB in 2023.

6.4.5.2   Yield and biomass per recruit analysis

The analysis is conducted following the Stock Annex specifications and results presented in Table 6.4.17. The left panel of Figure 6.4.8 plots yield-per-recruit and SSB-per-recruit vs. F_{bar}.

Under F s*tatus quo* (F_{bar} = 0.09 for landings and F_{bar} = 0.04 for discards and assuming GM_{90-18} recruitment of 43 million, the equilibrium yield would be around 1369 t of landings and 134 t of discards, with an SSB value of 10 025 t.

6.4.5.3   Biological reference points

The stock-recruitment time-series is plotted in Figure 6.4.9. See Stock Annex for more information about the biological reference points. The BRPs are:

	Type	Value	Technical basis
MSY Approach	MSY $B_{trigger}$	4600 t	B_{pa}
	F_{MSY}	0.193	
	F_{MSY} lower	0.125	based on 5% reduction in yield
	F_{MSY} upper (with advice rule)	0.29	based on 5% reduction in yield
	F_{MSY} upper (without advice rule)	0.29	based on 5% reduction in yield
	$F_{P.05}$	0.58	5% risk to B_{lim} with $B_{trigger}$.
Precautionary Approach	B_{lim}	3300 t	B_{loss} estimated in 2015
	B_{pa}	4600 t	1.4 B_{lim}
	F_{lim}	Undefined	
	F_{pa}	0.58	F_{pa} = $F_{P0.5}$

6.4.6   Comments on the assessment

Two commercial fleets (SP-LCGOTBDEF-1 and SP-LCGOTBDEF-2) and the Spanish survey (SP-NSGFS-Q4 (G2784)) were used for tuning. The commercial fleet data used for tuning corresponds to ages 3 and older, which are not well represented in the survey. The Spanish survey covers a large part of the distribution area of the stock. The survey appears to have been quite good at tracking cohorts.

Since the benchmark in 2014, the model converges. It seems that the convergence issue was solved for this stock.

6.4.6.1   Sensitivity analysis

Some missing data in 2020 had to be estimated due to the data issues in 2020 resulting from the impact of COVID-19 in the data collection from the commercial fishery and research surveys. In the case of discards, the first semester data are missing and were estimated based on the discard per unit of effort of the second semester applied to the exerted effort in the first semester. This estimation showed values that appear to be low. In order to check the impact of a possible un-derestimation of discards in the assessment and advice, a sensitivity analysis has been carried out. For that, a re-estimation of discards using the average of the last three years proportions of discards at age had done and the estimated values are shown in the next table:

	Landings (tonnes)	Discards (tonnes)	Catch (tonnes)
Duplicate	711	81	792
Average	711	154	865

The assessment and forecast were carried out again with the new discards by age and the impact on the results was negligible. A comparison between both assessments and forecasts are shown in the figure and table below, respectively.

Recruits at age 0

SSB

F (2-4)

WGBIE2021

2021

Biomass	SSB	FMult	Catch Landings		Discards	
			FBar	Yield	FBar	Yield
9105	8490	1	0.0862	1145	0.0416	129

2022 / 2023

Biomass	SSB	FMult	Catch Landings		Discards		Biomass	SSB
			FBar	Yield	FBar	Yield		
9587	8954	0	0.0000	0	0.0000	0	11485	10842
.	8954	0.1	0.0086	129	0.0042	13	11320	10678
.	8954	0.2	0.0172	256	0.0083	27	11159	10517
.	8954	0.3	0.0259	381	0.0125	40	11000	10359
.	8954	0.4	0.0345	503	0.0167	53	10845	10205
.	8954	0.5	0.0431	622	0.0208	66	10693	10053
.	8954	0.6	0.0517	739	0.0250	78	10543	9904
.	8954	0.7	0.0603	854	0.0291	91	10397	9758
.	8954	0.8	0.0689	967	0.0333	104	10253	9615
.	8954	0.9	0.0776	1077	0.0375	116	10112	9475
.	8954	1	0.0862	1185	0.0416	128	9974	9337
.	8954	1.1	0.0948	1291	0.0458	140	9838	9202
.	8954	1.2	0.1034	1395	0.0500	152	9705	9070
.	8954	1.3	0.1120	1497	0.0541	164	9574	8940
.	8954	1.4	0.1206	1597	0.0583	176	9446	8813
.	8954	1.5	0.1293	1695	0.0625	187	9321	8688
.	8954	1.6	0.1379	1791	0.0666	199	9197	8565
.	8954	1.7	0.1465	1885	0.0708	210	9076	8445
.	8954	1.8	0.1551	1978	0.0749	221	8958	8327
.	8954	1.9	0.1637	2068	0.0791	232	8841	8211
.	8954	2	0.1723	2157	0.0833	243	8727	8097

Input units are thousands and kg - output in tonnes

Sensitivity_analysis

2021

Biomass	SSB	FMult	Catch Landings		Discards	
			FBar	Yield	FBar	Yield
9068	8453	1	0.089	1174	0.0471	147

2022 / 2023

Biomass	SSB	FMult	Catch Landings		Discards		Biomass	SSB
			FBar	Yield	FBar	Yield		
9501	8870	0	0.0000	0	0.0000	0	11399	10758
.	8870	0.1	0.0089	132	0.0047	15	11228	10588
.	8870	0.2	0.0178	262	0.0094	30	11061	10422
.	8870	0.3	0.0267	389	0.0141	45	10897	10259
.	8870	0.4	0.0356	513	0.0188	60	10737	10099
.	8870	0.5	0.0445	635	0.0236	74	10579	9942
.	8870	0.6	0.0534	754	0.0283	89	10425	9789
.	8870	0.7	0.0623	871	0.0330	103	10274	9638
.	8870	0.8	0.0712	986	0.0377	117	10126	9491
.	8870	0.9	0.0801	1098	0.0424	131	9980	9346
.	8870	1	0.0890	1208	0.0471	145	9838	9204
.	8870	1.1	0.0979	1315	0.0518	158	9698	9066
.	8870	1.2	0.1068	1421	0.0565	172	9561	8929
.	8870	1.3	0.1157	1524	0.0612	185	9427	8796
.	8870	1.4	0.1246	1625	0.0659	198	9296	8665
.	8870	1.5	0.1336	1724	0.0707	211	9167	8537
.	8870	1.6	0.1425	1821	0.0754	224	9040	8411
.	8870	1.7	0.1514	1917	0.0801	237	8916	8288
.	8870	1.8	0.1603	2010	0.0848	249	8795	8167
.	8870	1.9	0.1692	2101	0.0895	262	8676	8049
.	8870	2	0.1781	2191	0.0942	274	8559	7933

Input units are thousands and kg - output in tonnes

6.4.7 Management considerations

This assessment indicates that SSB decreased substantially between 1988 and 2001, the year with the lowest SSB, followed by a smooth increasing trend from 2001 to the present. Fishing at *status quo* F during 2021 would result in some biomass increase for 2021 and 2022.

There is no evidence of reduced recruitment at low stock levels.

As with *L. whiffiagonis*, it should be noted that four-spot megrim (*L. boscii*) is caught in mixed fisheries, and management measures applied to this species may have implications for other stocks. Both species of megrim are subject to a common TAC, so the joint status of these species should be taken into account when formulating management advice.

6.4.8 References

ICES. 2014. Report of the Benchmark Workshop on Southern megrim and hake (WKSOUTH), 3–7 February 2014, ICES HQ, Copenhagen, Denmark. ICES CM 2014/ACOM:40. 236 pp.

Smith, M.T. 2000. Multi Fleet Deterministic Projection (MFDP): a user guide. NAFO Scientific Council Studies, 36: 115–134.

6.4.9 Tables and figures

Table 6.4.1. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Total landings (t).

Year	Spain landings 8c	Spain landings 9a*	Spain landings Total	Portugal landings 9a	Unallocated/ Non reported	Total landings	Discards	Total catch
1986	799	197	996	128		1124	284	1408
1987	995	586	1581	107		1688	333	2021
1988	917	1099	2016	207		2223	363	2586
1989	805	1548	2353	276		2629	408	3037
1990	927	798	1725	220		1945	409	2354
1991	841	634	1475	207		1682	447	2129
1992	654	938	1592	324		1916	437	2353
1993	744	419	1163	221		1384	438	1822
1994	665	561	1227	176		1403	517	1920
1995	685	826	1512	141		1652	406	2058
1996	480	448	928	170		1098	368	1466
1997	505	289	794	101		896	308	1204
1998	725	284	1010	113		1123	378	1501
1999	713	298	1011	114		1125	317	1442
2000	674	225	899	142		1041	373	1414
2001	629	177	807	124		931	290	1221
2002	343	247	590	130		720	308	1028
2003	393	314	707	169		876	191	1067
2004	534	295	829	177		1006	348	1354
2005	473	321	794	189		983	375	1358
2006	542	348	891	201		1092	335	1427
2007	591	295	886	218		1104	292	1396
**2008	546	262	808	172		980	202	1182
2009	577	342	919	215		1134	279	1413
2010	616	484	1100	197		1297	265	1562
^2011	390	384	774	181	172	1128	269	1397
^2012	240	239	479	98	374	952	369	1321
^2013	338	283	621	80	230	931	496	1427
2014	427	313	739	142	273	1154	788	1942
2015	460	255	715	137	296	1148	597	1745
2016	403	276	679	105	303	1087	332	1419
2017	346	265	611	144	172	926	246	1173
2018	381	231	612	130	72	814	92	906
2019	385	240	625	118		742	201	943
2020	346	224	569	141		711	81	792

^Data revised in WG2015

*9a is without Gulf of Cádiz till 2016

** Data revised in WG2010

* Official data by country and unallocated landings

Table. 6.4.2a. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Discard/Total Catch ratio and estimated CV for Spain from onboard sampling.

Year	1994	1997	1999	2000	2003	2004	2005	2006	2007
Weight Ratio	0.30	0.28	0.24	0.29	0.21	0.30	0.32	0.27	0.25
CV	23.2	11.2	14.4	16.5	10.2	23.1	24.0	48.4	18.3
Number Ratio	0.50	0.63	0.59	0.61	0.47	0.55	0.55	0.42	0.47

Year	2008	2009	2010	2011*	2012	2013	2014	2015	2016
Weight Ratio	0.20	0.23	0.19	0.24	0.39	0.35	0.41	0.34	0.23
CV	22.6	21.1	18.8	16.0	15.5	23.2	17.8	20.1	16.4
Number Ratio	0.42	0.39	0.62	0.50	0.52	0.63	0.67	0.60	0.47

Year	2017	2018	2019	2020
Weight Ratio	0.21	0.10	0.21	0.10
CV	15.2			
Number Ratio	0.39	0.24	0.41	0.21

**All discard data revised in WG2011

*Data revised in WG2013

Table. 6.4.2b. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Discards in numbers-at-age (thousands) for Spanish trawlers.

	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	1289	1289	1289	1289	1289	1289	1289	1289	678
1	3322	3322	3322	3322	3322	3322	3322	3322	2741
2	4322	4322	4322	4322	4322	4322	4322	4322	4134
3	2211	2211	2211	2211	2211	2211	2211	2211	2710
4	605	605	605	605	605	605	605	605	581
5	94	94	94	94	94	94	94	94	189
6	20	20	20	20	20	20	20	20	55
7	4	4	4	4	4	4	4	4	11

	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	1289	1289	256	1289	2933	354	208	208	238
1	3322	3322	3273	3322	3954	6148	5673	5673	4479
2	4322	4322	6099	4322	2734	1207	1750	1750	989
3	2211	2211	2108	2211	1815	1888	1025	1025	495
4	605	605	146	605	1088	1218	477	477	50
5	94	94	90	94	3	171	67	67	2
6	20	20	3	20	0	12	4	4	0
7	4	4	0	4	1	2	1	1	

	2004	2005	2006	2007	2008	2009	2010	2011*	2012
0	33	10	1	100	202	2	2879	30	682
1	6393	3515	1233	3248	2342	1525	10362	5132	5313
2	3053	5482	2497	4541	2374	2490	1301	3595	2480
3	693	609	1445	757	1384	1970	696	544	1057
4	163	183	486	105	52	480	283	174	15
5	27	56	168	44	10	51	83	37	5
6		23	22	7	3	7	11	1	2
7		6	9	1	3		1		0

	2013	2014	2015	2016	2017	2018	2019	2020
0	275	0	157	2	0	0	0	0
1	5499	5645	2437	1606	526	209	717	180
2	4379	11089	7061	5506	2116	1066	1183	628
3	3030	2139	4588	785	2305	638	2192	622
4	707	582	532	232	363	297	446	252
5	39	161	26	70	29	16	86	34
6	12	11	4	30	1	3	1	2
7	2	0	0	1	0	0	0	0

Table 6.4.3a. Four-spot megrim (*L. boscii*) divisions 8.c and 9.a. Annual length distributions in landings in 2019.

Length (cm)	Total
10	
11	
12	
13	
14	44638
15	15016
16	124760
17	71456
18	154860
19	285391
20	521371
21	749969
22	1046682
23	857567
24	751900
25	499105
26	398317
27	276268
28	166745
29	121349
30	80140
31	49234
32	20051
33	28070
34	29649
35	22710
36	28474
37	3457
38	5827
39	251
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50+	
Total	6353259

Table 6.4.3b. Four-spot megrim (*L. boscii*) divisions 8.c and 9.a. Mean lengths and mean weights in landings since 1990.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Mean length (cm)	23.1	23.5	23.8	24.2	23.3	22.3	23	23.3	23.3	23.5	24.2	23.8	23.1	22.9	22.7	22.7
Mean weight (g)	116	118	122	128	111	96	107	112	109	113	121	114	105	101	98	97.0

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mean length (cm)	22.9	23.5	23.6	23.6	24.1	23.7	23.7	23.9	24.2	24.1	24.2	23.7	24.0	23.8	23.5
Mean weight (g)	99.4	109.1	109.7	110.7	118.4	112.2	112.0	114.0	117.8	117.4	118.6	111.8	115.6	112.5	110.6

Table 6.4.4. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Catch numbers-at-age.

