

## 5 Megrim and four-spot megrim west and southwest of Ireland and in the Bay of Biscay

*meg.27.7b-k8abd and ldb.27.7b-k8abd – *Lepidorhombus whiffiagonis* and *Lepidorhombus boscii* in divisions 7.b-k, 8.a-b, and 8.d*

### 5.1 General

Megrim in divisions 7.b–k, 8.a–b, and 8.d (meg.27.7b-k8abd) is a category 1 stock (ICES, 2023a). This stock was last benchmarked at WKMEGRIM in 2022 (ICES, 2023b) using the a4a (Millar and Jardim, 2019) statistical catch-at-age model. Data revisions were also done at the benchmark (ICES, 2023b), including additional revision of discard data from Ireland for the year 2020.

Four-spot megrim in divisions 7.b–k, 8.a–b, and 8.d (ldb.27.7b-k8abd) is a category 5 stock (ICES, 2023a) with no quantitative assessment, for which either only data on landings or a short time-series of catch are available. Data revisions: first year of stock assessment (survey indices included) was done in 2022 (ICES, 2022).

#### 5.1.1 Ecosystem aspects

See the Stock Annex (note: SA for meg.27.7b-k8abd was updated in the 2022 following the WKMEGRIM benchmark; ICES, 2023b)<sup>1</sup> for more details on the ecosystem aspects related to the megrim assessment.

#### 5.1.2 Fishery description

Megrim (*L. whiffiagonis* and *L. boscii*) in the Celtic Sea, west of Ireland, and in the Bay of Biscay are caught in a mixed fishery predominantly by French vessels; followed by Spanish, UK, and Irish demersal vessels. In 2022, the four countries together have reported around 92% of the total landings (Table 5.2.1). Estimates of total landings (including unreported or misreported landings) and catches (landings and discards) as used by WGBIE up to 2022 are shown in Table 5.2.2.

#### 5.1.3 Summary of ICES advice for 2023 and management for 2021 and 2022

##### 5.1.3.1 ICES advice for 2023 (as extracted from ICES Advice 2022)

ICES advises that when the MSY approach is applied, catches in 2023 should be no more than 23 596 t.

ICES notes the existence of a precautionary management plan (ICES, 2023a), developed and adopted by one of the relevant management authorities for this stock.

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<sup>1</sup> ICES. 2022. ICES Stock Annex: Megrim (*Lepidorhombus whiffiagonis*) in divisions 7.b–k, 8.a–b, and 8.d (west and southwest of Ireland, Bay of Biscay). Produced by the Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE) and updated in August 2022 by the WKMEGRIM Benchmark workshop for selected megrim stocks (ICES, 2023b).

Management of catches of the two megrim species, *L. whiffiagonis* and *L. boscii*, under a combined species TAC prevents effective control of the single-species exploitation rates and could lead to the overexploitation of either species.

### 5.1.3.2 Management applicable for 2022 and 2023

The agreed TAC for the combined species was set at 23 459 t for 2022 and 2023.

The minimum landing size (MLS) for megrim was reduced from 25 to 20 cm in 2000.

## 5.2 Megrim (*L. whiffiagonis*) in divisions 7.b–k, 8.a, 8.b, and 8.d

### 5.2.1 General

See general section for both species.

### 5.2.2 Data

#### 5.2.2.1 Commercial catches and discards

Megrim (*L. whiffiagonis*) stock catches for the period 1984–2022, as estimated by WGBIE, are given in Table 5.2.1. This is the sixth year that all landings and discards data have been uploaded to InterCatch. In addition to these imported data, both the discard raising and data allocation were implemented using the InterCatch tool.

Landings in 2022 (10 821 t) are slightly lower than in 2021 (12 418 t; < 13%).

Since 2011, estimates of unallocated or non-reported landings have been included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier.

Spanish data showed a decreasing trend from 2009 onwards until 2018. During the IBPMegrim workshop held in 2016 (ICES, 2016), the French landing data series were updated from 2003–2014. Landings data from France showed initially an increasing trend from 2015 onwards and remained stable in the last three years. In 2021, landings from Ireland, UK and Belgium increased.

French discards data from 2004–2014 were provided for the IBPMegrim in 2016 (ICES, 2016) and were updated in 2017. Apart from France, an increase in discards was observed for all other countries fishing for this stock in 2021.

Discard data available by country and the procedure to derive them are summarized in Table 5.2.3. The discards decrease observed in year 2000 can be partly explained by the reduction in the MLS from 25 cm to 20 cm. Since 2000, fluctuating trends were observed with a peak in 2004 while the minimum observed level in the whole series was observed in 2019. When a country uploads a blank field for discards, then it means that the discards are unknown (i.e. not monitored). During the WKMEGRIM benchmark (ICES, 2023b) in 2022, a discard raising procedure was implemented to take into account these unaccounted values.

Table 5.2.4 presents the discard ratio in percentage (%) from catches in weight of the most recent years.

#### 5.2.2.2 Biological sampling

Age and length frequency distribution (AFD and LFD, respectively) data provided by countries are summarized in the Stock Annex (Annex E).

### Age

France, Ireland, UK and Belgium initially provided numbers-at-age to InterCatch then eventually submitted a complete series with numbers- and weights-at-age up to 2022. Age distribution for landings and discards from 2011–2022 is presented in Figure 5.2.1.

### Lengths

Table 5.2.5 shows the available original length composition of landings by Fishing Unit (FU) in 2022.

### Natural Mortality

A value of 0.2 for the natural mortality (M) has been used as input data for all ages and years in the final assessment model.

## 5.2.2.3 Survey data

### Western IBTS Q4 Porcupine Survey (Spain) – SP\_PORC

The Spanish Groundfish Survey in the Porcupine bank (SpPGFS -WIBTS-Q3, G5768) covers ICES divisions 27.7c,k and a small portion of 27.7b corresponding to the Porcupine Bank and the adjacent area in western Irish waters from longitude 12°W to 15°W and from latitude 51°N to 54°N, covering depths between 180 and 800 m. The survey takes place at the end of the third quarter (September), and the beginning of 4th quarter.

The available survey index consists of catch numbers-at-age per 30 minutes fished for the years 2001 onwards. The age composition by year is presented in Figure 5.2.3.

### Western IBTS Q4 EVHOE and IGFS surveys (France/Ireland) – FR\_IE\_IBTS

The Irish IBTS Q4 groundfish survey (IGFS-WIBTS-Q4, G7212) covers areas 27.7bgjk. The French EVHOE-WIBTS-Q4 (G9527) survey covers areas 27.7j8ab. Both surveys use a GOV trawl and are coordinated and largely standardized by the WGIBTS (ICES, 2009). Together the two surveys cover the majority of the stock area up to depths of 200–300 m. This is where most of the young fish occur. Older fishes migrate to deeper waters and, thus, are not well sampled by these surveys.

Data for Irish and French IBTS Q4 groundfish surveys (IGFS-WIBTS-Q4, G7212 and EVHOE-WIBTS-Q4, G9527) were obtained from DATRAS and then quality checked and cleaned. The two surveys were combined by weighting the average catches by the area covered by each survey series. This combined French and Irish survey index is referred to by the ICES acronym FR\_IE\_IBTS. Thus, IGFS-WIBTS-Q4 (G7212) represents a catch weight of approximately 45% and 55% for the EVHOE WIBTS-Q4 (G9527). The combined survey index appears to give a more coherent recruitment signal when used in the assessment than when each survey is used separately.