YEAR	1986	1987	1988	1989	1990
AGE					
0	1289	1289	1289	1289	1289
1	3432	5605	4847	4055	4766
2	7797	15902	14414	11462	9506
3	5901	7284	7666	7603	4096
4	4545	4198	5384	6514	4434
5	1226	1438	2460	3573	2405
6	869	589	1181	1798	1403
+gp	233	145	467	634	807
TOTALNUM	25292	36450	37708	36928	28706
TONSLAND	1408	2021	2586	3037	2354
SOPCOF %	100	100	100	100	100

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
0	1289	1289	1289	678	1289	1289	256	1289	2933	354
1	4482	4168	3868	2824	4743	3719	3308	3367	3992	6193
2	8001	6989	6656	7049	6527	6458	7343	5526	3895	1862
3	5539	6211	4307	7225	8349	3478	4978	6447	4596	3533
4	2516	5784	4404	2849	6201	4419	890	3545	4996	4000
5	2744	2294	1245	1801	1150	1990	1714	792	1405	2020
6	1048	758	655	894	602	224	1069	849	235	797
+gp	483	71	282	457	284	555	443	353	489	840
TOTALNUM	26102	27564	22706	23777	29145	22132	20001	22168	22541	19599
TONSLAND	2129	2353	1822	1920	2058	1466	1204	1501	1442	1414
SOPCOF %	99	103	99	100	100	100	102	100	101	100

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE										
0	208	208	238	33	10	1	100	202	2	2879
1	5840	5863	4846	6785	3638	1267	3257	2357	1546	10377
2	2888	4139	3791	5568	8004	5232	6147	3935	3136	2364
3	2276	3386	3368	3777	3604	5951	3390	4879	4887	3568
4	2870	1220	1526	2602	2024	2639	2705	2204	4640	3817
5	1937	454	501	1155	1426	1156	1909	1003	1662	2529
6	941	240	447	279	802	274	855	354	640	496
+gp	358	360	142	337	399	228	461	298	222	438
TOTALNUM	17318	15870	14859	20536	19907	16748	18824	15232	16735	26468
TONSLAND	1221	1028	1067	1354	1358	1427	1396	1182	1413	1562
SOPCOF %	100	100	101	101	100	101	101	101	100	101

YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AGE										
0	30	682	275	0	157	2	0	0	0	0
1	5139	5342	5499	5646	2438	1610	527	209	720	235
2	4397	3260	4919	11954	7412	6739	2458	1296	1251	937
3	2454	4101	4820	4249	7742	2844	4986	2050	3783	1598
4	2833	1926	4113	3214	3622	2495	2469	2754	2783	3040
5	2711	1620	1363	2983	1580	1936	1817	1388	2072	1359
6	1164	991	846	751	1105	1153	684	954	365	618
+gp	399	422	371	562	462	559	618	555	188	285
TOTALNUM	19127	18344	22206	29359	24518	17338	13559	9206	11162	8072
TONSLAND	1397	1321	1427	1942	1745	1419	1173	906	943	792
SOPCOF %	101	101	101	100	100	100	101	101	101	101

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

Table 6.4.5. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Mean weights-at-age in catches (kg).

YEAR	1986	1987	1988	1989	1990
AGE					
0	0.004	0.004	0.004	0.004	0.003
1	0.013	0.027	0.027	0.027	0.019
2	0.034	0.046	0.049	0.055	0.051
3	0.055	0.062	0.069	0.079	0.081
4	0.090	0.089	0.100	0.108	0.134
5	0.129	0.125	0.138	0.144	0.154
6	0.159	0.151	0.167	0.167	0.183
+gp	0.263	0.239	0.280	0.275	0.272
SOPCOFAC	1.0014	1.0022	1.0034	0.9996	1.0009

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
0	0.004	0.004	0.003	0.005	0.004	0.003	0.004	0.004	0.0060	0.006
1	0.022	0.021	0.014	0.023	0.030	0.023	0.016	0.019	0.018	0.023
2	0.055	0.052	0.052	0.056	0.046	0.043	0.030	0.040	0.045	0.057
3	0.097	0.093	0.092	0.082	0.082	0.054	0.063	0.073	0.072	0.066
4	0.114	0.120	0.136	0.114	0.096	0.106	0.091	0.105	0.090	0.087
5	0.164	0.159	0.174	0.148	0.143	0.135	0.123	0.137	0.147	0.126
6	0.19	0.225	0.218	0.178	0.168	0.209	0.180	0.179	0.197	0.169
+gp	0.263	0.351	0.295	0.243	0.255	0.231	0.252	0.293	0.268	0.228
SOPCOFAC	0.993	1.0284	0.9892	1.0015	0.9963	0.9993	1.0171	1.0027	1.0090	1.001

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE										
0	0.004	0.006	0.008	0.006	0.006	0.006	0.005	0.005	0.004	0.004
1	0.024	0.024	0.025	0.027	0.021	0.023	0.022	0.017	0.025	0.012
2	0.05	0.057	0.066	0.053	0.05	0.06	0.045	0.053	0.045	0.056
3	0.073	0.09	0.088	0.081	0.083	0.091	0.079	0.079	0.069	0.084
4	0.099	0.109	0.123	0.108	0.108	0.104	0.114	0.112	0.104	0.108
5	0.122	0.163	0.142	0.131	0.122	0.136	0.123	0.151	0.142	0.141
6	0.166	0.209	0.201	0.175	0.132	0.176	0.152	0.201	0.175	0.182
+gp	0.255	0.247	0.247	0.235	0.197	0.233	0.198	0.235	0.288	0.271
SOPCOFAC	1.0012	0.9993	1.0129	1.0069	1.0038	1.0066	1.0109	1.0063	1.0011	1.0104

YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AGE										
0	0.003	0.009	0.004	0.002	0.008	0.004	0.001	0.001	0.002	0.001
1	0.02	0.033	0.017	0.024	0.026	0.022	0.029	0.013	0.018	0.022
2	0.039	0.052	0.045	0.044	0.04	0.048	0.044	0.041	0.037	0.041
3	0.078	0.076	0.063	0.071	0.066	0.086	0.067	0.068	0.061	0.063
4	0.099	0.105	0.099	0.101	0.099	0.107	0.096	0.093	0.095	0.096
5	0.128	0.127	0.131	0.133	0.136	0.13	0.126	0.126	0.126	0.125
6	0.168	0.159	0.159	0.165	0.172	0.149	0.164	0.156	0.186	0.169
+gp	0.24	0.199	0.21	0.222	0.23	0.217	0.212	0.224	0.274	0.251
SOPCOFAC	1.009	1.006	1.0065	1.0046	1.0018	1.0027	1.0054	1.0073	1.0087	1.0128

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

Table 6.4.6. Four-spot megrim (*L. boscii*) divisions 8.c and 9.a. Abundance and Recruitment indices of Portuguese and Spanish surveys.

	Biomass Index						Abundance index					Recruitment index		
	Portugal (k/h)			Spain (k/30 min)			Portugal (n/h)		Spain (n/30 min)			At age 1 Portugal (n)	At age 0 Spain (n/30 min)	At age 1
	October	Crustacean	SE	Mean	SE		Crustacean	SE	Mean	SE		October		
1983				0.67	0.13	1983			11.80	1.80	1983		0.98	5.74
1984				0.76	0.08	1984			15.80	2.00	1984		1.80	7.83
1985				0.71	0.11	1985			14.00	1.74	1985		0.15	7.45
1986				1.68	0.28	1986			32.60	3.82	1986		2.99	16.36
1987				ns	-	1987			ns	-	1987		ns	ns
1988				3.10	0.33	1988			59.20	6.49	1988		2.90	24.64
1989				1.97	0.28	1989			40.75	6.24	1989		8.49	16.68
1990	0.26			1.93	0.14	1990			40.30	3.00	1990	153	0.44	19.06
1991	0.18			1.67	0.17	1991			27.70	2.62	1991	26	2.53	9.25
1992	0.14			1.98	0.20	1992			49.10	5.20	1992	42	2.37	35.00
1993	0.11			2.07	0.25	1993			43.30	5.39	1993	8	0.30	21.38
1994	0.16			1.82	0.23	1994			26.90	3.63	1994	2	3.48	2.94
1995	0.08			1.51	0.12	1995			32.30	2.78	1995	4	1.92	19.58
A,1996	0.10			2.00	0.19	A,1996			44.80	4.05	A,1996	16	3.57	20.56
1997	0.06	2.97	1.31	2.17	0.22	1997	31.57	15.52	43.50	3.84	1997	1	3.54	13.34
1998	0.04	2.66	0.87	1.80	0.20	1998	26.46	10.68	34.30	4.45	1998	+	0.27	9.57
A,B,1999	+	0.04	0.02	1.93	0.24	A,B,1999	1.23	1.07	29.30	3.22	A,B,1999	+	0.94	7.46
2000	0.08	2.18	0.84	1.89	0.28	2000	20.61	8.47	33.00	4.56	2000	16	1.07	13.96
2001	0.09	1.72	0.75	2.65	0.25	2001	17.17	7.08	42.70	3.35	2001	25	0.59	16.95
2002	0.02	2.78	1.02	2.21	0.22	2002	40.61	13.69	34.60	3.33	2002	1	1.04	9.95
A,2003	1.36	3.65	1.20	1.32	0.16	A,2003	60.80	20.97	16.90	1.54	A,2003	8	0.65	4.95
A,2004	1.27	ns		2.40	0.24	A,2004	ns		43.94	3.71	A,2004	5	1.19	21.10
2005	0.05	2.62	0.85	3.84	0.41	2005	34.51	12.03	62.89	6.16	2005	+	4.71	17.70
2006	0.10	1.63	0.56	2.56	0.24	2006	19.89	6.49	41.47	3.02	2006		0.59	14.70
2007	0.14	2.20	0.70	3.75	0.35	2007	32.30	11.30	51.10	4.30	2007		0.88	11.30
2008	0.07	2.50	0.87	2.08	0.22	2008	26.27	9.60	32.20	3.00	2008		0.37	8.13
2009	0.06	*1.50	0.65	3.96	0.32	2009	*12.22	5.88	52.83	3.97	2009		3.37	7.42
2010	0.03	4.03	1.44	4.04	0.38	2010	63.78	22.64	72.75	6.82	2010		0.65	34.22
2011	0.14	4.55	1.78	4.64	0.39	2011	68.56	26.34	69.26	5.72	2011		0.91	8.90
2012	ns	ns	ns	5.92	0.47	2012	ns	ns	82.14	5.98	2012		1.71	11.58
**2013	0.10	1.45	0.51	8.17	1.13	2013	23.81	8.02	119.99	17.48	2013		1.32	25.86
2014	0.12	1.40	0.56	4.75	0.28	2014	20.31	8.18	67.42	3.72	2014		3.72	12.32
2015	0.13	1.66	0.52	4.62	0.48	2015	27.29	8.25	78.00	7.47	2015		1.12	33.18
2016	0.12	1.80	0.65	4.84	0.32	2016	35.62	12.16	86.70	5.19	2016		2.43	18.06
2017	0.22	1.91	0.74	6.21	0.96	2017	37.79	14.77	111.24	13.61	2017		1.03	23.69
2018	0.11	3.59	1.70	5.35	0.45	2018	57.65	27.61	88.04	7.05	2018		0.46	6.36
2019	ns	ns	ns	5.77	0.48	2019	ns	ns	102.03	8.21	2019		0.94	20.46
2020	ns	ns	ns	5.56	0.49	2020	ns	ns	97.85	7.88	2020		1.42	15.66

+	less than 0.04
ns	no survey
A	Portuguese October Survey with different vessel and gear (Capricórnio and CAR net)
B	Portuguese Crustacean Survey covers partial area only with a different Vessel (Mestre Costeiro)
*	Revised in WGHMM2011
**	From 2013 new vessel for Spanish survey (Miguel Oliver)

Table 6.4.7. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Tuning data.

FLT01: SP-LCGOTBDEF1. 1000 Days by 100 HP (thousand)

1986 1999
1 1 0 1
1 7   Eff.

								Eff.	
10	98	376	337	251	95	30	13	7.1	1986
10	473	963	565	318	97	31	16	12.7	1987
10	35	202	200	163	76	30	19	11.3	1988
10	11	86	126	136	83	39	22	11.9	1989
10	5	104	60	174	105	73	38	8.8	1990
10	10	89	145	93	189	80	41	9.6	1991
10	0.4	20	100	168	105	39	2	10.2	1992
10	0.1	37	98	227	85	46	17	7.1	1993
10	0	62	208	169	156	87	46	8.5	1994
10	1	33	278	301	124	83	24	13.4	1995
10	1	33	34	222	133	20	51	11.0	1996
10	0.4	23	111	40	143	125	59	12.5	1997
10	0.3	82	420	350	98	127	62	8.2	1998
10	0.3	62	210	331	165	33	45	8.8	1999

FLT02: SP-LCGOTBDEF2. 1000 Days by 100 HP (thousand)

2000 2020
1 1 0 1
1 7   Eff.

								Eff.	
10	0.4	70	144	349	303	164	153	10.5	2000
10	14	148	219	475	436	242	83	12.1	2001
10	7	126	214	91	66	45	70	11.0	2002
10	19	287	363	214	75	67	22	10.2	2003
10	29	341	496	440	219	60	81	7.0	2004
10	10	248	383	253	196	114	68	7.1	2005
10	7	364	625	305	151	41	40	7.8	2006
10	2	261	403	415	298	143	82	7.3	2007
10	3	313	727	481	227	88	81	9.0	2008
10	8	145	524	640	226	87	34	8.0	2009
10	0.1	146	520	743	616	132	105	5.8	2010
10	0	48	224	424	594	323	133	5.1	2011
10	1	107	719	562	505	302	123	7.6	2012
10	0	87	336	806	313	170	65	10.8	2013
10	0.1	119	332	427	431	99	55	13.4	2014
10	0.1	67	619	625	322	218	80	9.8	2015
10	0.1	244	402	449	383	230	117	10.6	2016
10	0.1	77	641	494	417	154	132	8.7	2017
10	0.2	87	530	821	392	238	118	8.1	2018
10	0.3	21	514	725	613	104	51	7.8	2019

FLT03: SP-NSGFS-Q4 (n/30 min)

1988 2019
1 1 0.75 0.83
0 7   Eff.

									Eff.	
1	2.9	24.6	20.6	7.3	1.9	1.1	0.4	0.3	101	1988
1	8.5	16.7	8.4	3.6	2.1	1.1	0.3	0.1	91	1989
1	0.4	19.1	13.0	2.2	2.8	1.6	0.7	0.4	120	1990
1	2.5	9.3	9.3	3.7	1.6	1.0	0.2	0.1	107	1991
1	2.4	35.0	4.1	4.1	2.1	1.0	0.4	0.0	116	1992
1	0.3	21.4	16.7	2.3	1.5	0.5	0.4	0.2	109	1993
1	3.5	2.9	11.2	6.3	1.5	0.7	0.4	0.4	118	1994
1	1.9	19.6	2.4	4.4	3.2	0.3	0.2	0.2	116	1995
1	3.6	20.6	14.4	1.4	1.9	2.4	0.3	0.3	114	1996
1	3.5	13.3	14.0	8.7	1.1	1.5	1.0	0.3	116	1997
1	0.3	9.6	10.0	9.2	3.6	0.7	0.8	0.3	114	1998
1	0.9	7.5	10.9	6.0	2.9	1.0	0.2	0.3	116	1999
1	1.1	14.0	5.4	5.2	4.1	1.7	0.6	0.9	113	2000
1	0.6	17.0	12.7	4.7	3.8	2.2	1.0	0.7	113	2001
1	1.0	10.0	12.7	7.4	1.8	0.7	0.3	0.6	110	2002
0	0.7	5.0	4.1	4.1	1.7	0.6	0.5	0.3	112	2003
1	1.2	21.1	11.3	6.1	2.7	0.8	0.2	0.5	114	2004
1	4.7	17.7	22.4	11.2	4.0	1.6	0.6	0.7	116	2005
1	0.6	14.7	13.3	8.2	2.5	1.0	0.5	0.6	115	2006
1	0.9	11.3	21.3	10.2	4.9	1.4	0.7	0.3	117	2007
1	0.4	8.1	11.7	7.9	2.6	0.8	0.5	0.3	115	2008
1	3.4	7.4	13.6	14.1	9.6	3.1	1.1	0.5	117	2009
1	0.6	34.2	16.6	10.8	7.2	2.2	0.5	0.6	114	2010
1	0.9	8.9	33.8	13.8	7.7	2.8	0.9	0.5	111	2011
1	1.7	11.6	22.1	31.1	9.6	3.4	1.7	1.0	115	2012
0	1.3	25.9	29.6	35.7	21.1	3.9	1.5	1.0	114	2013
1	3.7	12.3	21.8	12.1	7.6	8.0	1.1	0.7	116	2014
1	1.1	33.2	14.3	15.9	7.6	3.3	1.9	0.7	114	2015
1	2.4	18.1	45.4	10.6	4.3	2.8	2.0	1.1	114	2016
1	1.0	23.7	31.2	40.1	8.38	4.31	1.17	1.29	112	2017
1	0.5	6.4	32.1	22.4	19.3	3.7	2.6	1.0	113	2018
1	0.9	20.5	18.5	41.5	12.8	6.33	0.9	0.62	113	2019
1	1.4	15.7	28.8	24.6	20.3	4.7	1.8	0.6	109	2020

Table 6.4.8. Four-spot megrim (*L. boscii*). LPUE data by fleet in divisions 8.c and 9.a.