The age composition by year is presented in Figure 5.2.4.

### Irish Anglerfish and Megrim Survey (Ireland) – IE\_Monksurvey

Ireland has carried out the Irish Anglerfish and Megrim (IAMS, G3098) survey every year in Q1 since 2016.

The survey covers ICES areas 7bcjk and the western part of 7gh; the depth range is from around 50 to 1000 m. The survey covers the main distribution area of megrims in Area 7 and although areas 8.a, 8.b, and 8.d is not covered, this area only contributes around 10% of the landings. Therefore, the survey can be considered to cover the vast majority of the stock distribution.

The survey uses a relatively large mesh gear and the catchability of small megrims is relatively low. Because female megrims grow to a larger size than males, the catchability is expected to be different by sex. Therefore, both sex-specific and sex-combined indices are provided.

**Available fisheries independent surveys used as tuning fleets.**

Type	Name	Year range	Age range	Used in the assessment
Spanish Porcupine groundfish survey	SpPGFS-WIBST-Q3 (G5768)	2001-present	0–10+	Yes
Combined French and Irish survey	FR_IE_IBTS	2003-present	0–10+	Yes
French EVHOE groundfish survey	EVHOE-WIBTS-Q4 (G9527)	1997-present	1–9	No
Irish groundfish survey	IGFS-WIBTS-Q4 (G7212)	2003-present	0–10+	No
Irish Anglerfish and Megrim survey	IAMS-Q1 (G3098)	2016-present	0–10+	No

Abundance Indices for SpPGFS-WIBTS-Q4 (G5768) and for the combined FR\_IE\_IBTS surveys are presented in numbers-at-age in Table 5.2.6. The biomass abundance index is given in Table 5.2.7 while the scaled biomass indices trends are shown in Figure 5.2.2.

#### 5.2.2.4 Commercial catch and effort data

The use of commercial CPUE data was rejected during the WKMEGRIM benchmark (ICES, 2023b) due to concerns about the changes in efficiency, targeting behaviour, quota restrictions, technical measures, discarding and compliance. However, information on trends in effort, landings and LPUE or CPUE may be used by WGBIE as supplementary information.

### 5.2.3 Assessment

A statistical catch-at-age stock assessment model developed as part of the Assessment For All (a4a; Millar and Jardim, 2019) initiative of the European Commission Joint Research Centre is used. The stock assessment model framework is a non-linear catch-at-age model implemented in R (R Core Team, 2022) and FLR (Kell *et al.*, 2007), and uses an ADMB (Fournier *et al.*, 2012) that can be applied rapidly to a wide range of situations with low parameterization requirements. The model structure is defined by sub-models, which are different parts, that require structural assumptions. There are five sub-models in operation: a model for F-at-age, a model for the initial age structure, a model for recruitment, a (list) of model(s) for abundance indices catchability-at-age, and a list of models for the observed variance of catch-at-age and abundance indices. The sub-models form use linear models.

- See <https://github.com/flr/FLa4a/blob/master/docs/articles/sca.pdf/> for details on the a4a framework.

#### 5.2.3.1 Data exploratory analysis

In summary, the stock's catch-at-age matrix shows three periods: 1984–1989; 1990–1998 and 1999–2022.

The data analysed consist of landed, discarded and catch numbers-at-age and abundance indices-at-age. Three of the available surveys were considered appropriate to include in the assessment model as tuning fleets: SpPGFS\_WIBTS-Q4 (G5768) and the combined FR\_IE\_IBTS surveys based on their representativeness of the megrim stock abundance. Several exploratory data analyses were performed to examine their ability to track cohorts through time.

The time-series of catch-at-age (Figure 5.2.6) showed very low catches of ages 1–5 from 1984 to 1989. From 2004 to 2010, the catch of older ages ( $> 6$ ) was remarkably low, whereas catches of ages 1 and 2 increased considerably from 2003. This could be a result of an underestimation of catches of these younger ages (especially age 1) during the previous years coupled by the sparseness of discard data during the same period. For ages 6 and older, large discrepancies in the number of individuals caught before and after 1990 are apparent, with large catches of these ages before 1990 and a decrease of all ages at the end of the data series.

The analysis of landings since 1990 is presented in Figure 5.2.7. Landings of ages 1 and 2 have increased from the beginning of the time-series. In fact, the proportion of older ages in the landings decreased significantly from 2004 to 2009, as already discussed in relation to the catch. Ages 1 increased significantly since 2017 mainly due to the French landings and there was an increase of age 4 in the last year 2022.

The signal coming from the discard data showed that the discards of age 1 were low at the beginning of the data series (Figure 5.2.8). Discards of this age increased particularly from 2003 onwards. From 2010 to 2013, ages 1 to 3 appeared to be highly discarded. An overall increase in older ages discards is observed during the last years (2016–2022).

The analysis of the standardized log abundance indices for the updated data revealed a strong year class in 2007 for the SpPGFS-WIBTS-Q4 (G5768) survey (Figure 5.2.9) but in general, shows little or no cohort tracking in the other surveys. Presumably, this is a consequence of the lack in recruitment variability which led to an absence of contrast between cohorts. In Figure 5.2.10, the combined FR\_IE\_IBTS survey shows a reduction of older ages in the years 2018–2020 then a slight increase in 2022.

### 5.2.3.2 Model

#### Model Specification

The model structure is defined by sub-models, which are the different parts that require structural assumptions. There are five sub-models in operation:

1. model for F-at-age,
2. model for the initial age structure,
3. model for recruitment,
4. (list) of model(s) for abundance indices catchability-at-age,
5. list of models for the observation variance of catch-at-age and abundance indices.

These sub-models were defined as:

fmodel:	$\sim \text{factor}(\text{replace}(\text{age}, \text{age} > 7, 7)) + \text{factor}(\text{year})$
srmodel:	$\sim \text{factor}(\text{year})$
n1model:	$\sim s(\text{age}, k = 3)$
qmodel:	
SP_PORC:	$\sim I(1/(1 + \exp(-\text{age})))$
CPUE.IRLFRsurvey:	$\sim I(1/(1 + \exp(-\text{age})))$
vmodel:	
catch:	$\sim s(\text{age}, k = 3)$
SP_PORC:	$\sim 1$
CPUE.IRLFRsurvey:	$\sim 1$

The F model is a separable model. The shape of the F-at-age pattern is independently estimated for each age except for ages 7 and older, which are assumed to have the same F. This F pattern is then independently scaled up and down for each year.

Stock–recruit model: Freely estimated for each year.

Catchability models:

For both the SpPGFS-WIBTS-Q4 (G5768) and the combined FR\_IE\_IBTS surveys, catchability is assumed to increase asymptotically.

N1 model (population in the first year of the time-series): default value a4aSCA function (independently estimated for each age).

Vmodel (the shape of the observation variances): default value a4aSCA function: smooth function for the catch numbers-at-age and ‘flat’ for the indices

### Model Settings

- $F_{\text{bar}}$  is set to ages 3–6.

After some exploratory analysis, the following changes were done to the initial input data

Age 1 in 2011 was removed from the combined FR\_IE\_IBTS survey as the value was not considered credible.

The catch-at-age matrix was explored due to doubts arising for the age 1 total catches data at the beginning of the historical series. The increase in age 1 from year 2000 onwards was considered not reasonable which may be due to the bad quality of discard data at the beginning of the time-series. Therefore, the catch.n of 1-year-olds is set to NA for the early years (1984: 2000).