Year	SP-LCGOTBDEF Landings (t)	Effort	LPUE [1]	SP-AVSOTBDEF*** Landings (t)	Effort	LPUE [1]	Portugal trawl in 9a Landings (t)	Effort	LPUE [2]
1986	69.0	7.1	9.8	26.5	3.9	6.8			
1987	189.8	12.7	14.9	30.7	3.0	10.4			
1988	78.6	11.3	7.0	47.3	3.4	14.0	146	38.5	3.8
1989	72.9	11.9	6.2	36.1	3.3	10.9	183	44.7	4.1
1990	68.8	8.8	7.8	63.8	3.2	19.7	164	39.0	4.2
1991	94.0	9.6	9.8	42.1	3.5	12.2	166	45.0	3.7
1992	67.2	10.2	6.6	35.2	2.3	15.5	280	50.9	5.5
1993	55.2	7.1	7.8	38.9	2.4	16.1	180	44.2	4.1
1994	90.8	8.5	10.6	63.7	4.5	14.0	146	45.8	3.2
1995	147.6	13.4	11.0	85.9	3.5	24.7	121	37.0	3.3
1996	78.7	11.0	7.2	37.1	2.3	16.4	155	46.5	3.3
1997	99.0	12.5	7.9	49.5	2.6	18.7	76	33.4	2.3
1998	117.4	8.2	14.4	56.2	5.1	11.0	83	43.1	1.9
1999	103.9	8.8	11.7	55.9	4.9	11.3	73	25.3	2.9
2000	172.3	10.5	16.4	34.1	2.5	13.8	93	27.0	3.4
2001	245.0	12.1	20.2	16.5	1.3	12.5	89	43.1	2.1
2002	143.8	11.0	13.0	22.5	2.0	11.3	97	31.2	3.1
2003	118.7	10.2	11.6	12.4	2.2	5.7	117	40.5	2.9
2004	127.3	7.0	18.2	23.5	1.6	14.8	111	35.4	3.1
2005	96.0	7.1	13.6	45.0	3.0	15.2	140	42.6	3.3
2006	123.5	7.8	15.9	32.3	2.8	11.6	149	40.3	3.7
2007*	130.5	7.3	17.9	19.9	2.2	8.9	165	43.8	3.8
2008*	196.8	9.0	22.0	14.5	2.0	7.2	146	38.4	3.8
2009	138.8	8.0	17.3	42.0	2.3	18.5	183	49.3	3.7
2010	170.7	5.8	29.3	51.1	2.0	25.4	150	48.0	3.1
2011	126.9	5.1	24.8	43.1	2.2	19.6	134	49.4	2.7
2012	127.8	7.6	16.7	11.1	2.6	4.3	78	30.9	2.5
2013**	212.8	10.8	19.8	19.5	1.5	13.2	59	28.0	2.1
2014	220.8	13.4	16.5	31.9	3.0	10.7	120	49.2	2.4
2015	219.1	9.8	22.5	13.8	1.8	7.5	109	17.7	6.1
2016	233.8	10.6	22.0				84.9	16.4	5.2
2017	183.0	8.7	20.9				117.6	15.4	7.6
2018	187.5	8.1	23.0				108.5	7.9	13.8
2019	175.3	7.8	22.4				102.3	7.1	14.4
2020							125.8	7.9	15.8

[1] LPUE as catch (kg) per fishing day per 100 HP
[2] LPUE as catch (kg) per hour
* Effort from Portuguese trawl revised in WG2010 from original value presented
** Effort from SP-LCGOTBDEF and SP-AVSOTBDEF revised in WG2015 from original value presented
*** Sampling suspended in 2015

Table 6.4.9. Four-spot megrim (*L.boscii*) in divisions 8.c and 9.a. Tuning diagnostics.

Lowestoft VPA Version 3.1

3/05/2021 12:37

Extended Survivors Analysis

Four spot megrim (L. boscii) Divisions 27.7.8c and 27.7.9a

CPUE data from file fleetb.txt

Catch data for 35 years. 1986 to 2020. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF1	1986	2020	3	6	0	1
SP-LCGOTBDEF2	2000	2020	3	6	0	1
SP-GFS	1988	2020	0	6	0.75	0.83

Time series weights :

   Tapered time weighting not applied

Catchability analysis :

   Catchability independent of stock size for all ages

   Catchability independent of age for ages >=   5

Terminal population estimation :

   Survivor estimates shrunk towards the mean F
   of the final   5 years or the   3 oldest ages.

   S.E. of the mean to which the estimates are shrunk =   1.500

   Minimum standard error for population
   estimates derived from each fleet =   .300

   Prior weighting not applied

Tuning converged after   29 iterations

                 1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0	0.001	0.011	0.007	0	0.004	0	0	0	0	0
1	0.164	0.167	0.117	0.197	0.06	0.05	0.012	0.009	0.021	0.009
2	0.163	0.148	0.229	0.399	0.43	0.235	0.1	0.037	0.071	0.034
3	0.266	0.225	0.341	0.317	0.49	0.29	0.273	0.113	0.146	0.122
4	0.395	0.346	0.369	0.402	0.492	0.287	0.442	0.238	0.221	0.168
5	0.505	0.413	0.442	0.503	0.352	0.536	0.35	0.48	0.284	0.159
6	0.484	0.347	0.395	0.469	0.35	0.472	0.365	0.313	0.221	0.127

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6
2011	4.68E+04	3.76E+04	3.24E+04	1.16E+04	9.59E+03	7.56E+03	3.35E+03
2012	6.81E+04	3.83E+04	2.61E+04	2.25E+04	7.28E+03	5.29E+03	3.74E+03
2013	4.29E+04	5.51E+04	2.65E+04	1.84E+04	1.47E+04	4.21E+03	2.86E+03
2014	5.64E+04	3.49E+04	4.02E+04	1.73E+04	1.07E+04	8.34E+03	2.22E+03
2015	4.51E+04	4.62E+04	2.34E+04	2.21E+04	1.03E+04	5.88E+03	4.13E+03
2016	5.88E+04	3.68E+04	3.56E+04	1.25E+04	1.11E+04	5.16E+03	3.39E+03
2017	3.05E+04	4.81E+04	2.86E+04	2.31E+04	7.64E+03	6.80E+03	2.47E+03
2018	4.68E+04	2.49E+04	3.89E+04	2.12E+04	1.44E+04	4.02E+03	3.93E+03
2019	3.68E+04	3.84E+04	2.02E+04	3.07E+04	1.55E+04	9.27E+03	2.04E+03
2020	4.59E+04	3.01E+04	3.08E+04	1.54E+04	2.17E+04	1.02E+04	5.71E+03

Estimated population abundance at 1st Jan 2021

0.00E+00	3.76E+04	2.45E+04	2.43E+04	1.12E+04	1.50E+04	7.11E+03

Taper weighted geometric mean of the VPA populations:

4.46E+04	3.63E+04	2.65E+04	1.64E+04	9.11E+03	4.19E+03	1.79E+03

Standard error of the weighted Log(VPA populations) :

0.2788	0.2989	0.3432	0.362	0.4327	0.4748	0.5578

1

Log catchability residuals.

Fleet : SP-LCGOTBDEF1

Age	1986	1987	1988	1989	1990
0	No data for this fleet at this age				
1	No data for this fleet at this age				
2	No data for this fleet at this age				
3	0.55	0.86	-0.1	-0.41	-0.76
4	0.29	0.27	-0.61	-0.55	-0.21
5	0.04	-0.26	-0.85	-0.86	-0.2
6	-0.3	-0.18	-0.4	-0.24	0.16

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.19	-0.46	-0.04	-0.09	0.37	-0.56	-0.3	0.71	0.41	99.99
4	-0.58	-0.08	0.31	0.48	0.13	0.05	-0.46	0.65	0.29	99.99
5	0.42	-0.02	-0.24	0.53	0.8	-0.31	-0.04	0.78	0.21	99.99
6	0.82	0.06	0.35	0.72	1.03	-0.05	0.37	0.58	0.65	99.99

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-6.6988	-5.8259	-5.3772	-5.3772
S.E(Log q)	0.5018	0.4191	0.5171	0.5297

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	0.57	2.049	8.02	0.66	14	0.26	-6.7
4	0.96	0.153	5.97	0.52	14	0.42	-5.83
5	-22.54	-4.696	72.76	0	14	7.2	-5.38
6	1.21	-0.626	4.67	0.43	14	0.57	-5.12
1							

Fleet : SP-LCGOTBDEF2

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.58
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.06
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.22
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.2

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.36	-0.25	0.22	0.46	0.12	0.53	0.2	0.19	-0.12	0.21
4	0.77	-0.48	-0.37	0.4	-0.31	-0.19	0.16	0.24	-0.07	0.04
5	0.97	-0.63	-0.23	-0.05	0.2	-0.52	0.34	-0.07	-0.1	0.28
6	0.26	-0.28	0.08	0.28	0.1	-0.51	0.19	-0.03	-0.39	0.1

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.35	0.14	-0.38	-0.33	0.12	0.18	0.02	-0.16	-0.54	99.99
4	-0.18	0.37	0.02	-0.28	0.18	-0.31	0.23	0.01	-0.2	99.99
5	0.14	0.29	0.05	-0.28	-0.3	0.1	-0.18	0.35	-0.13	99.99
6	0.33	0.1	-0.2	-0.45	-0.34	-0.02	-0.15	-0.21	-0.42	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-5.6739	-4.9636	-4.6518	-4.6518
S.E(Log q)	0.3226	0.3079	0.3569	0.2775

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age		Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
	3	1.27	-1.085	4.62	0.48	20	0.41	-5.67
	4	1.05	-0.259	4.77	0.62	20	0.33	-4.96
	5	0.94	0.353	4.86	0.69	20	0.34	-4.65
	6	1	0.032	4.73	0.8	20	0.27	-4.72
	1							

Fleet : SP-GFS

Age		1986	1987	1988	1989	1990
	0	99.99	99.99	0.52	1.66	-1.01
	1	99.99	99.99	0.37	-0.13	0.09
	2	99.99	99.99	0.04	-0.45	-0.28
	3	99.99	99.99	-0.49	-1.02	-1.16
	4	99.99	99.99	-1.19	-0.74	-0.43
	5	99.99	99.99	-0.57	-0.68	0.15
	6	99.99	99.99	-0.04	-0.11	0.18

Age		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	0	0.28	0.29	-1.07	0.88	0.07	1.02	1.35	-0.83	-0.09	-0.02
	1	-0.31	0.5	0.08	-1.15	0.23	0.03	-0.05	-0.02	0.26	0.37
	2	-0.54	-0.97	-0.26	-0.56	-1.06	-0.02	-0.34	-0.31	0.16	-0.02
	3	-0.97	-0.71	-0.87	-0.69	-0.83	-0.7	0.06	-0.22	-0.26	0.04
	4	-0.79	-0.45	-0.72	-0.31	-0.49	-0.81	-0.2	-0.04	-0.56	0.32
	5	-0.18	-0.1	-0.9	-0.3	-0.52	0.07	-0.19	0.36	-0.56	-0.27
	6	-0.35	0.02	0.05	0.04	-0.33	0.05	-0.06	-0.03	-0.16	-0.24

Age		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	0	-0.65	-0.16	99.99	0.06	1.08	-0.98	-0.26	-0.82	0.56	-0.8
	1	0.45	-0.12	99.99	0.28	0.38	-0.25	-0.44	-0.45	-0.25	0.59
	2	0.29	0.23	99.99	-0.03	0.47	0.16	0.1	-0.48	0	0.5
	3	0.47	0.32	99.99	0	0.5	0.18	0.44	-0.44	0.14	0.21
	4	0.81	0.35	99.99	0.05	0.23	-0.27	0.46	-0.3	0.43	0.07
	5	1.07	-0.14	99.99	-0.51	0.63	-0.44	0.26	-0.69	0.78	-0.24
	6	-0.08	-0.04	99.99	-0.17	0.11	0.24	0.14	-0.08	0.31	-0.36

Age		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	0	-0.46	-0.2	99.99	0.76	-0.22	0.29	0.09	-1.15	-0.19	0
	1	-0.53	-0.28	99.99	-0.1	0.5	0.11	0.09	-0.57	0.17	0.14
	2	0.54	0.32	99.99	0.08	0.22	0.8	0.54	0.21	0.34	0.33
	3	0.74	0.85	99.99	0.25	0.41	0.42	1.13	0.5	0.77	0.92
	4	0.49	0.95	99.99	0.38	0.49	-0.31	0.84	0.89	0.39	0.47
	5	-0.1	0.38	99.99	0.86	0.19	0.32	0.32	0.81	0.35	-0.15
	6	-0.46	0.02	99.99	0.21	0.02	0.33	0.04	0.34	-0.14	-0.55

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4	5	6
Mean Log q	-10.2262	-7.536	-7.1218	-7.1055	-7.152	-7.2523	-7.2523
S.E(Log q)	0.7361	0.3844	0.4397	0.6401	0.5726	0.5076	0.2264

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.53	1.962	10.44	0.37	31	0.37	-10.23
1	0.7	1.777	8.42	0.54	31	0.26	-7.54
2	0.98	0.092	7.19	0.38	31	0.44	-7.12
3	1.04	-0.107	7.01	0.23	31	0.67	-7.11
4	1.17	-0.609	6.82	0.31	31	0.68	-7.15
5	0.93	0.337	7.33	0.48	31	0.48	-7.25
6	1	0.023	7.29	0.87	31	0.23	-7.29
1							

Terminal year survivor and F summaries :

Age 0   Catchability constant w.r.t. time and dependent on age

Year class = 2020

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	1	0	0	0	0	0	0
SP-GFS	37604	0.748	0	0	1	1	0
F shrinkage mean	0	1.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
37604	0.75	0	1	0	0

Age 1   Catchability constant w.r.t. time and dependent on age

Year class = 2019

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	1	0	0	0	0	0	0
SP-GFS	26178	0.346	0.135	0.39	2	0.949	0.008
F shrinkage mean	6866	1.5				0.051	0.03

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
24451	0.34	0.23	3	0.691	0.009

Age 2 Catchability constant w.r.t. time and dependent on age
Year class = 2018

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	1	0	0	0	0	0	0
SP-GFS	25822	0.274	0.338	1.23	3	0.966	0.032
F shrinkage mean	4425	1.5				0.034	0.175

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
24331	0.27	0.33	4	1.224	0.034

Age 3 Catchability constant w.r.t. time and dependent on age
Year class = 2017

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	1	0	0	0	0	0	0
SP-GFS	11519	0.252	0.32	1.27	4	0.967	0.118
F shrinkage mean	4786	1.5				0.033	0.264

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11191	0.25	0.28	5	1.139	0.122

Age 4 Catchability constant w.r.t. time and dependent on age
Year class = 2016

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	8712	0.331	0	0	1	0.323	0.274
SP-GFS	20173	0.232	0.113	0.49	5	0.655	0.128
F shrinkage mean	6844	1.5				0.021	0.338

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
15024	0.19	0.18	7	0.968	0.168

Age 5 Catchability constant w.r.t. time and dependent on age
Year class = 2015

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	5938	0.229	0.016	0.07	2	0.466	0.188
SP-GFS	8660	0.215	0.125	0.58	6	0.517	0.133
F shrinkage mean	2477	1.5				0.017	0.403

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7114	0.16	0.11	9	0.698	0.159

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5
Year class = 2014

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	3975	0.197	0.05	0.25	3	0.418	0.132
SP-GFS	4247	0.189	0.256	1.35	7	0.568	0.124
F shrinkage mean	3448	1.5				0.013	0.15

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4120	0.14	0.15	11	1.1	0.127

Table 6.4.10. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Estimates of fishing mortality-at-age.