The model is described in the Stock Annex.

### 5.2.3.3 Results

This model was selected based on a thorough investigation and selection of the input data (as described above) and optional model settings selected (by visual inspection) to reduce model residuals and improve both the model parsimony (AIC) and predictive capability (visual inspection of both Mohn’s rho [Mohn, 1999] and retrospective analyses).

Results of the estimated spawning-stock biomass (SSB), reference fishing mortality ( $F_{\text{bar}}$ ), recruits and catches are shown in Figure 5.2.11. The SSB shows an overall decreasing trend from the start of the series in 1984–2005 followed by a marked increasing trend in recent years until 2022. The uncertainty in the SSB was low for the whole time-series. The median recruitment fluctuated between 200 000 and 300 000 thousand in the whole series, with a decreasing trend in the last period. The  $F$  showed three marked data periods: 1984–1989, 1990–1998 and 1999–2022, with a decreasing trend, reaching the lowest value in 2022 of the series but with low uncertainty. This decreasing  $F$  trend explains the increase of SSB since catches and recruitment remain relatively constant in recent years. Overall, the catches showed a slightly decreasing trend.

A new assessment model is implemented and the reference points were revised during the WKMEGRIM benchmark (ICES, 2023b). New relative values in relation to these reference points for SSB,  $F$  and  $R$  were obtained during the WGBIE last year (ICES, 2022). Figure 5.2.13 shows the historical assessment results (final-year recruitment assumptions included for each line) relative to each year’s reference points for comparison. The 2023 assessment is represented in orange while the previous year’s assessment results are in blue.

### 5.2.3.4 Retrospective pattern

Retrospective analysis was conducted for 5 years. The retrospective time-series of the most relevant indicators are shown in Figure 5.2.12.

In terms of SSB, estimates were very similar throughout the entire time-series and there was a downward revision of the SSB with a Mohn’s rho (Mohn, 1999) value of 0.254.  $F$  was revised

upwards year after year with a Mohn's rho value of  $-0.229$ . Recruitment estimates towards the end of the time-series showed significant revisions in the retrospective analysis with a Mohn's rho value of  $0.364$ . The latter is a common pattern as recruitment in the most recent year(s) is usually not correctly estimated by the assessment model. These Mohn's rho values are slightly out of the defined bounds in WKFORBIAS (ICES, 2020). However, a revision of the diagram was done by the EG and as the  $F < F_{MSY}$ ,  $B \gg MSY$   $B_{trigger}$ , it was decided to give advice for this stock.

### 5.2.3.5 Short-term forecasts

#### Assumptions for the Interim Year

- Initial stock size: Taken from the a4a model survivors.
- Weight-at-age in the stock: average of the last five years.
- Weight-at-age in the catch: average of the last five years.
- Proportion discards-at-age in the catch: average of the last three years.
- Geometric mean (GM) recruitment: full time-series excluding the last two years.
- Recruitment assumptions: Recruitment in last year of assessment is not replaced with GM unless the estimate is highly uncertain or there appears to be a retrospective bias.
- Exploitation pattern: If there is a decreasing  $F$  trend the assessment time-series results,  $F_{status\ quo}$  should be scaled to  $F_{bar}$  of the final assessment year. If not,  $F_{status\ quo}$  should be replaced by the average  $F$  of the last three years.
- Stock-recruitment model used: None.
- No medium-term projections are proposed for this stock.

#### Assumptions for Forecast

- Same as for the interim year.

#### Methods

- Model used: `stf()` and `fwd()` functions in R packages *FLasher* and *FLCore*.
- Software used: R packages *FLasher* (version 0.6.7) and *FLCore* (version 2.6.18) in R (version 4.1.2).

#### Forecast Results

There is no clear decreasing trend in the  $F$  estimates during the last years, therefore, the mean of  $F$  during the last three years was used for the projections. For the 2023 recruitment, the GM of the recruitment posteriors during all the assessment years was used except for the final 2 years.

Landings in 2024 and SSB in 2025 predicted for various levels of  $F$  in 2024 are given in Table 5.2.8.

### 5.2.4 Biological reference points

Biological reference points were calculated during the WKMEGRIM benchmark (ICES, 2023b) and are shown in the Stock Annex.

### 5.2.5 Conclusions

During the WKMEGRIM benchmark (ICES, 2023b), a4a (Millar and Jardim, 2019) method was implemented as a new assessment model to replace the previous Bayesian SCA (Plummer, 2003) model. This previous model needed 10 hours to run so it was difficult to explore alternative settings and input thoroughly while the new a4a (Millar and Jardim, 2019) model is less time-consuming, thus, allowing for better and diverse settings explorations. The residual plots are not perfectly random and some retro bias remain (overestimation of SSB and underestimation of  $F$ ),

with Mohn's rho values slightly out of bounds, despite these, it was still decided to provide advice.

New maturity ogives based on the best practice histological methods (Dominguez-Petit, 2021) were adopted and the use of the female-only ogives was selected.

Several surveys were considered. Both the SpPGFS-WIBTS-Q4 (G5768) and the combined FR\_IE\_IBTS survey indices were included. No commercial CPUEs were explored due to their unreliability.

New biomass reference points obtained from the new assessment are fairly similar to the old ones,  $F_{MSY}$  is slightly higher. Thus, the status of the stock remains unchanged relative to these results ( $F < F_{MSY}$ ,  $B \gg MSY B_{trigger}$ ).

## 5.2.6 References

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## 5.2.1 Tables and figures

Table 5.2.1. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Nominal landings and catches (in tonnes) by country provided by WGBIE.

	Landings									Discards										
	France	Spain	U.K. (England & Wales)	U.K. (Scotland)	Ireland	Northern Ireland	Belgium	Unallocated	Total landings	France	Spain	U.K.	Ireland	Northern Ireland	Belgium	Others	Total discards	WK Raised Discard	Total catches	TAC
1984									16659							2169	2169		18828	
1985									17865							1732	1732		19597	
1986	4896	10242	2048		1563		178		18927							2321	2321		21248	
1987	5056	8772	1600		1561		125		17114							1705	1705		18819	16460
1988	5206	9247	1956		995		173		17577							1725	1725		19302	18100
1989	5452	9482	1451		2548		300		19233							2582	2582		21815	18100
1990	4336	7127	1380		1381		147		14370							3284	3284		17654	18100
1991	3709	7780	1617		1956		32		15094							3282	3282		18376	18100
1992	4104	7349	1982		2113		52		15600							2988	2988		18588	18100
1993	3640	6526	2131		2592		40		14929							3108	3108		18037	21460
1994	3214	5624	2309		2420		117		13684							2700	3284		16968	20330
1995	3945	6129	2658		2927		203		15862				422			2230	2652		18514	22590
1996	4146	5572	2493		2699		199		15109				410			2616	3026		18135	21200
1997	4333	5472	2875		1420		130		14230		414		568			2083	3066		17296	25000
1998	4232	4870	2492		2621		129		14345		381		681			4309	5371		19716	25000
1999	3751	4615	2193		2597		149		13305		3135		162				3297		16601	20000
2000	4173	6047	2185		2512		115		15031		1033	208	630				1870		16901	20000
2001	3645	7575	1710		2767		80		15778		1275	250	736				2262		18040	16800
2002	2929	8797	1787		2413		62		15987		1466	435	912				2813		18800	14900
2003	3227	8340	1732		2249		163		15711		3147	279	582				4008		19719	16000
2004	2817	7526	1622		2288		106		14358	1003	4511	257	472				6243		20602	20200
2005	2972	5841	1764		2155		156		12888	697	1831	289	458				3275		16163	21500
2006	2763	5916	1509		1751		99		12037	382	2568	271	529				3751		15788	20400
2007	2745	6895	1462		1763		195		13060	330	2114	272	317				3033		16092	20400
2008	2578	5402	1387		1514		167		11048	329	1479	289	764				2860		13908	20400
2009	3032	8062	1840		1918	2	209		15064	674	1761	389	454				3278		18342	20400
2010	3651	7095	1805		2283	5	261		15101	937	3489	463	453				5343		20444	20106
2011	3235	3500	1845		2227		330	2089	13226	847	2097	898	344				4187		17413	20106
2012	4012	4055	1744		3047		609	966	14433	796	2668	88	152				3704		18137	19101
2013	4549	4982	2918		3038		538		16025	748	3792	53	286		5		4885		20910	19101
2014	4311	3318	2753	176	2391		179	150	13277	795	1337	72	360		5		2569		15846	19101
2015	3073	2863	2804	147	2436		246	1	11569	634	513	47	308		4		1507	887	13962	19101
2016	3141	2672	2694	145	2593		302	1	11548	1276	649	74	404		42		2445	870	14863	20056
2017	5101	3178	2512	176	2458		360		13784	783	706	265	378		40		2173	1345	17303	15043
2018	4680	2276	2337	112	2128	6	347	261	12147	610	483	85	495		66		1738	1677	15562	13528
2019	4332	2617	2150	129	2454	1	481		12164	424	130	63	252		120		989	977	14130	19836
2020	4387	2420	1883	5	1797	1	649		11141	398	253	53	510		117		1331	1154	13626	20526
2021	4380	2896	2199	144	2075	5	718	0	12418	238	437	90	877		166		1807	796	15020	20181
2022	3842	2813	1772	8	1506	1	879		10821	297	319	13	739		201		1568	772	13161	23459

**Table 5.2.2. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Nominal landings and catches (in tonnes) provided by WGBIE.**

	<b>Total landings</b>	<b>Total discards</b>	<b>Total catches</b>	<b>Agreed TAC (1)</b>
<b>1984</b>	16659	2169	18828	
<b>1985</b>	17865	1732	19597	
<b>1986</b>	18927	2321	21248	
<b>1987</b>	17114	1705	18819	16460
<b>1988</b>	17577	1725	19302	18100
<b>1989</b>	19233	2582	21815	18100
<b>1990</b>	14370	3284	17654	18100
<b>1991</b>	15094	3282	18376	18100
<b>1992</b>	15600	2988	18588	18100
<b>1993</b>	14929	3108	18037	21460
<b>1994</b>	13684	3284	16968	20330
<b>1995</b>	15862	2652	18514	22590
<b>1996</b>	15109	3026	18135	21200
<b>1997</b>	14230	3066	17296	25000
<b>1998</b>	14345	5371	19716	25000
<b>1999</b>	13305	3297	16601	20000
<b>2000</b>	15031	1870	16901	20000
<b>2001</b>	15778	2262	18040	16800
<b>2002</b>	15987	2813	18800	14900
<b>2003</b>	15711	4008	19719	16000
<b>2004</b>	14358	6243	20602	20200
<b>2005</b>	12888	3275	16163	21500
<b>2006</b>	12037	3751	15788	20425
<b>2007</b>	13060	3033	16092	20425
<b>2008</b>	11048	2860	13908	20425
<b>2009</b>	15064	3278	18342	20425
<b>2010</b>	15101	5343	20444	20106
<b>2011</b>	13226	4187	17413	20106
<b>2012</b>	14433	3704	18137	19101
<b>2013</b>	16025	4885	20910	19101
<b>2014</b>	13277	2569	15846	19101
<b>2015</b>	11569	2393	13962	19101
<b>2016</b>	11548	3315	14863	20056
<b>2017</b>	13784	3518	17303	15043
<b>2018</b>	12147	3415	15562	13528
<b>2019</b>	12164	1966	14130	19836
<b>2020</b>	11141	2485	13626	20526
<b>2021</b>	12418	2603	15020	20181
<b>2022</b>	10821	2340	13161	23459

(1) for both megrim species and VIIa included.

Table 5.2.3. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Discards information and derivation.

	FR	SP	IR	UK
1984	<b>FR84-85</b>	-	-	-
1985	<b>FR84-85</b>	-	-	-
1986	(FR84-85)	(SP87)	-	-
1987	(FR84-85)	<b>SP87</b>	-	-
1988	(FR84-85)	<b>SP88</b>	-	-
1989	(FR84-85)	(SP88)	-	-
1990	(FR84-85)	(SP88)	-	-
1991	<b>FR91</b>	(SP94)	-	-
1992	(FR91)	(SP94)	-	-
1993	(FR91)	(SP94)	-	-
1994	(FR91)	<b>SP94</b>	-	-
1995	(FR91)	(SP94)	<b>IR</b>	-
1996	(FR91)	(SP94)	<b>IR</b>	-
1997	(FR91)	(SP94)	<b>IR</b>	-
1998	(FR91)	(SP94)	<b>IR</b>	-
1999	-	<b>SP99</b>	<b>IR</b>	-
2000	-	<b>SP00</b>	<b>IR</b>	<b>UK</b>
2001	-	<b>SP01</b>	<b>IR</b>	<b>UK</b>
2002	-	(SP01)	<b>IR</b>	<b>UK</b>
2003	-	<b>SP03</b>	<b>IR</b>	<b>UK</b>
2004	<b>FR04</b>	<b>SP04</b>	<b>IR</b>	<b>UK</b>
2005	<b>FR05</b>	<b>SP05</b>	<b>IR</b>	<b>UK</b>
2006	<b>FR06</b>	<b>SP06</b>	<b>IR</b>	<b>UK</b>
2007	<b>FR07</b>	<b>SP07</b>	<b>IR</b>	<b>UK</b>
2008	<b>FR08</b>	<b>SP08</b>	<b>IR</b>	<b>UK</b>
2009	<b>FR09</b>	<b>SP09</b>	<b>IR</b>	<b>UK</b>
2010	<b>FR10</b>	<b>SP10</b>	<b>IR</b>	<b>UK</b>
2011	<b>FR11</b>	<b>SP11 (*)</b>	<b>IR</b>	<b>UK</b>
2012	<b>FR12</b>	<b>SP12 (*)</b>	<b>IR</b>	<b>UK</b>
2013	<b>FR13</b>	<b>SP13 (*)</b>	<b>IR</b>	<b>UK</b>
2014	<b>FR14</b>	<b>SP14 (*)</b>	<b>IR</b>	<b>UK</b>
2015	<b>FR15</b>	<b>SP15 (*)</b>	<b>IR</b>	<b>UK</b>
2016	<b>FR16</b>	<b>SP16 (*)</b>	<b>IR</b>	<b>UK</b>
2017	<b>FR17</b>	<b>SP17 (*)</b>	<b>IR</b>	<b>UK</b>
2018	<b>FR18</b>	<b>SP18 (*)</b>	<b>IR</b>	<b>UK</b>
2019	<b>FR19</b>	<b>SP19 (*)</b>	<b>IR</b>	<b>UK</b>
2020	<b>FR20</b>	<b>SP20 (*)</b>	<b>IR</b>	<b>UK</b>
2021	<b>FR21</b>	<b>SP21 (*)</b>	<b>IR</b>	<b>UK</b>
2022	<b>FR22</b>	<b>SP22 (*)</b>	<b>IR</b>	<b>UK</b>