Run title : Four spot megrim (L. boscii) Divisions 27.7.8c and 27.7.9a

At 3/05/2021 12:38

Terminal Fs derived using XSA (With F shrinkage)

Table 8   Fishing mortality (F) at age

YEAR	1986	1987	1988	1989	1990
AGE					
0	0.0201	0.0277	0.0254	0.027	0.0361
1	0.0641	0.1139	0.1381	0.1039	0.1322
2	0.2441	0.4696	0.4762	0.5582	0.3761
3	0.38	0.3789	0.4352	0.4991	0.3949
4	0.7292	0.5136	0.5377	0.8346	0.6182
5	0.6338	0.5359	0.6549	0.8609	0.8867
6	1.0242	0.7321	1.2418	1.7469	1.0636
+gp	1.0242	0.7321	1.2418	1.7469	1.0636
FBAR 2- 4	0.4511	0.454	0.483	0.6306	0.4631

Table 8   Fishing mortality (F) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
0	0.023	0.0247	0.0497	0.0159	0.0245	0.034	0.0095	0.0694	0.0945	0.011
1	0.1695	0.0962	0.0962	0.1465	0.1472	0.0914	0.1147	0.1657	0.3171	0.2951
2	0.3421	0.4336	0.2194	0.2544	0.5896	0.3063	0.2625	0.2849	0.2939	0.239
3	0.393	0.4891	0.5252	0.3935	0.5433	0.7399	0.4115	0.3885	0.4078	0.4756
4	0.4515	0.9519	0.7903	0.8167	0.7042	0.6283	0.4193	0.5849	0.5968	0.7663
5	1.0405	1.0091	0.5416	0.9197	0.9746	0.5119	0.5349	0.8351	0.4858	0.516
6	1.4251	0.9614	0.9363	0.9955	0.9569	0.4985	0.5774	0.5585	0.6404	0.568
+gp	1.4251	0.9614	0.9363	0.9955	0.9569	0.4985	0.5774	0.5585	0.6404	0.568
FBAR 2- 4	0.3955	0.6249	0.5116	0.4882	0.6124	0.5582	0.3645	0.4195	0.4328	0.4936

Table 8   Fishing mortality (F) at age

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE										
0	0.0063	0.0058	0.0052	0.001	0.0002	0	0.003	0.0082	0	0.067
1	0.2525	0.2447	0.1821	0.2015	0.1451	0.0336	0.0908	0.0902	0.0801	0.2546
2	0.2175	0.2859	0.2471	0.3289	0.388	0.3207	0.226	0.1511	0.1666	0.1693
3	0.5159	0.4277	0.3989	0.4173	0.368	0.563	0.3556	0.2821	0.2842	0.2902
4	0.927	0.5834	0.3478	0.621	0.4139	0.5073	0.5441	0.4142	0.4758	0.3763
5	1.1434	0.3496	0.5063	0.4854	0.8584	0.4426	0.8766	0.3967	0.6398	0.5202
6	0.4849	0.3908	0.6996	0.5949	0.7548	0.3842	0.699	0.3823	0.4772	0.3955
+gp	0.4849	0.3908	0.6996	0.5949	0.7548	0.3842	0.699	0.3823	0.4772	0.3955
FBAR 2- 4	0.5535	0.4323	0.3313	0.4557	0.39	0.4637	0.3752	0.2825	0.3089	0.2786

Table 8   Fishing mortality (F) at age

YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	FBAR 18-20
AGE											
0	0.0007	0.0111	0.0071	0	0.0039	0	0	0	0	0	0
1	0.1638	0.1673	0.1168	0.1972	0.0601	0.0496	0.0122	0.0093	0.021	0.0087	0.013
2	0.1626	0.1484	0.2292	0.3988	0.4302	0.2347	0.0997	0.0375	0.0708	0.0343	0.0475
3	0.2664	0.2246	0.3409	0.3171	0.4904	0.2902	0.2731	0.1129	0.1464	0.1215	0.1269
4	0.3952	0.3461	0.3689	0.4018	0.4918	0.2865	0.4417	0.2381	0.2208	0.1681	0.209
5	0.5048	0.4133	0.4423	0.5028	0.3523	0.5356	0.3497	0.4802	0.2838	0.1595	0.3078
6	0.4838	0.347	0.3952	0.4691	0.3504	0.4722	0.3649	0.3126	0.2206	0.1273	0.2202
+gp	0.4838	0.347	0.3952	0.4691	0.3504	0.4722	0.3649	0.3126	0.2206	0.1273	
FBAR 2- 4	0.2747	0.2397	0.313	0.3725	0.4708	0.2705	0.2715	0.1295	0.146	0.108	

Table 6.4.11. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Estimates of stock numbers-at-age.

Run title : Four spot megrim (L. boscii) Divisions 27.7.8c and 27.7.9a

At 3/05/2021 12:38

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year)   Numbers*10**-3

YEAR	1986	1987	1988	1989	1990
AGE					
0	71718	52147	56895	53386	40227
1	61076	57552	41528	45415	42542
2	39791	46899	42048	29614	33514
3	20629	25523	24009	21383	13875
4	9702	11550	14306	12720	10628
5	2886	3831	5658	6841	4521
6	1498	1254	1835	2407	2368
+gp	394	304	710	824	1337
TOTAL	207696	199061	186989	172591	149010

Table 10 Stock number at age (start of year)   Numbers*10**-3

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
0	62747	58378	29393	47513	58876	42636	30047	21255	35958	35716
1	31769	50206	46630	22899	38287	47038	33741	24368	16236	26786
2	30518	21954	37334	34677	16193	27055	35146	24632	16905	9681
3	18837	17747	11651	24544	22013	7352	16307	22131	15167	10316
4	7654	10411	8910	5642	13557	10468	2872	8847	12286	8259
5	4689	3990	3290	3310	2041	5489	4572	1546	4036	5538
6	1525	1356	1191	1567	1080	631	2693	2193	549	2033
+gp	686	125	504	787	501	1547	1104	902	1129	2119
TOTAL	158424	164167	138902	140938	152548	142215	126482	105874	102264	100447

Table 10 Stock number at age (start of year)   Numbers*10**-3

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE										
0	36690	39523	50457	36385	51826	50661	36991	27341	62312	49092
1	28921	29851	32171	41095	29760	42423	41477	30195	22202	51015
2	16327	18395	19135	21954	27507	21074	33586	31011	22589	16779
3	6241	10754	11315	12236	12937	15278	12519	21936	21829	15657
4	5249	3051	5741	6217	6600	7331	7124	7183	13545	13450
5	3142	1701	1394	3319	2735	3572	3614	3385	3886	6891
6	2706	820	982	688	1673	949	1879	1231	1864	1678
+gp	1020	1220	308	821	821	783	1000	1028	640	1470
TOTAL	100297	105314	121501	122716	133858	142071	138190	123311	148868	156031

Table 10 Stock number at age (start of year)   Numbers*10**-3

YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	GMST 90-18
AGE												
0	46845	68109	42880	56411	45070	58781	30467	46848	36792	45928	0	44225
1	37588	38326	55146	34859	46185	36758	48124	24944	38356	30123	37604	
2	32378	26124	26545	40174	23431	35607	28638	38924	20233	30752	24451	
3	11598	22530	18439	17282	22075	12477	23055	21223	30695	15434	24331	
4	9590	7275	14735	10735	10305	11069	7642	14364	15521	21708	11191	
5	7558	5288	4214	8343	5881	5160	6805	4023	9269	10189	15024	
6	3354	3735	2864	2217	4131	3385	2473	3927	2038	5714	7114	
+gp	1139	1579	1246	1643	1714	1626	2217	2269	1044	2625	6012	
TOTAL	150050	172968	166070	171664	158794	164863	149420	156522	153948	162472	125726	

Table 6.4.12. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Summary of landings and XSA results.

Run title : Four spot megrim (L. boscii) Divisions 27.7.8c and 27.7.9a

At 3/05/2021 12:38

Table 16   Summary   (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 0	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2- 4
1986	71718	5156	4280	1408	0.329	0.4511
1987	52147	7271	6004	2021	0.3366	0.454
1988	56895	7783	6698	2586	0.3861	0.483
1989	53386	7745	6688	3037	0.4541	0.6306
1990	40227	6679	5908	2354	0.3985	0.4631
1991	62747	6567	5703	2129	0.3733	0.3955
1992	58378	6313	5383	2353	0.4371	0.6249
1993	29393	5947	5249	1822	0.3471	0.5116
1994	47513	6322	5509	1920	0.3485	0.4882
1995	58876	5837	4913	2058	0.4189	0.6124
1996	42636	5110	4309	1466	0.3402	0.5582
1997	30047	4328	3784	1204	0.3182	0.3645
1998	21255	4946	4457	1501	0.3368	0.4195
1999	35958	4470	3973	1442	0.363	0.4328
2000	35716	4306	3710	1414	0.3812	0.4936
2001	36690	3725	3133	1221	0.3897	0.5535
2002	39523	4052	3314	1028	0.3102	0.4323
2003	50457	4644	3665	1067	0.2912	0.3313
2004	36385	4902	3985	1354	0.3398	0.4557
2005	51826	4814	3990	1358	0.3404	0.39
2006	50661	5532	4563	1427	0.3127	0.4637
2007	36991	5338	4493	1396	0.3107	0.3752
2008	27341	5831	5174	1182	0.2285	0.2825
2009	62312	5798	5098	1413	0.2772	0.3089
2010	49092	6191	5534	1562	0.2823	0.2786
2011	46845	5813	5121	1397	0.2728	0.2747
2012	68109	7292	5861	1321	0.2254	0.2397
2013	42880	6193	5383	1427	0.2651	0.313
2014	56411	6869	6084	1942	0.3192	0.3725
2015	45070	6881	5794	1745	0.3011	0.4708
2016	58781	6538	5656	1419	0.2509	0.2705
2017	30467	6697	5809	1173	0.2019	0.2715
2018	46848	6374	5901	906	0.1535	0.1295
2019	36792	6692	6132	943	0.1538	0.146
2020	45928	7924	7353	792	0.1077	0.108
Arith. Mean	46180	5911	5103	1565	0.3115	0.3957
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 6.4.13. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a.

Prediction with management option table: Input data

MFDP version 1a
Run: ldb
Time and date: 13:34 03/05/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2021 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight LWt	Exploit pattern	Weight DWt
0	43194	0.2	0	0	0	0.002	0.0000	0.001	0.0000	0.002
1	35364	0.2	0.55	0	0	0.021	0.0003	0.030	0.0131	0.020
2	24451	0.2	0.86	0	0	0.042	0.0098	0.066	0.0497	0.038
3	24331	0.2	0.97	0	0	0.069	0.0784	0.079	0.0514	0.053
4	11191	0.2	0.99	0	0	0.097	0.1703	0.102	0.0238	0.065
5	15024	0.2	1	0	0	0.127	0.2590	0.128	0.0068	0.083
6	7114	0.2	1	0	0	0.165	0.2074	0.165	0.0020	0.110
7	6012	0.2	1	0	0	0.236	0.2093	0.236	0.0001	0.031

2022 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight LWt	Exploit pattern	Weight DWt
0	43194	0.2	0	0	0	0.002	0.0000	0.001	0.0000	0.002
1 .		0.2	0.55	0	0	0.021	0.0003	0.030	0.0131	0.020
2 .		0.2	0.86	0	0	0.042	0.0098	0.066	0.0497	0.038
3 .		0.2	0.97	0	0	0.069	0.0784	0.079	0.0514	0.053
4 .		0.2	0.99	0	0	0.097	0.1703	0.102	0.0238	0.065
5 .		0.2	1	0	0	0.127	0.2590	0.128	0.0068	0.083
6 .		0.2	1	0	0	0.165	0.2074	0.165	0.0020	0.110
7 .		0.2	1	0	0	0.236	0.2093	0.236	0.0001	0.031

2023 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight LWt	Exploit pattern	Weight DWt
0	43194	0.2	0	0	0	0.002	0.0000	0.001	0.0000	0.002
1 .		0.2	0.55	0	0	0.021	0.0003	0.030	0.0131	0.020
2 .		0.2	0.86	0	0	0.042	0.0098	0.066	0.0497	0.038
3 .		0.2	0.97	0	0	0.069	0.0784	0.079	0.0514	0.053
4 .		0.2	0.99	0	0	0.097	0.1703	0.102	0.0238	0.065
5 .		0.2	1	0	0	0.127	0.2590	0.128	0.0068	0.083
6 .		0.2	1	0	0	0.165	0.2074	0.165	0.0020	0.110
7 .		0.2	1	0	0	0.236	0.2093	0.236	0.0001	0.031

Input units are thousands and kg - output in tonnes

Table 6.4.14. Four-sport megrim (*L. boscii*) in divisions 8.c and 9.a catch forecast: management option table.

MFDP version 1a
Run: ldb
Time and date: 13:34 03/05/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2021

Biomass	SSB	FMult	Catch FBar	Landings Yield	Discards FBar	Yield
9105	8490	1	0.0862	1145	0.0416	129

2022   2023

Biomass	SSB	FMult	Catch FBar	Landings Yield	Discards FBar	Yield	Biomass	SSB
9587	8954	0	0.0000	0	0.0000	0	11485	10842
.	8954	0.1	0.0086	129	0.0042	13	11320	10678
.	8954	0.2	0.0172	256	0.0083	27	11159	10517
.	8954	0.3	0.0259	381	0.0125	40	11000	10359
.	8954	0.4	0.0345	503	0.0167	53	10845	10205
.	8954	0.5	0.0431	622	0.0208	66	10693	10053
.	8954	0.6	0.0517	739	0.0250	78	10543	9904
.	8954	0.7	0.0603	854	0.0291	91	10397	9758
.	8954	0.8	0.0689	967	0.0333	104	10253	9615
.	8954	0.9	0.0776	1077	0.0375	116	10112	9475
.	8954	1	0.0862	1185	0.0416	128	9974	9337
.	8954	1.1	0.0948	1291	0.0458	140	9838	9202
.	8954	1.2	0.1034	1395	0.0500	152	9705	9070
.	8954	1.3	0.1120	1497	0.0541	164	9574	8940
.	8954	1.4	0.1206	1597	0.0583	176	9446	8813
.	8954	1.5	0.1293	1695	0.0625	187	9321	8688
.	8954	1.6	0.1379	1791	0.0666	199	9197	8565
.	8954	1.7	0.1465	1885	0.0708	210	9076	8445
.	8954	1.8	0.1551	1978	0.0749	221	8958	8327
.	8954	1.9	0.1637	2068	0.0791	232	8841	8211
.	8954	2	0.1723	2157	0.0833	243	8727	8097

Input units are thousands and kg - output in tonnes

Table 6.4.15. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Single option prediction. Detail Tables.

MFDP version 1a
Run: ldb
Time and date: 13:34 03/05/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2021   F multiplier: 1   Fleet1 HCFbar: 0.0862 Fleet1 DFbar: 0.0416

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0	0	0	43194	78	0	0	0	0
1	0.0003	8	0	0.0131	417	9	35364	736	19450	405	19450	405
2	0.0098	211	14	0.0497	1070	41	24451	1032	21028	887	21028	887
3	0.0784	1625	129	0.0514	1065	57	24331	1679	23601	1628	23601	1628
4	0.1703	1575	161	0.0238	220	14	11191	1090	11079	1079	11079	1079
5	0.259	3111	398	0.0068	82	7	15024	1902	15024	1902	15024	1902
6	0.2074	1211	200	0.002	12	1	7114	1172	7114	1172	7114	1172
7	0.2093	1033	243	0.0001	0	0	6012	1416	6012	1416	6012	1416
Total		8773	1145		2867	129	166681	9105	103308	8490	103308	8490

Year: 2022   F multiplier: 1   Fleet1 HCFbar: 0.0762 Fleet1 DFbar: 0.0359

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0	0	0	43194	78	0	0	0	0
1	0.0003	8	0	0.0131	417	9	35364	736	19450	405	19450	405
2	0.0098	247	16	0.0497	1251	48	28569	1206	24570	1037	24570	1037
3	0.0784	1260	100	0.0514	826	44	18862	1302	18297	1262	18297	1262
4	0.1703	2462	251	0.0238	344	22	17496	1704	17321	1687	17321	1687
5	0.259	1562	200	0.0068	41	3	7546	955	7546	955	7546	955
6	0.2074	1605	265	0.002	15	2	9430	1554	9430	1554	9430	1554
7	0.2093	1497	353	0.0001	1	0	8716	2054	8716	2054	8716	2054
Total		8641	1185		2895	128	169177	9587	105329	8954	105329	8954

Year: 2023   F multiplier: 1   Fleet1 HCFbar: 0.0762 Fleet1 DFbar: 0.0359

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0	0	0	43194	78	0	0	0	0
1	0.0003	8	0	0.0131	417	9	35364	736	19450	405	19450	405
2	0.0098	247	16	0.0497	1251	48	28570	1206	24570	1037	24570	1037
3	0.0784	1472	117	0.0514	965	52	22039	1521	21378	1475	21378	1475
4	0.1703	1909	195	0.0238	267	17	13563	1321	13428	1308	13428	1308
5	0.259	2443	313	0.0068	64	5	11797	1494	11797	1494	11797	1494
6	0.2074	806	133	0.002	8	1	4736	781	4736	781	4736	781
7	0.2093	2070	488	0.0001	1	0	12050	2839	12050	2839	12050	2839
Total		8954	1261		2972	132	171313	9974	107409	9337	107409	9337

Input units are thousands and kg - output in tonnes

Table 6.4.16. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Stock numbers of recruits and their source of recent year-classes used in predictions and the relative (%) contributions to catches and SSB (by weight) of these year-classes.

Year-class	2018	2019	2020	2021	2022
Stock No. (thousands) of 0 year-olds	46848	36792	43194	43194	43194
Source	XSA	XSA	GM90-18	GM90-18	GM90-18
Status Quo F:					
% in 2021 catch	14.6	4.3	0.7	0.0	-
% in 2022	20.8	11.0	4.9	0.7	0.0
% in 2021 SSB	19.2	10.4	4.8	0.0	-
% in 2022 SSB	18.8	14.1	11.6	4.5	0.0
% in 2023 SSB	16.0	14.0	15.8	11.1	4.3

GM : geometric mean recruitment

Four-spot megrim (L. boscii) in Divisions 8c and 9a : Year-class % contribution to

a)   2022 catches   b)   2023 SSB
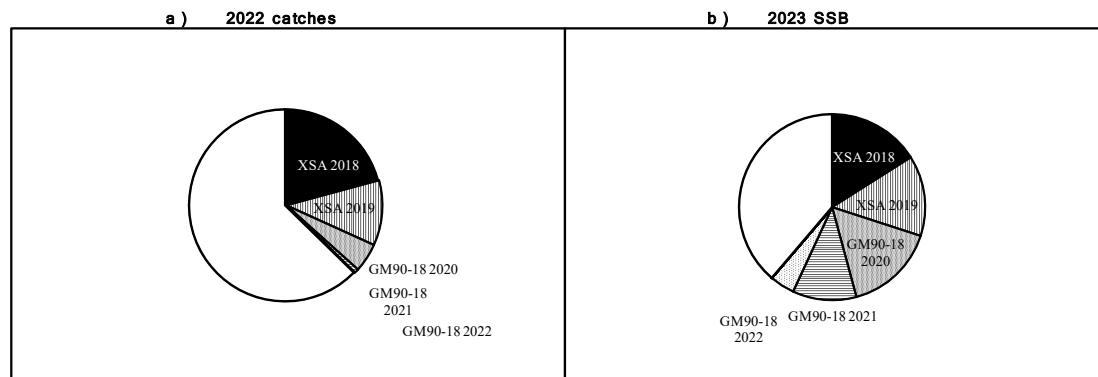
Table 6.4.17. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Yield-per-recruit results.

MFYPR version 2a
Run: ldb
Time and date: 13:40 03/05/2021
Yield per results

Catch	Landings			Discards								
FMult	Fbar	CatchNos	Yield	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	0.5455	4.0334	0.5305	4.0334	0.5305
0.1	0.0086	0.046	0.008	0.0042	0.0077	0.0004	5.2488	0.4874	3.7659	0.4724	3.7659	0.4724
0.2	0.0172	0.083	0.0141	0.0083	0.0152	0.0007	5.0273	0.44	3.5448	0.4251	3.5448	0.4251
0.3	0.0259	0.1131	0.0187	0.0125	0.0226	0.001	4.841	0.4008	3.3588	0.3859	3.3588	0.3859
0.4	0.0345	0.1379	0.0223	0.0167	0.0298	0.0014	4.6821	0.3678	3.2002	0.3529	3.2002	0.3529
0.5	0.0431	0.1585	0.025	0.0208	0.0368	0.0017	4.5448	0.3399	3.0632	0.325	3.0632	0.325
0.6	0.0517	0.1757	0.0272	0.025	0.0437	0.002	4.4251	0.3158	2.9438	0.301	2.9438	0.301
0.7	0.0603	0.1903	0.0288	0.0291	0.0504	0.0023	4.3196	0.295	2.8387	0.2802	2.8387	0.2802
0.8	0.0689	0.2026	0.0301	0.0333	0.057	0.0026	4.226	0.2769	2.7454	0.2621	2.7454	0.2621
0.9	0.0776	0.2131	0.03	0.0375	0.0635	0.0028	4.14	0.261	2.6619	0.2462	2.6619	0.2462
1	0.0862	0.222	0.0317	0.0416	0.0698	0.0031	4.0669	0.2469	2.5869	0.2321	2.5869	0.2321
1.1	0.0948	0.2296	0.0322	0.0458	0.076	0.0034	3.9987	0.2344	2.519	0.2196	2.519	0.2196
1.2	0.1034	0.2361	0.0325	0.05	0.082	0.0036	3.9366	0.2232	2.4572	0.2085	2.4572	0.2085
1.3	0.112	0.2417	0.0327	0.0541	0.088	0.0039	3.8798	0.2132	2.4007	0.1984	2.4007	0.1984
1.4	0.1206	0.2465	0.0328	0.0583	0.0938	0.0041	3.8276	0.2041	2.3488	0.1894	2.3488	0.1894
1.5	0.1293	0.2505	0.0328	0.0625	0.0995	0.0044	3.7795	0.1959	2.301	0.1812	2.301	0.1812
1.6	0.1379	0.254	0.0328	0.0666	0.1051	0.0046	3.735	0.1885	2.2568	0.1738	2.2568	0.1738
1.7	0.1465	0.2569	0.0327	0.0708	0.1106	0.0048	3.6936	0.1817	2.2157	0.1671	2.2157	0.1671
1.8	0.1551	0.2594	0.0325	0.0749	0.116	0.005	3.6551	0.1755	2.1775	0.1609	2.1775	0.1609
1.9	0.1637	0.2615	0.0323	0.0791	0.1213	0.0053	3.619	0.1698	2.1417	0.1552	2.1417	0.1552
2.0	0.1723	0.2632	0.0321	0.0833	0.1265	0.0055	3.5852	0.1646	2.1082	0.15	2.1082	0.15

| Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.0862
FMax	1.4689	0.1266
F0.1	0.8571	0.0739
F35%SPR	1.4447	0.1245

Weights in kilograms
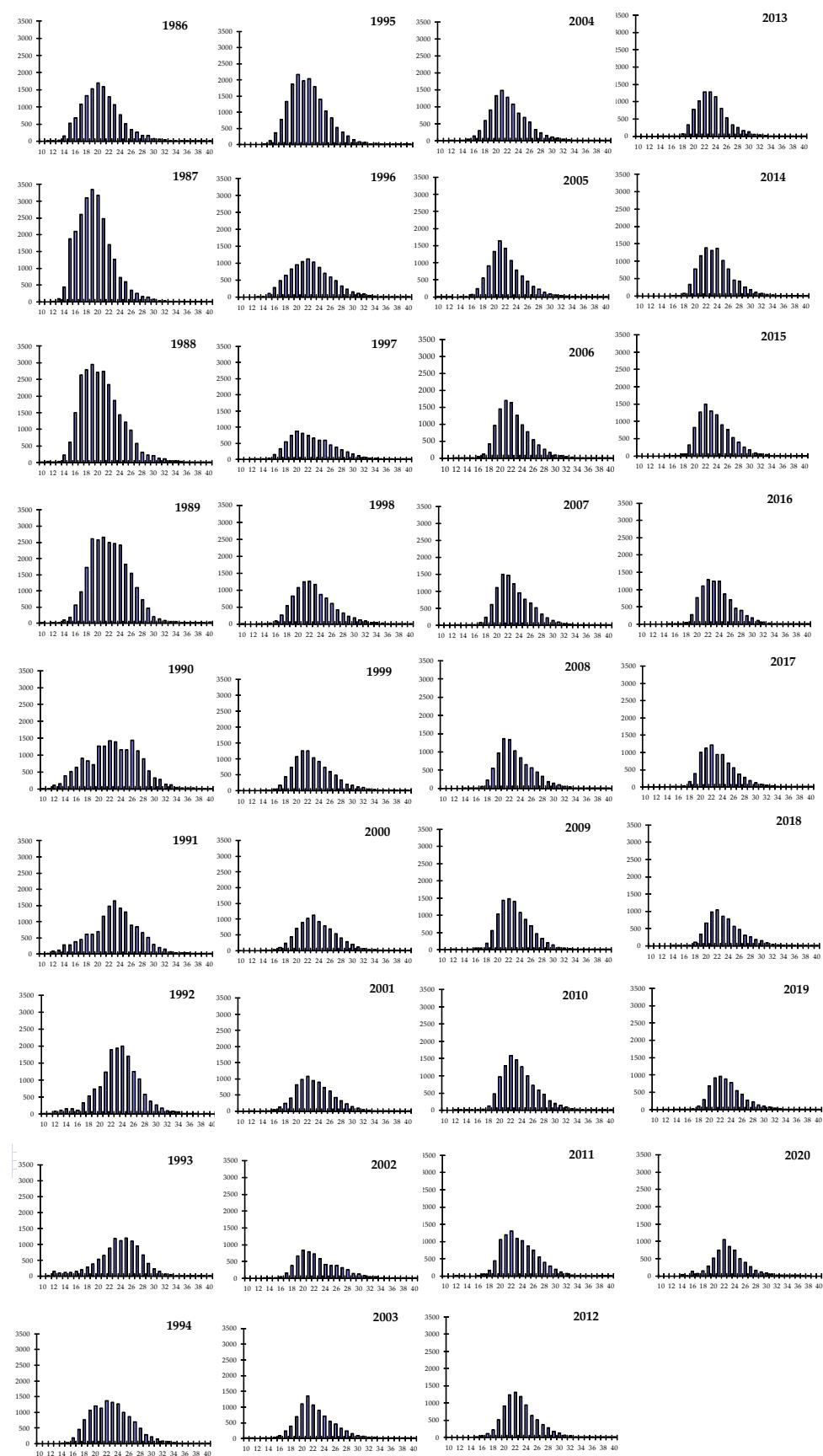
Figure 6.4.1. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Annual length compositions of landings ('000).
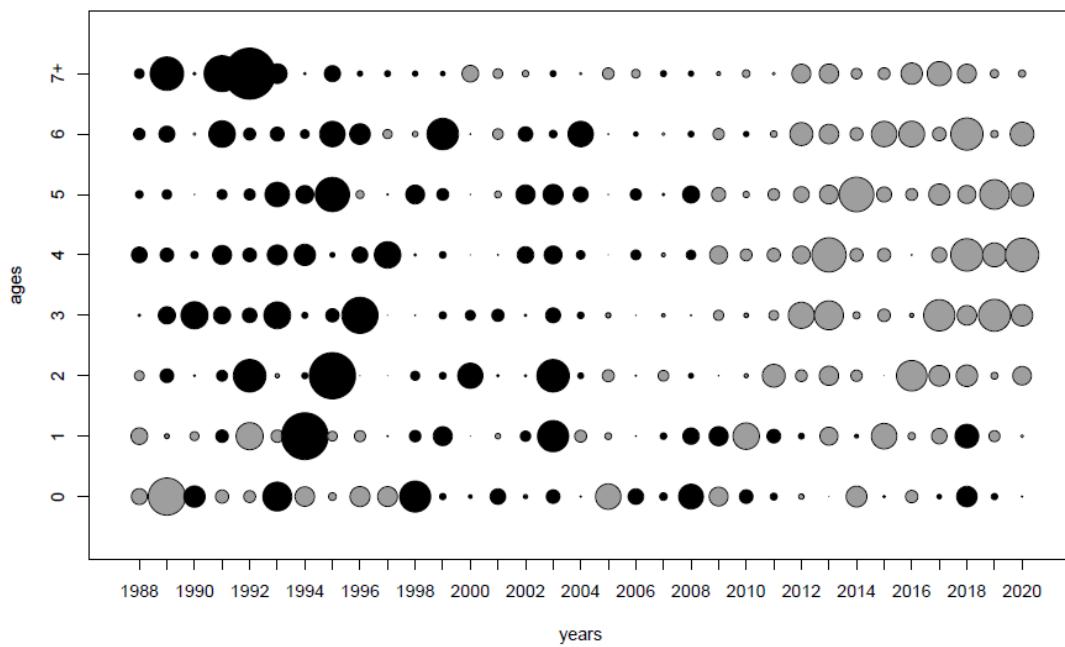
Figure 6.4.2. Four-spot megrim (*L. boscii*) in Divisions 8c&9a. Standardized log (abundance index at age) from survey SP-NSGFS-Q4 (G2784) (Bubbles colour scale: black – negative, grey – positive).
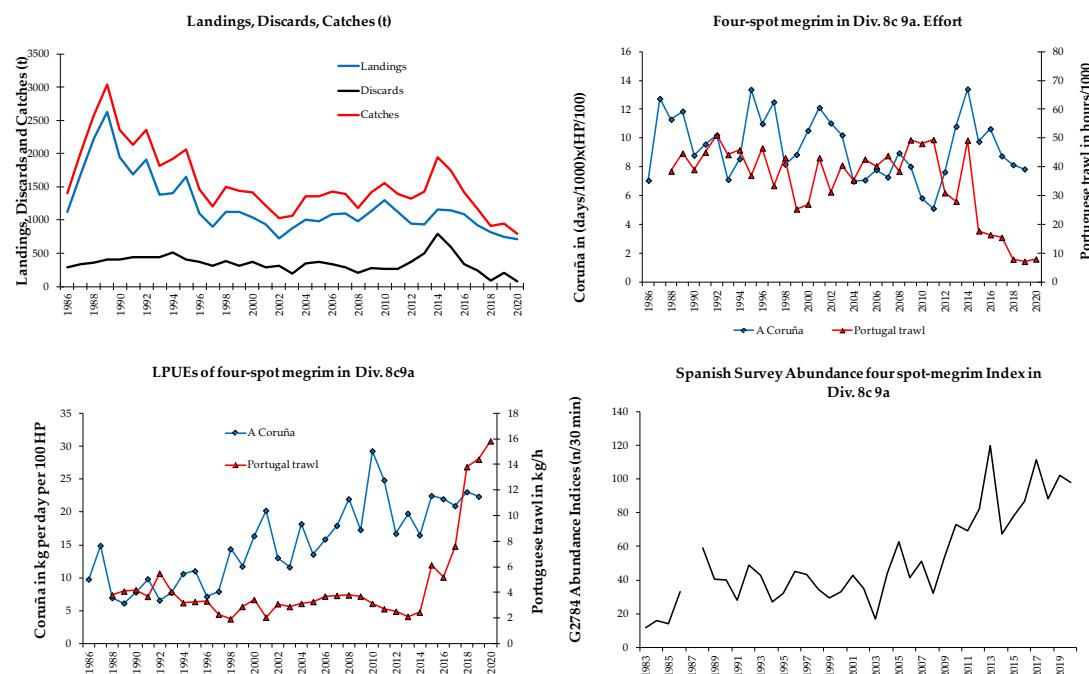