- In bold: years where discards sampling programs provided information

- In (): years for which the length distribution of discards has been derived

(\*) Scientific estimates were provided

Table 5.2.4. Megrin (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Discard ratio in percentage (%) from catches-in-weight for the years 2008–2022.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
% Discard	21%	18%	26%	24%	20%	23%	16%	17%	22%	20%	22%	14%	18%	17%	18%

**Table 5.2.5. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Length composition by fleet (thousands) in 2022.**

Length class (cm)	FRANCE OTT_DEF_>=70_0_0 (ICES 8a)	SPAIN OTB_DEF_70-99_0_0 (ICES 7b-k)
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		3
21	2	10
22	2	70
23	0	151
24	8	455
25	38	974
26	60	1383
27	73	1277
28	48	1320
29	58	1209
30	61	980
31	49	770
32	61	586
33	90	449
34	62	305
35	83	218
36	80	156
37	64	124
38	69	96
39	51	65
40	49	65
41	53	59
42	31	47
43	21	30
44	19	28
45	15	19
46	11	18
47	13	13
48	9	11
49	4	8
50	1	5
51	0	2
52	0	1
53		2
54		
55		
56		
57		
58		
59		
60		
61		
62		
TOTAL	1185	10908

**Table 5.2.6. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Abundance Indices for the SpPGFS-WIBTS-Q3 (G5768) and the combined FR\_IE\_IBTS surveys. Megrim numbers-at-age index (numbers per 10 hours fished) from the combined FR\_IE\_IBTS survey.**

Year	1	2	3	4	5	6	7	8	9	10
2003	41.8	62.0	57.7	60.1	23.1	11.2	6.5	2.8	1.7	0.6
2004	34.6	80.9	72.7	51.4	26.5	12.2	6.3	3.3	1.3	1.1
2005	45.5	88.1	69.9	43.3	30.0	18.4	5.7	3.0	3.1	1.8
2006	65.9	96.2	75.6	47.5	26.1	13.5	6.2	4.9	1.3	0.8
2007	53.7	74.4	35.9	33.5	33.1	11.0	6.6	4.2	2.2	1.4
2008	29.4	129.7	76.4	37.6	17.3	9.2	4.0	2.3	0.7	0.6
2009	16.8	70.0	128.4	65.3	40.4	20.3	8.1	5.4	2.4	2.3
2010	29.1	44.2	73.9	70.3	38.1	20.5	7.7	3.8	2.2	0.6
2011	0.3	78.3	93.3	70.8	37.4	19.9	8.0	3.2	2.6	2.4
2012	19.8	71.9	101.5	35.0	23.4	12.0	8.2	2.2	2.3	1.2
2013	17.1	63.8	60.1	54.3	12.8	8.2	5.0	1.7	2.1	1.5
2014	14.8	83.4	39.5	56.0	21.2	9.0	4.3	3.6	1.6	0.8
2015	42.9	48.0	77.6	38.7	25.5	13.1	4.9	1.6	2.0	1.1
2016	42.2	95.0	56.8	43.5	33.8	21.2	7.8	7.1	2.7	1.5
2017	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018	75.4	126.9	93.2	62.1	27.3	17.0	5.6	3.0	1.5	1.2
2019	58.7	171.0	131.1	67.1	25.8	10.5	6.6	2.6	1.7	0.8
2020	53.8	164.0	128.5	71.1	44.0	20.7	6.3	4.5	2.3	1.0
2021	48.7	122.4	114.9	75.7	60.4	27.8	15.7	5.4	3.0	0.9
2022	48.7	146.8	118.6	70.2	34.6	20.7	8.2	4.8	3.6	1.6

**Table 5.2.6 (cont) Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Northern megrim. Age composition Porcupine Bank groundfish survey. Stratified abundance indices per age group. Mean catches per 30' haul.**

Year/Age	1	2	3	4	5	6	7	8
2001	18	22	28	34	19	14	5	3
2002	11	25	32	40	22	11	3	2
2003	11	29	41	53	28	13	4	2
2004	7	35	55	56	31	11	5	3
2005	6	6	23	82	50	26	5	2
2006	18	14	33	47	33	9	2	2
2007	49	70	36	36	18	9	2	2
2008	3	22	54	40	18	12	3	1
2009	5	7	53	70	16	9	4	2
2010	3	22	26	67	23	5	2	2
2011	4	12	25	39	51	15	3	3
2012	2	7	38	29	32	29	12	7
2013	15	12	12	16	37	27	17	8
2014	2	32	10	23	44	34	12	10
2015	22	22	41	21	18	21	11	7
2016	11	61	33	41	22	22	9	8
2017	19	52	36	26	31	16	5	5
2018	8	53	77	28	18	9	6	4
2019	9	44	55	33	33	19	6	6
2020	2	30	51	42	28	21	4	3
2021	3	13	43	68	65	26	12	4
2022	1	11	24	48	42	29	13	6

SpPGFS-WIBTS-Q4 (G5768): Megrim whiff: Stratified abundance index per 30 mins haul

New stratification			New stratification		
Kg / lance	TOTAL		Nº / lance	TOTAL	
AÑO	Yst	SE	AÑO	Yst	SE
2001	6.80	0.88	2001	143.34	19.71
2002	6.66	0.82	2002	146.00	21.40
2003	8.16	0.98	2003	180.81	21.50
2004	9.01	1.05	2004	202.72	23.27
2005	9.81	1.26	2005	201.19	30.69
2006	7.64	1.22	2006	158.14	30.69
2007	9.15	0.94	2007	221.18	30.67
2008	8.46	1.13	2008	153.61	23.26
2009	11.79	1.03	2009	165.49	19.37
2010	11.47	1.28	2010	150.76	23.08
2011	11.89	1.40	2011	152.72	23.50
2012	13.03	1.77	2012	155.08	27.79
2013	12.82	1.71	2013	143.96	27.69
2014	15.78	2.16	2014	166.68	31.60
2015	13.07	1.44	2015	163.42	25.37
2016*	14.77	2.00	2016*	207.93	31.84
2017*	14.11	2.02	2017*	190.65	25.73
2018*	11.15	1.24	2018*	202.65	28.26
2019*	13.64	1.41	2019*	205.12	20.16
2020*	12.63	1.64	2020*	181.00	27.36
2021*	18.16	2.86	2021*	233.81	34.83
2022*	13.50	1.30	2022*	173.76	16.49

**Table 5.2.7 (cont). Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Abundance Indices by kilograms and numbers per 30 minutes haul duration of the SpPGFS-WIBTS-Q4 (G5768) and combined FR\_IE\_IBTS surveys. Biomass index from the combined FR\_IE\_IBTS survey.**

Year	Kg/h	ci_lower	ci_upper	Survey
2003	3.20	2.48	3.93	Combined
2004	3.27	2.54	4.01	Combined
2005	3.58	2.86	4.29	Combined
2006	3.63	2.93	4.33	Combined
2007	3.33	2.68	3.97	Combined
2008	4.26	3.56	4.96	Combined
2009	5.61	4.62	6.60	Combined
2010	4.73	3.93	5.52	Combined
2011	5.92	4.81	7.04	Combined
2012	4.81	3.93	5.69	Combined
2013	4.25	3.44	5.05	Combined
2014	3.78	3.14	4.42	Combined
2015	4.55	3.68	5.41	Combined
2016	5.06	4.21	5.91	Combined
2017	NA	NA	NA	Combined
2018	4.99	4.18	5.80	Combined
2019	6.09	5.04	7.14	Combined
2020	5.76	4.78	6.74	Combined
2021	5.88	4.89	6.87	Combined
2022	5.59	4.66	6.52	Combined