* Spanish Landings of 2008 revised in WG2010 from original value presented

* Portuguese Trawl Effort of 2007 and 2008 revised in WG2010 from original value presented

Figure 6.4.3a. Four-spot megrim (*L.boscii*) in divisions 8.c and 9.a. Landings (t), Efforts, LPUEs and Abundance Indices.

Standardized log(abundance index at age) from SP-LCGOTBDEF-1

Standardized log(abundance index at age) from SP-LCGOTBDEF-2
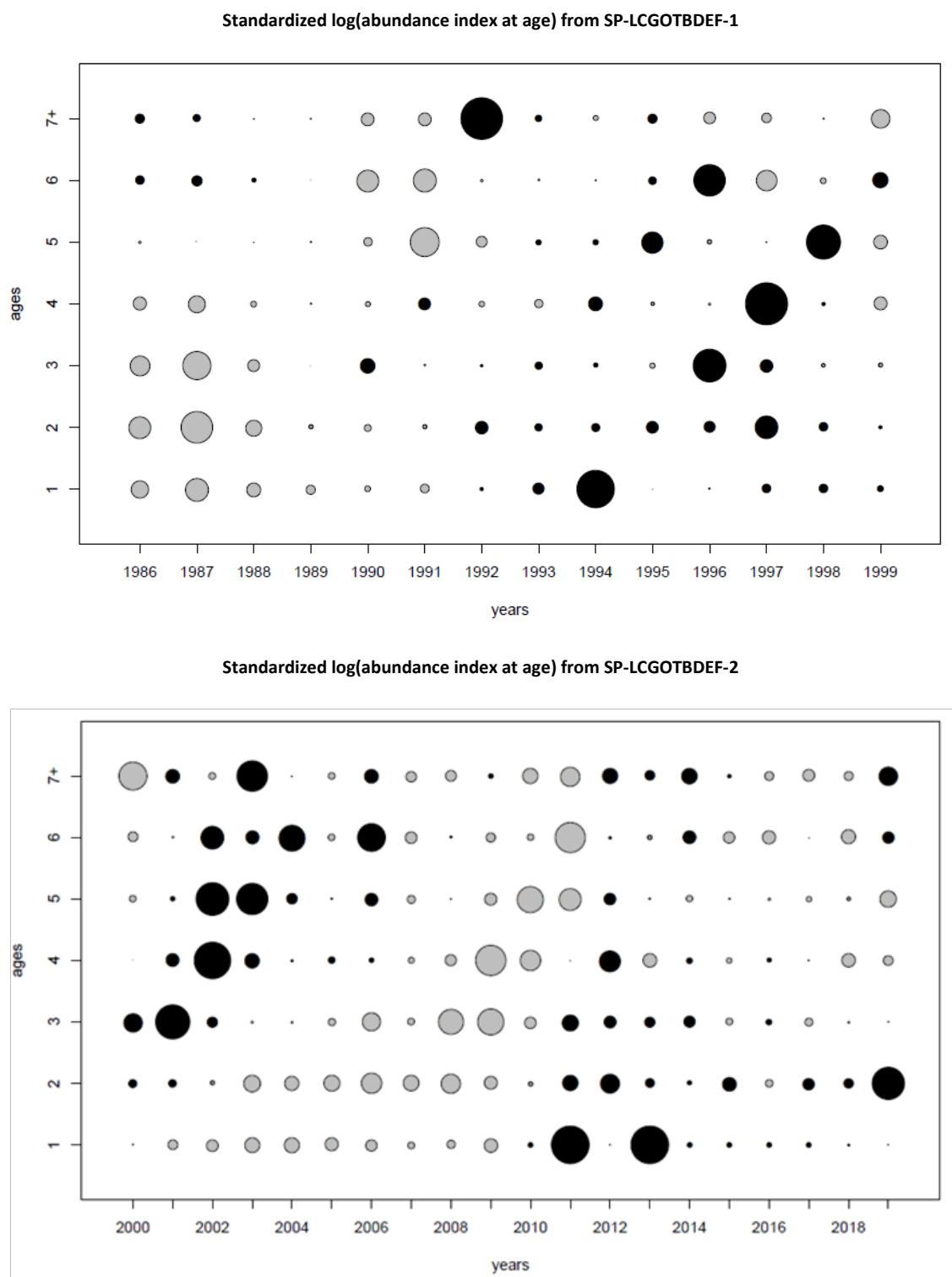
Figure 6.4.3b. Four-spot megrim (*L. boscii*) in Divisions 8c&9a. Standardized log(abundance index at age) of SP-LCGOT-BDEF-1 and SP-LCGOTBDEF-2 (Bubbles colour scale: black – negative, grey – positive).

Catches proportions-at-age

Standardized catches proportions-at-age (Bubbles colour scale: black – negative, grey – positive)
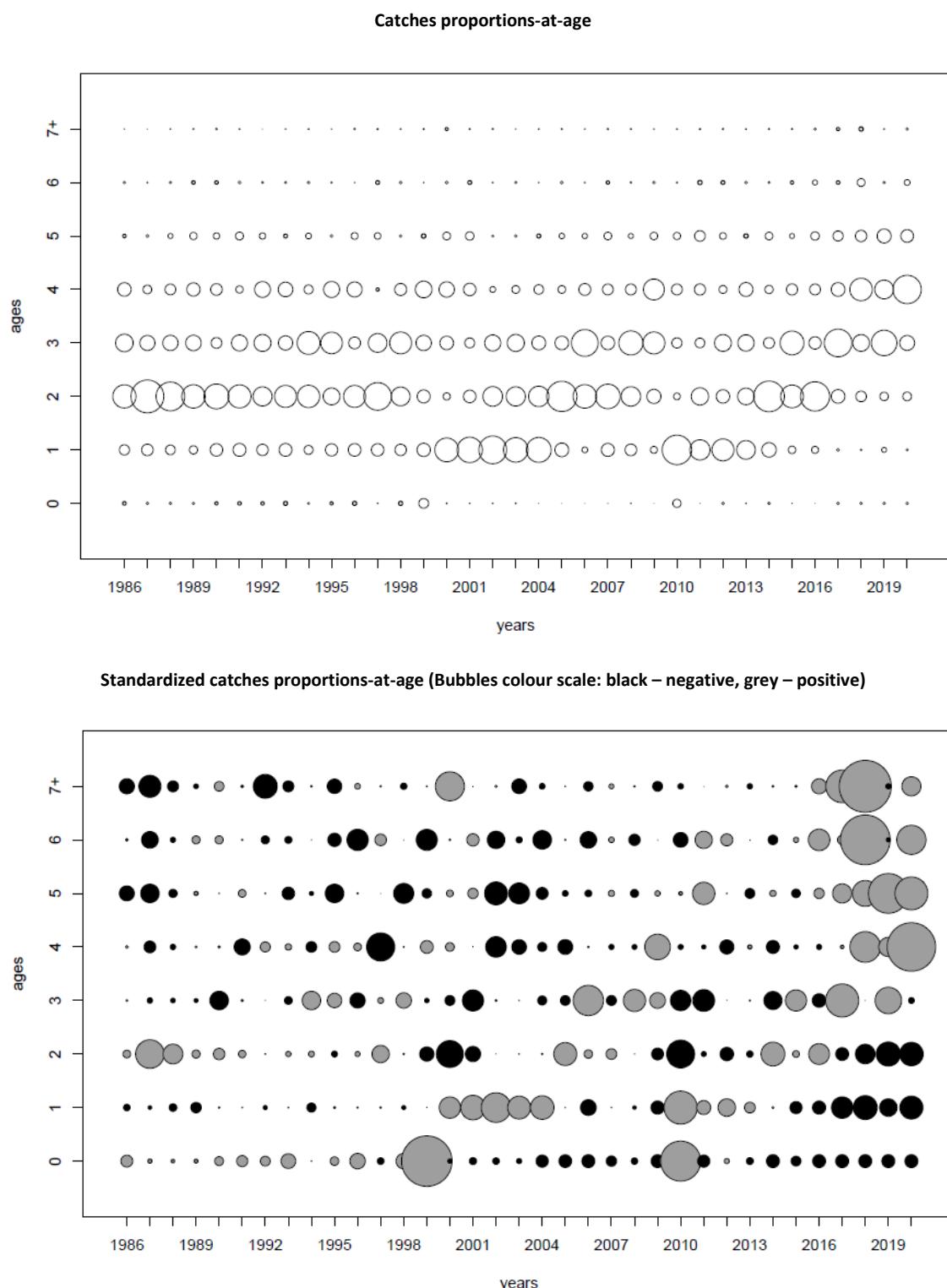
Figure 6.4.4a. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Catches proportions-at-age.

Landings proportions-at-age

Standardized landings proportions-at-age (Bubbles colour scale: black – negative, grey – positive)
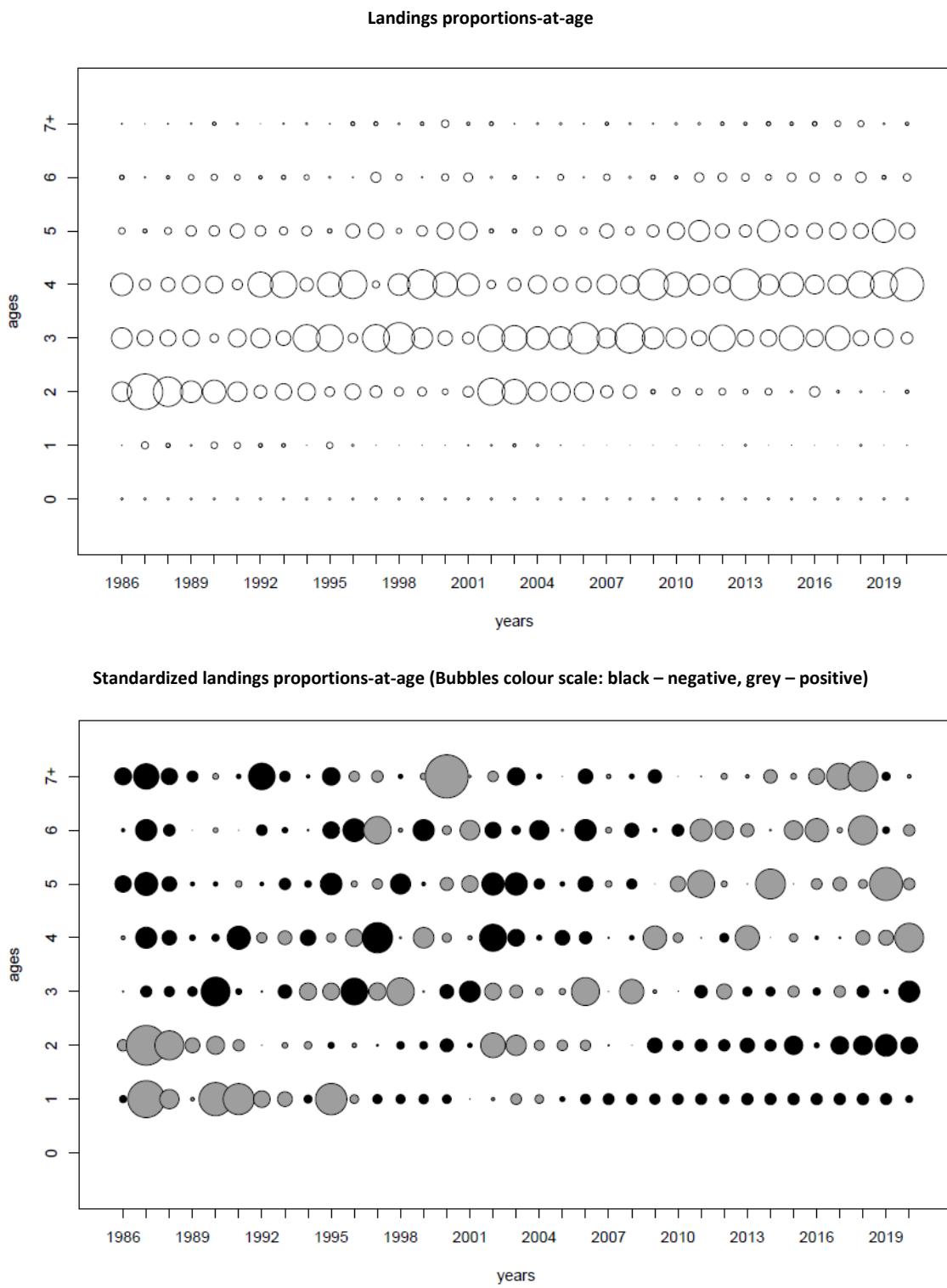
Figure 6.4.4b. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Landings proportions-at-age.

Discards proportions-at-age

Standardized discards proportions-at-age (Bubbles colour scale: black – negative, grey – positive)
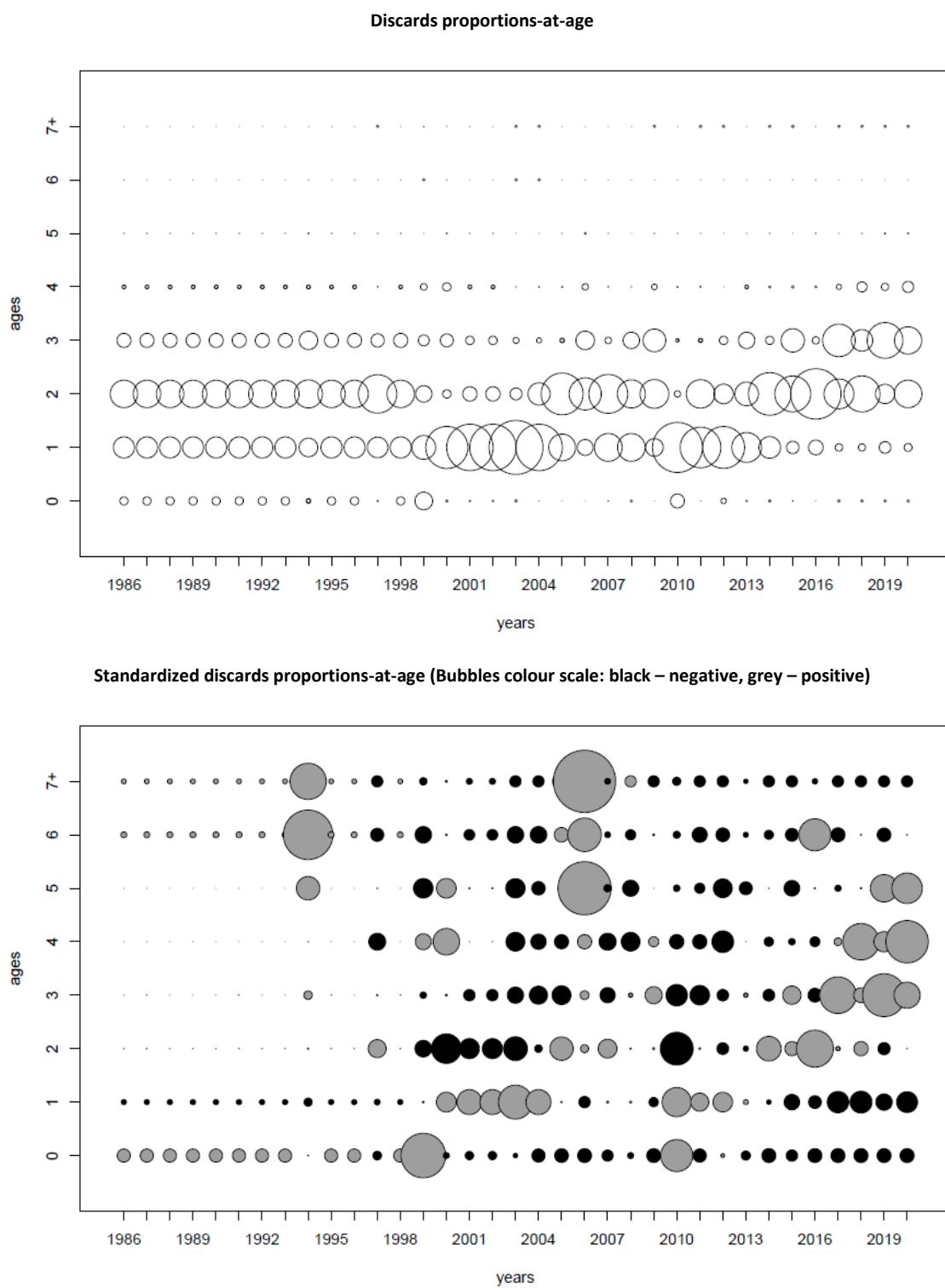
Figure 6.4.4c. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Discards proportions-at-age.
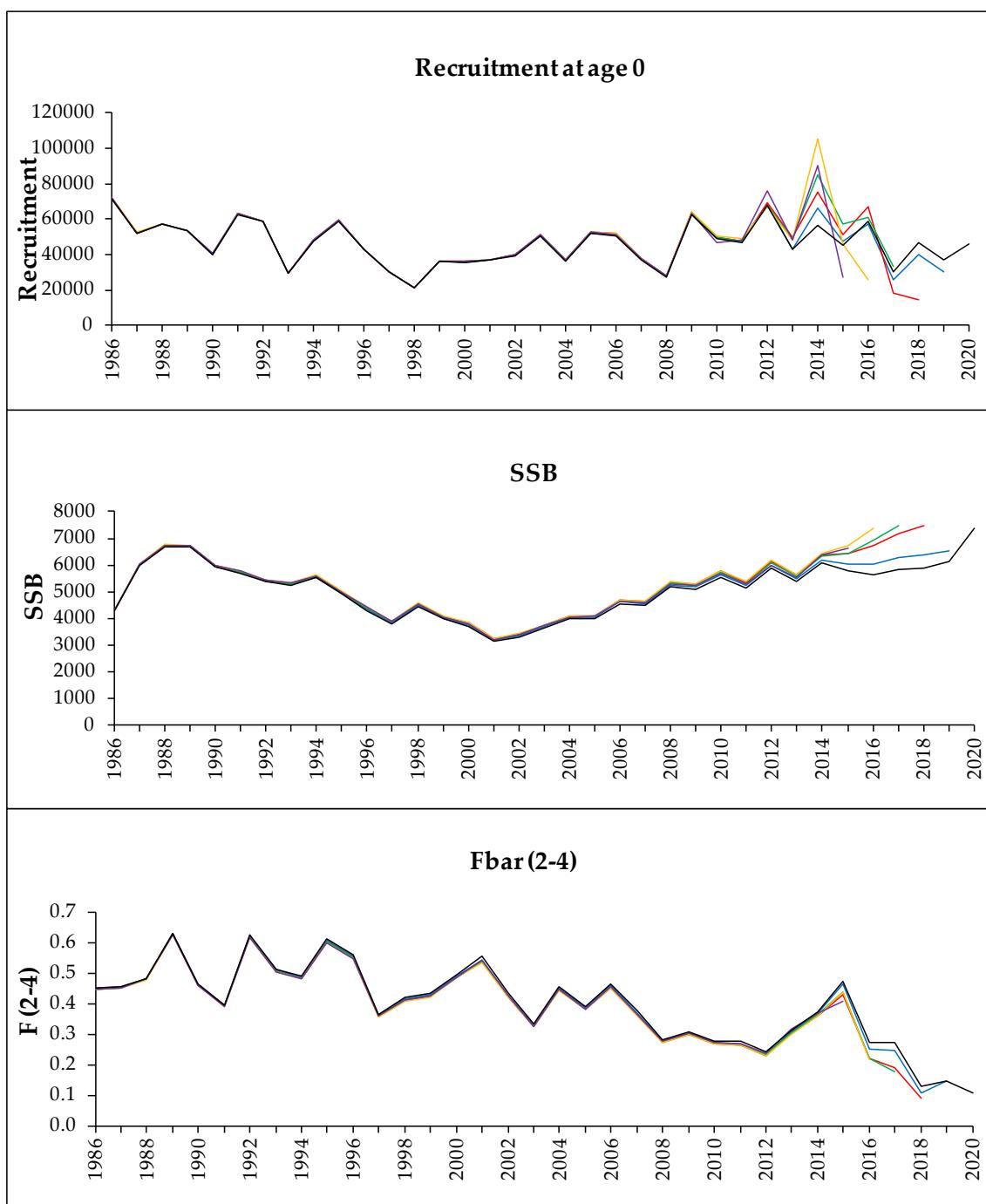
Figure 6.4.5. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Retrospective XSA.
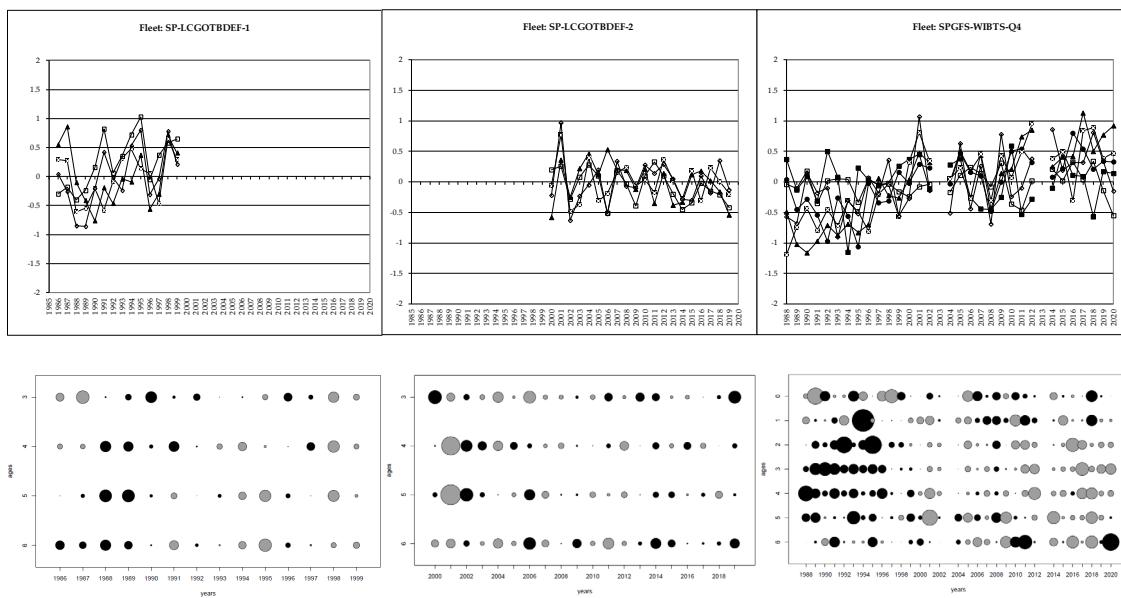
Figure 6.4.6. Four spot megrim (*L. boscii*) in divisions 8.c and 9.a. LOG-CATCHABILITY RESIDUAL PLOTS (XSA)
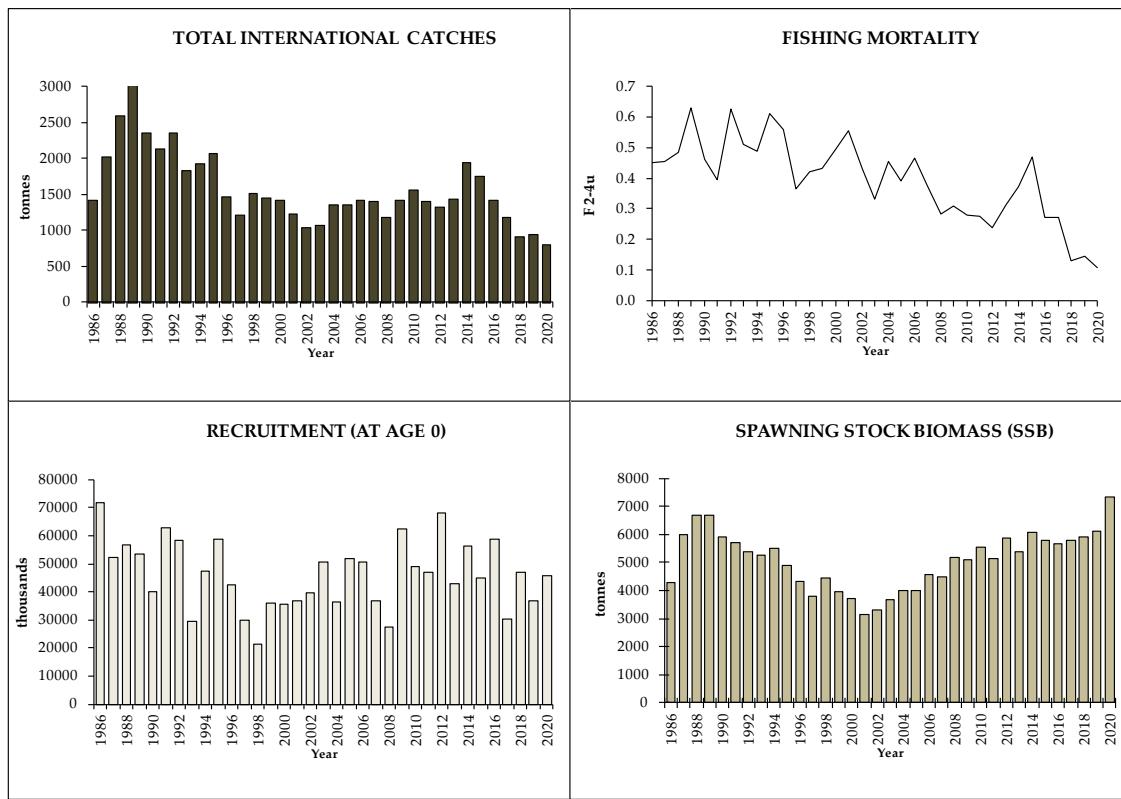
Figure 6.4.7a. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Stock Summary.