**Table 5.2.8. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Catch forecast: management option table.**

Basis	Total catch (2024)	Projected landings* (2024)	Projected discards** (2024)	F <sub>ages 3–6</sub> Total (2024)	SSB (2025)	% SSB change***	% advice change^
ICES advice basis							
MSY approach: F <sub>MSY</sub>	23303	19670	3633	0.23	89889	-6.1	-1.24
Other scenarios							
EU MAP^^ = F <sub>MSY</sub>	23303	19670	3633	0.23	89889	-6.1	-1.24
F = MAP^^ F <sub>MSY lower</sub>	14912	12606	2306	0.14	98649	3.1	-
F = MAP^^ F <sub>MSY upper</sub>	37722	31750	5972	0.41	74956	-22	-
F = 0	0	0	0	0.00	114313	19.5	-100
F <sub>pa</sub>	39152	32943	6209	0.43	73485	-23	66
F <sub>lim</sub>	49586	41616	7970	0.59	62817	-34	110
SSB (2025) = B <sub>lim</sub>	72018	59997	12021	1.07	40444	-58	210
SSB (2025) = B <sub>pa</sub>	77246	64204	13042	1.23	35398	-63	230
SSB (2025) = MSY B <sub>trig-</sub>	72018	59997	12021	1.07	40444	-58	210
SSB (2025) = SSB	20166	17032	3134	0.195	93158	-3.5	-14.5
F = F <sub>2023</sub>	17739	14988	2751	0.169	95693	2.7	-25

\* Marketable landings, assuming recent discard rate.

\*\* Including BMS landings (EU stocks), assuming recent discard rate.

\*\*\* SSB 2025 relative to SSB 2024.

^ Advice value for 2024 relative to advice value for 2023 (23 596 tonnes).

^^ EU multiannual plan (MAP) for the Western Waters (EU, 2019).

^^^ Advice value for 2024 relative to the advice value for 2023 for the F<sub>MSY lower</sub> (15 101 tonnes) and F<sub>MSY upper</sub> (38 191 tonnes).

The advice is 1.24% lower than last year due to a downward revision of SSB in the advised year.

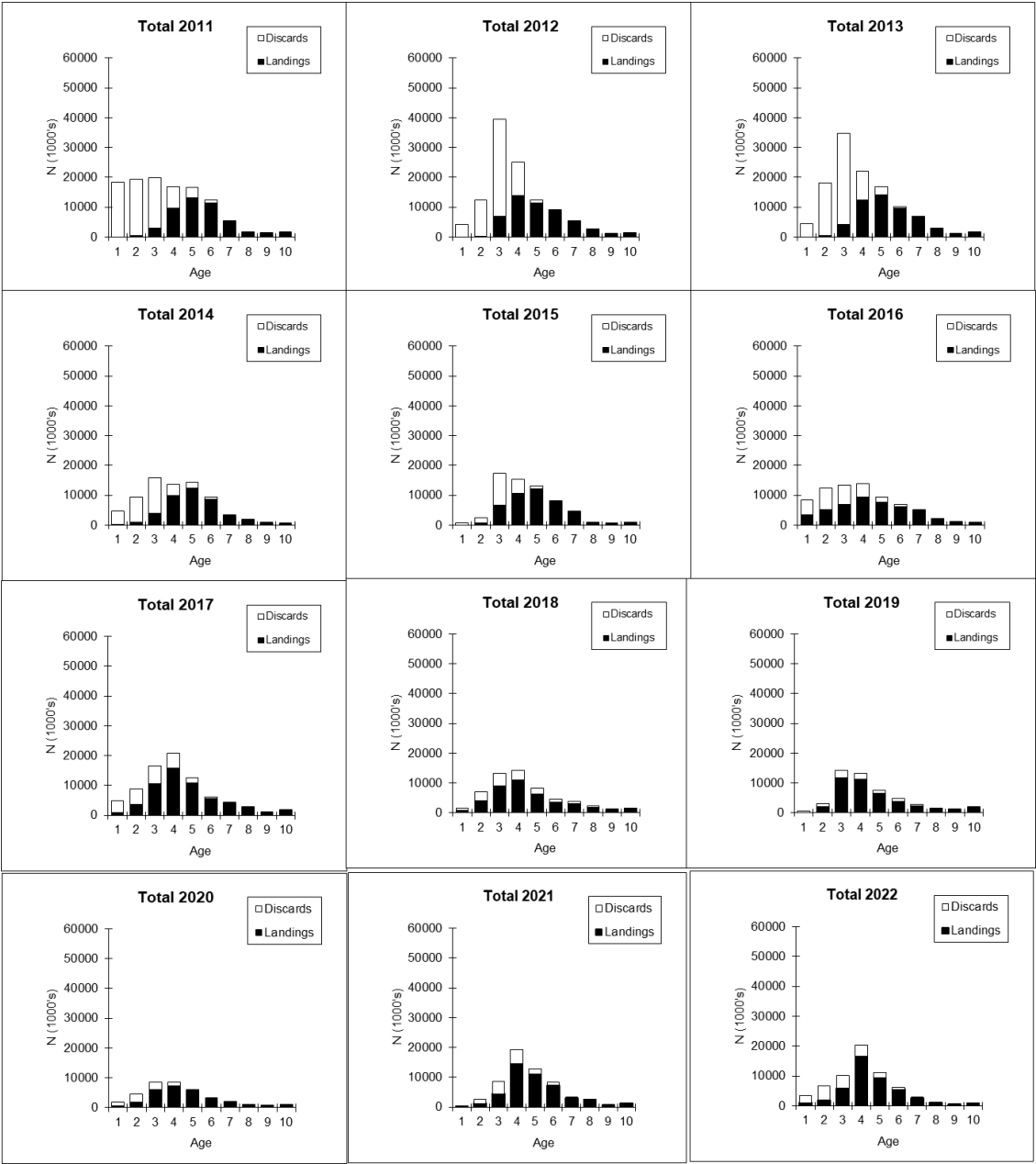


Figure 5.2.1. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8. Age composition of catches for the years 2008–2021.

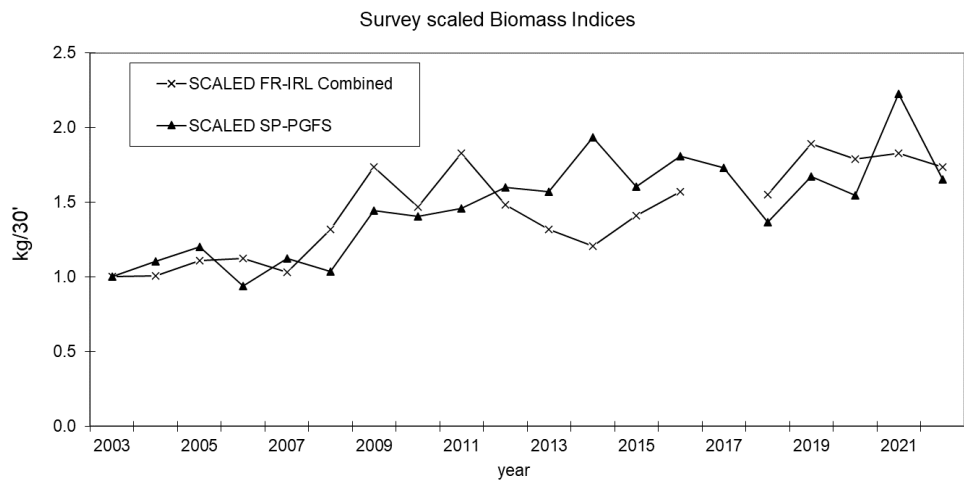


Figure 5.2.2. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Scaled Biomass Indices for both the SpPGFS-WIBTS-Q3 (G5768) and the combined FR\_IE\_IBTS surveys.