Standardized F-at-age (Bubbles colour scale: black – negative, grey – positive)

Standardized relative F-at-age (Bubbles colour scale: black – negative, grey – positive)
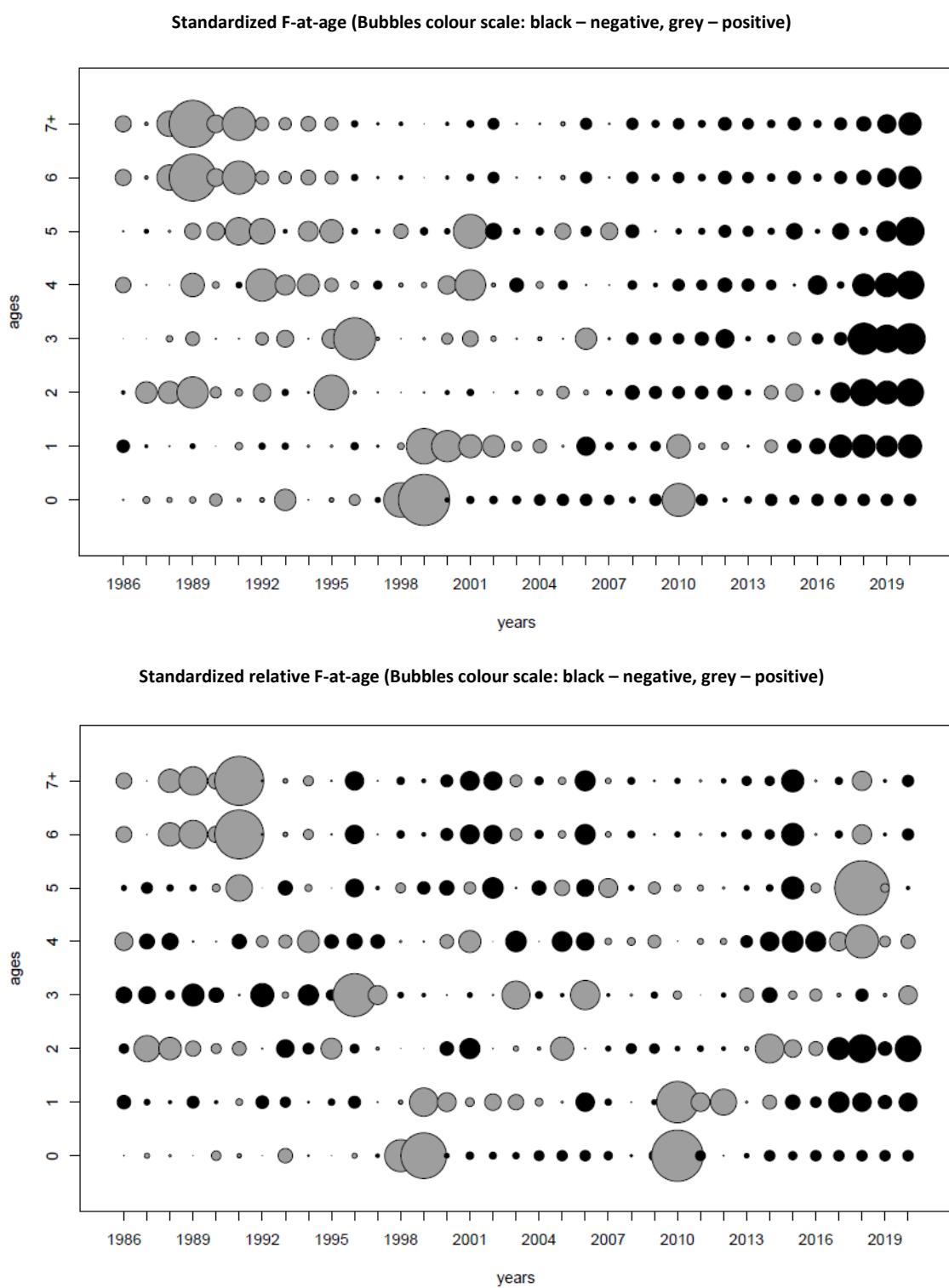
Figure 6.4.7b. Four-spot megrim (*L. boscii*) in Divisions 8cand9a. F-at-age.
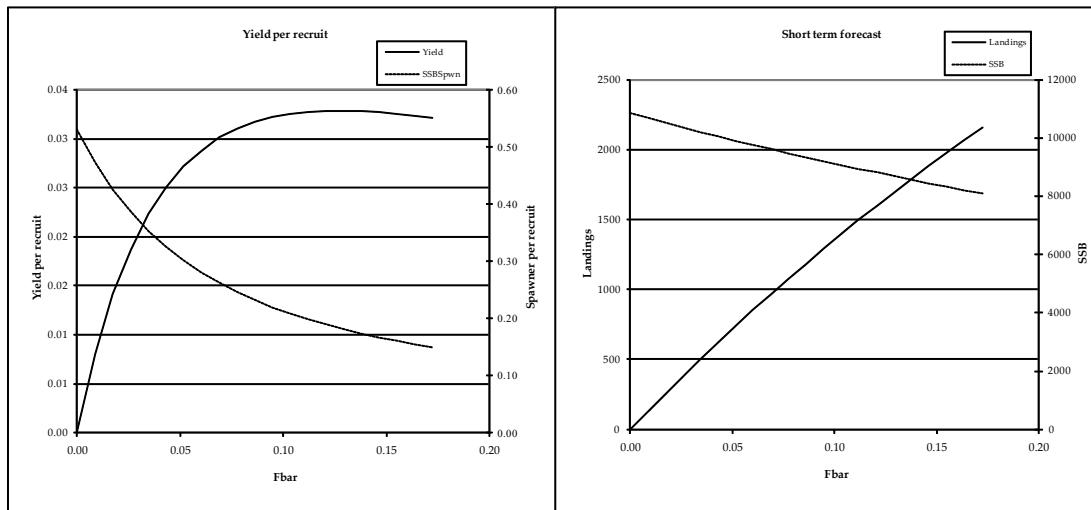
MFYPR version 2a
Run: ldb
Time and date: 13:40 03/05/2021

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.0862
FMax	1.4689	0.1266
F0.1	0.8571	0.0739
F35%SPR	1.4447	0.1245

MFDP version 1a
Run: ldb
Time and date: 13:34 03/05/2021
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

Figure 6.4.8. Four-spot megrim (*L. boscii*) in divisions 8.c and 9.a. Forecast summary.
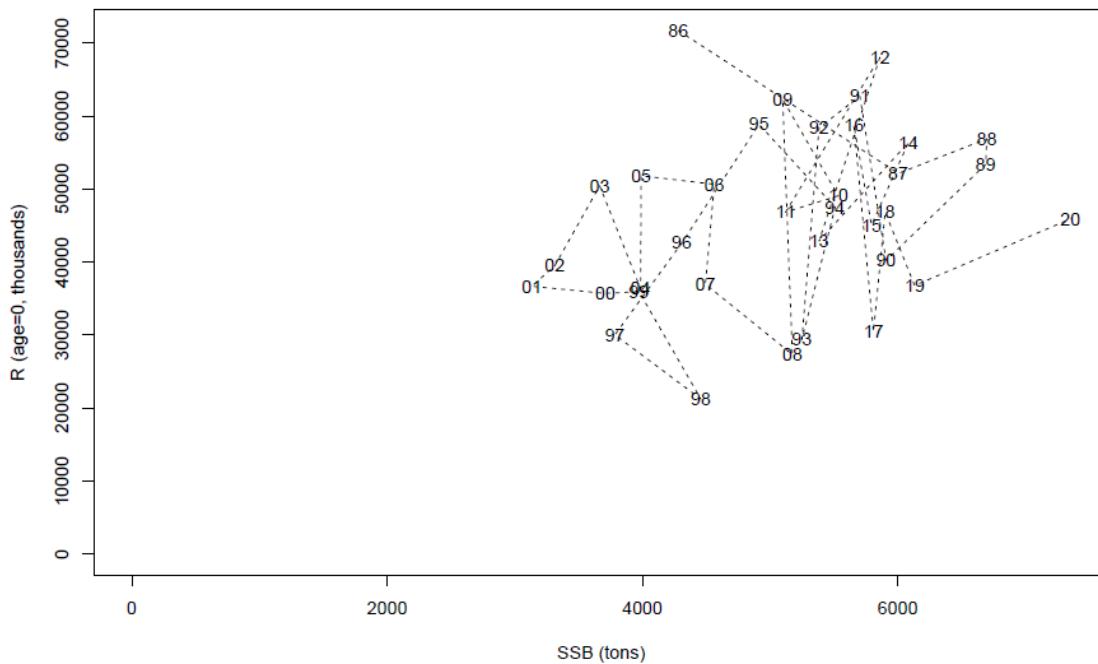
Figure 6.4.9. Four spot megrim (*L. boscii*) in divisions 8.c and 9.a. SSB-Recruitment plot.

6.5 Combined forecast for megrims (*L. whiffiagonis and L. boscii*)

Figure 6.5.1 plots total international landings and estimated stock trends for both species of megrim in the same graph, in order to facilitate comparisons. The two species of megrims are included in the landings from ICES divisions 8.c and 9.a. Both are taken as bycatch in mixed bottom-trawl fisheries.

Assuming status quo F for both species in 2020 (average of estimated F over 2018–2020, corresponding to $F_{bar} = 0.175$ for landings and $F_{bar} = 0.024$ for discards for *L. whiffiagonis* and $F_{bar} = 0.09$ for landings and $F_{bar} = 0.04$ for discards for *L. boscii*), Figure 6.5.2 gives the combined predicted landings for 2022 and individual SSB for 2023, under different multiplying factors of their respective status quo F values. The combined projected values for the two species have been computed as the sum of the individual projected values obtained for each species separately under its assumed exploitation pattern. As usual, the exploitation pattern for each species has been assumed to remain constant during the forecast period.

At F *status quo* (average F over 2018–2020) for both species, predicted combined landings in 2022 are 1739 t and individual SSBs in 2023 are 2425 t for *L. whiffiagonis* and 9337 t for *L. boscii*.
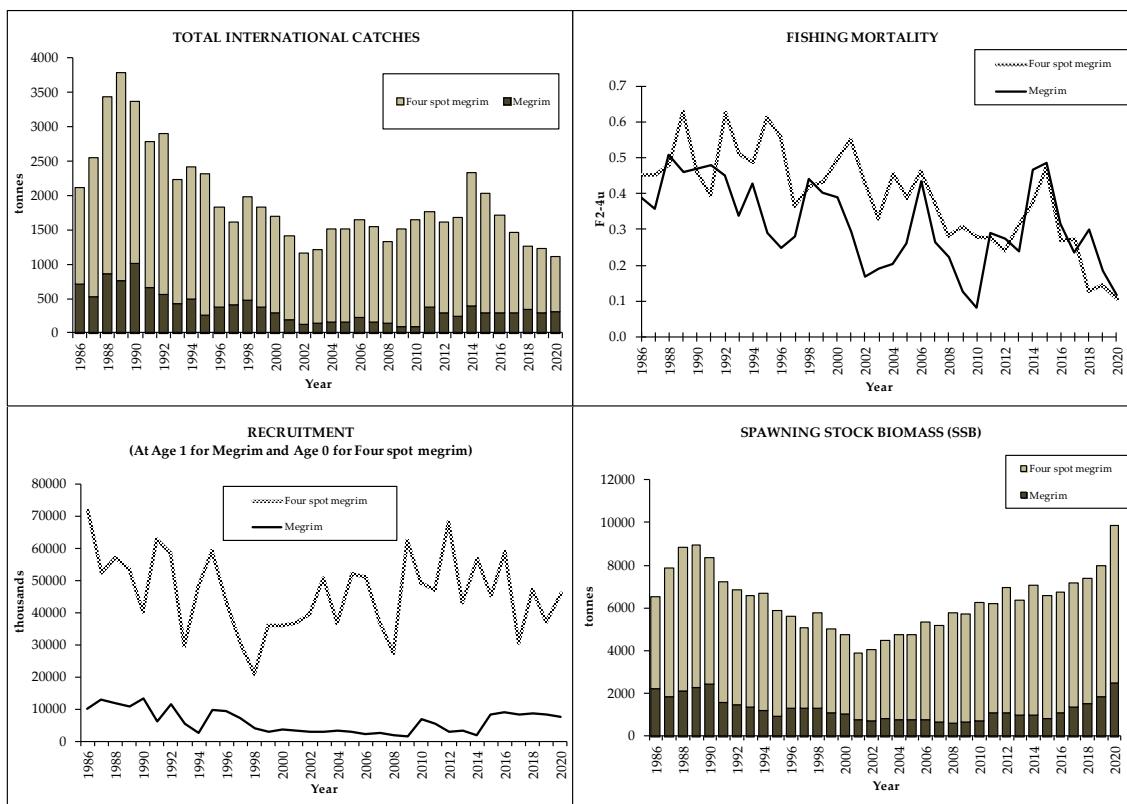
Figure 6.5.1. Stock trends for both stocks. Megrim and four-spot megrim in divisions 8.c and 9.a.
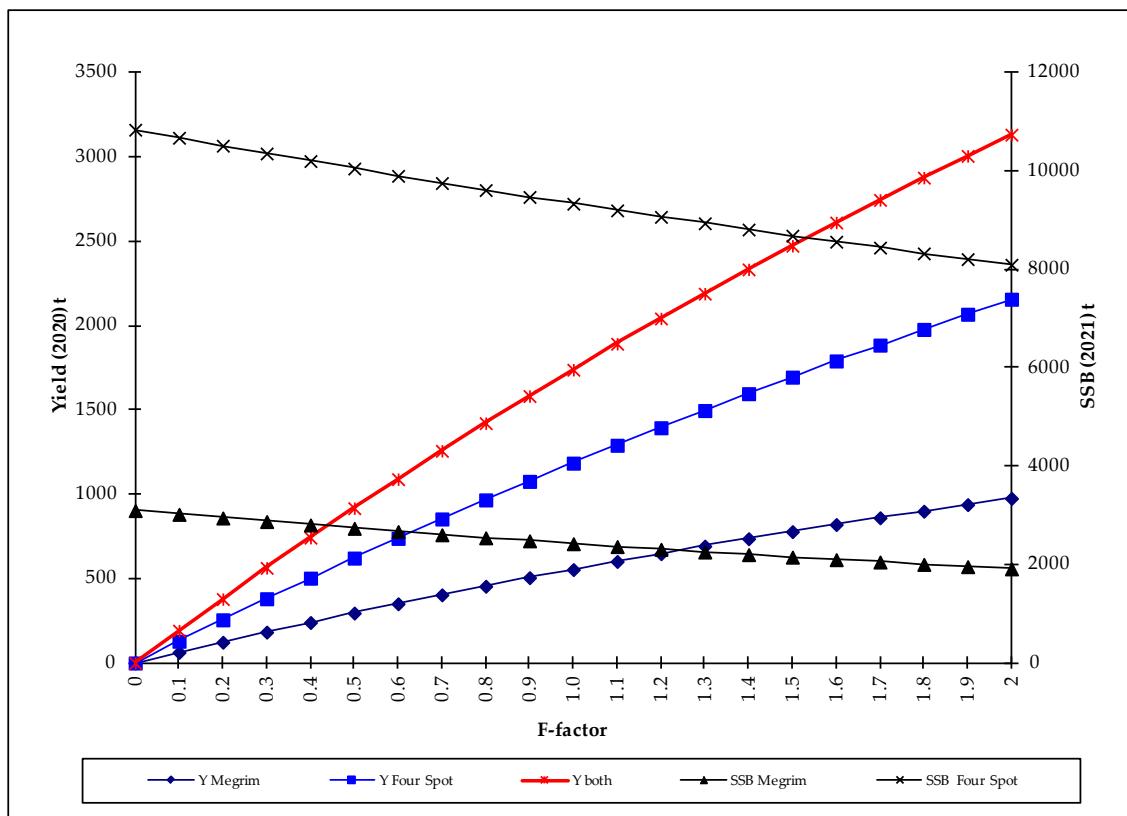

Figure 6.5.2. Megrims (*L. whiffiagonis* and *L. boscii*) in divisions 8.c and 9.a. Combined Short-term Forecasts assuming status quo in 2020 and 2021.