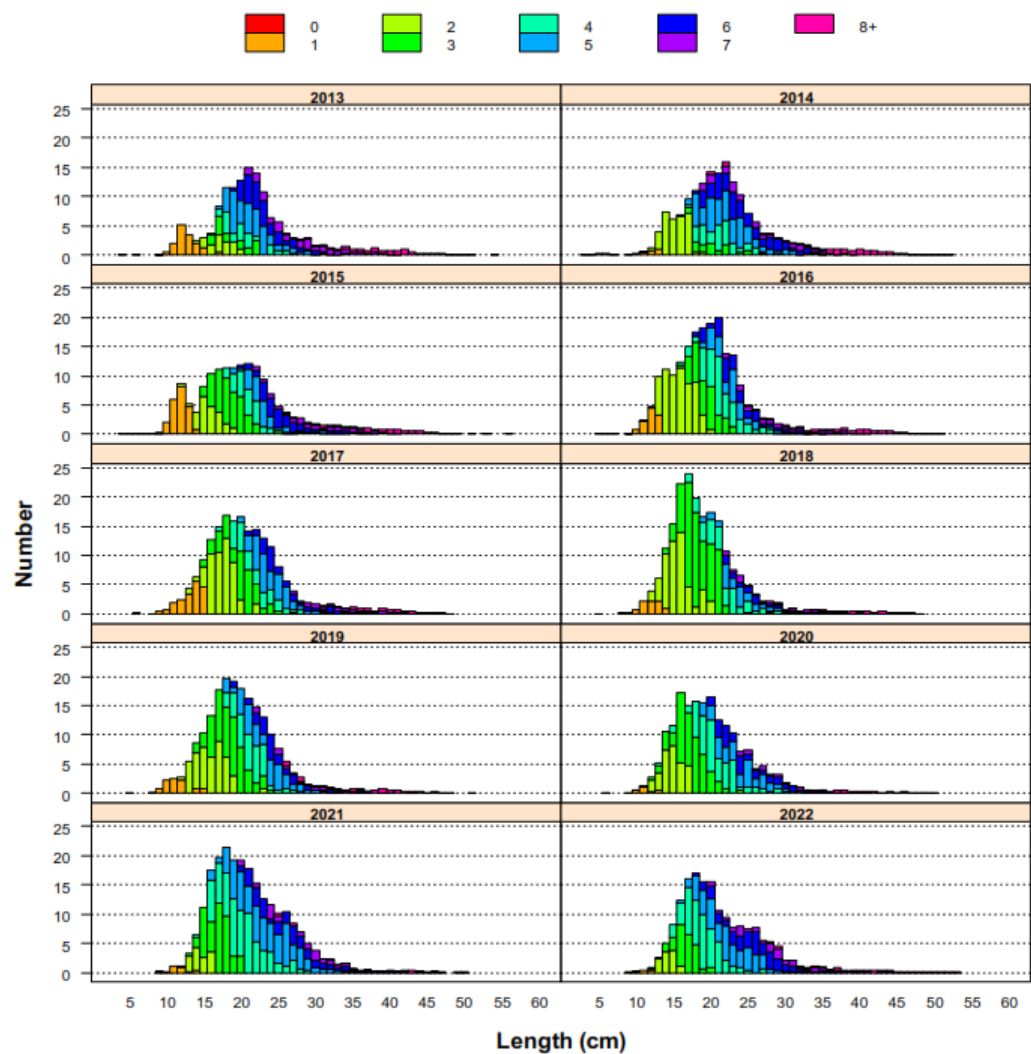


Figure 5.2.3. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Age composition of SpPGFS-WIBTS-Q4 (G5768) survey in abundance (numbers).

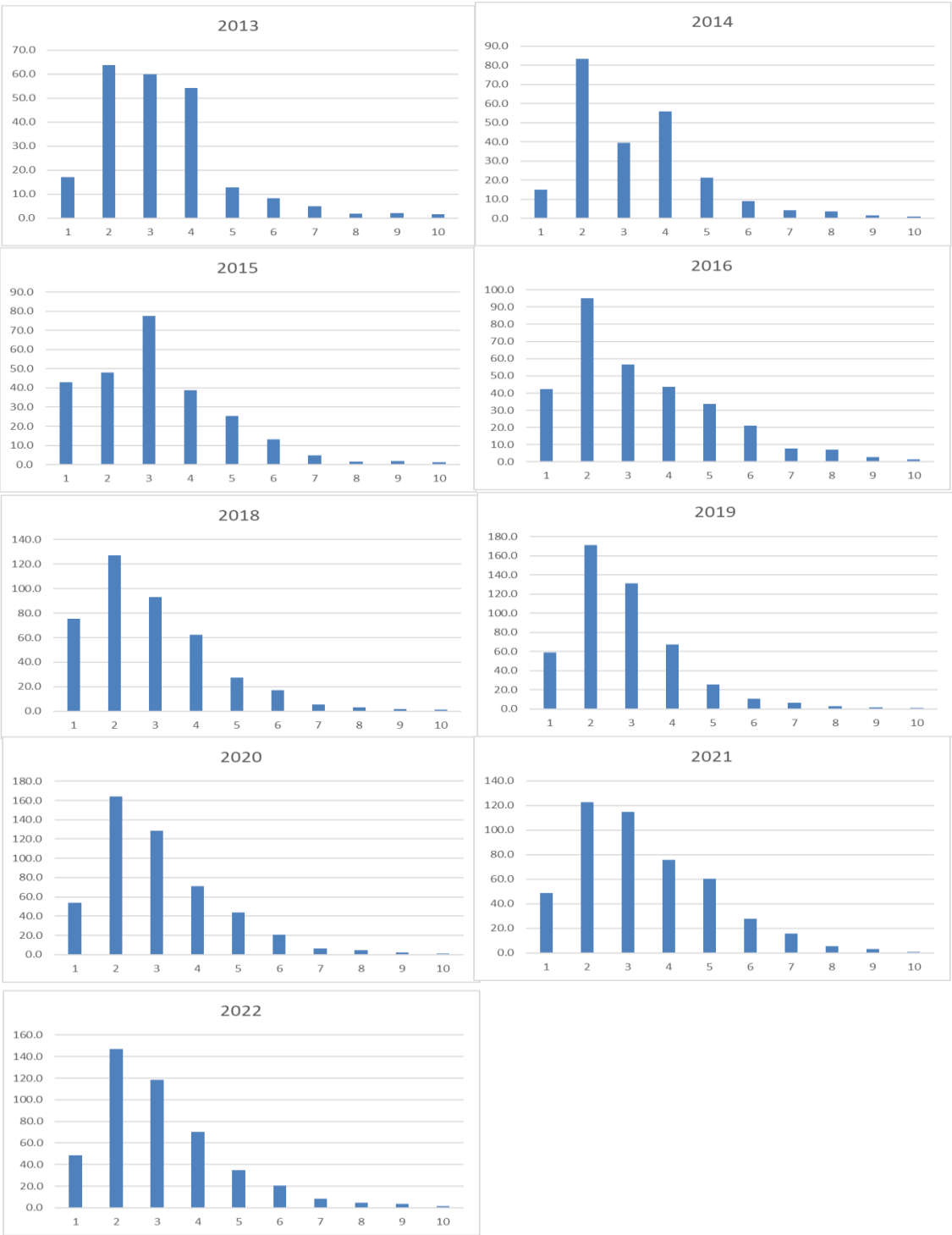


Figure 5.2.4. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Age composition of the combined FR\_IE\_IBTS survey in abundance (numbers/30min haul).

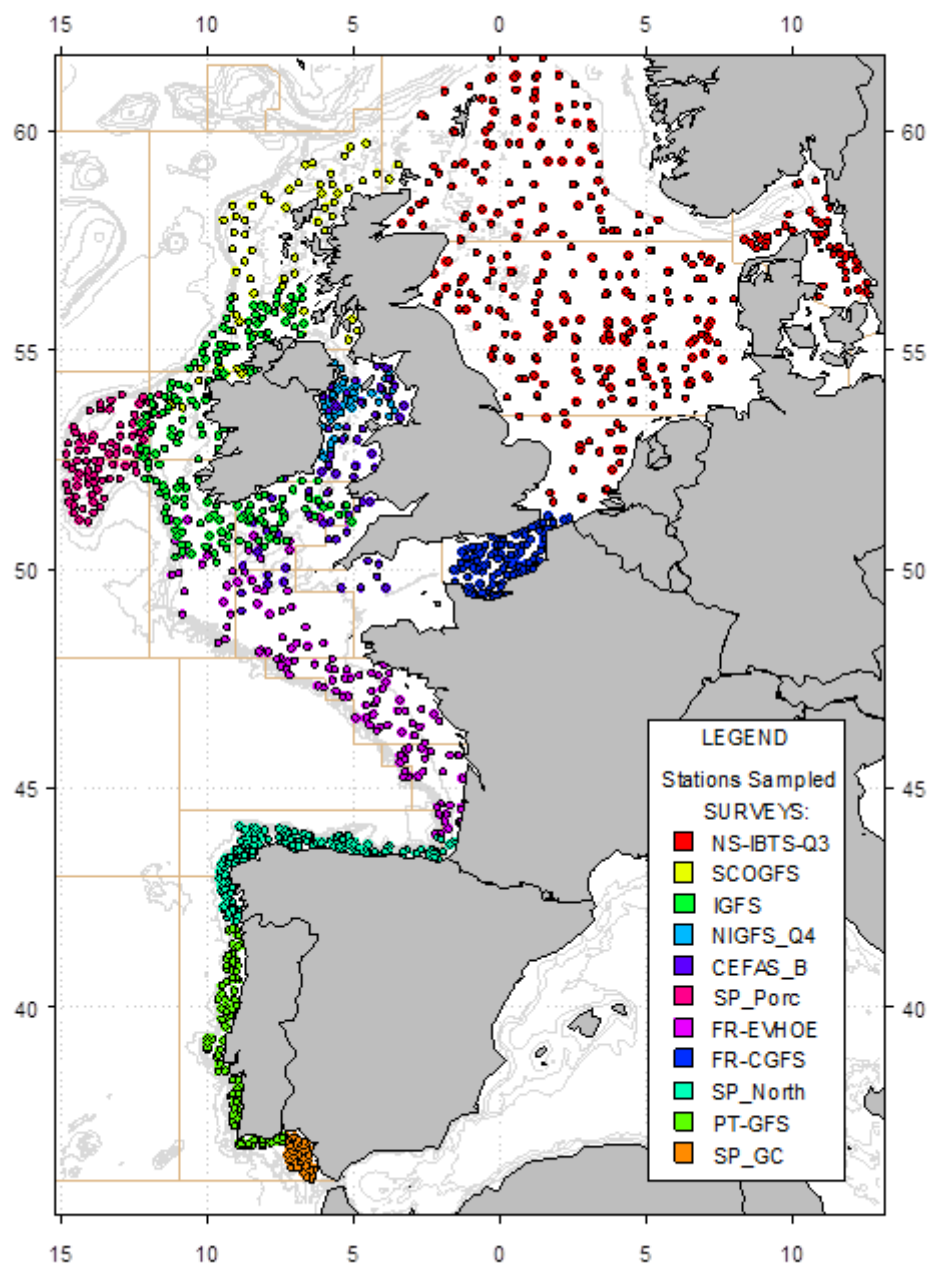


Figure 5.2.5. Station positions for the different IBTS surveys carried out in the Western Atlantic and North Sea area in autumn/winter of 2008 (ICES, 2009). Only used as general survey locations.

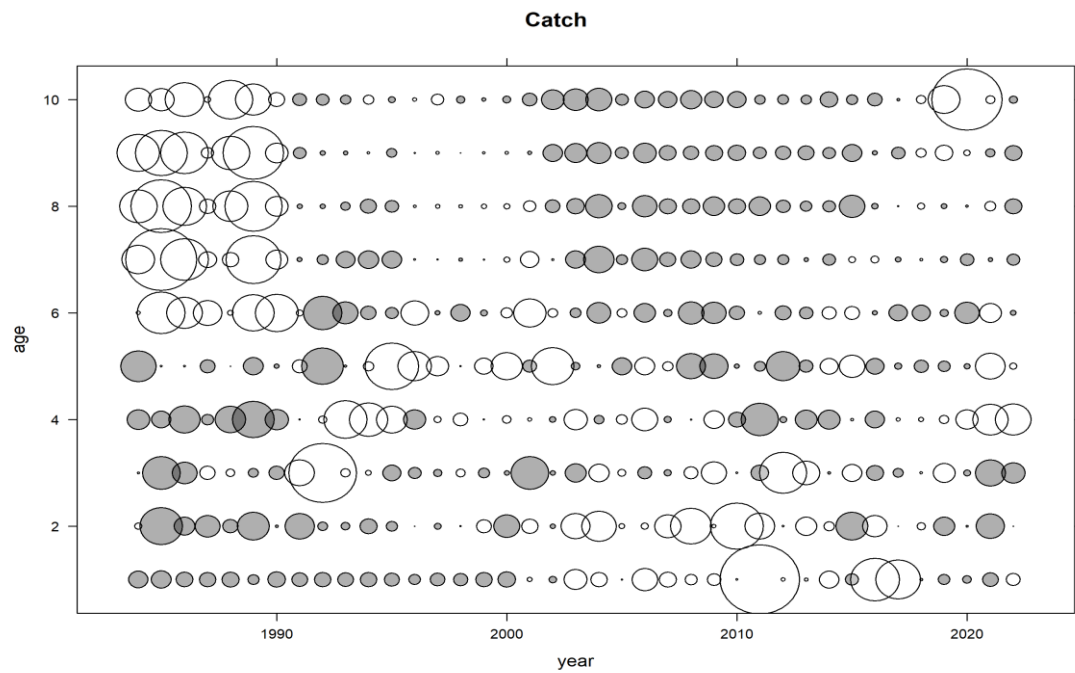


Figure 5.2.6. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Bubble plots for catch numbers-at-age (white – positive values, black – negative values).

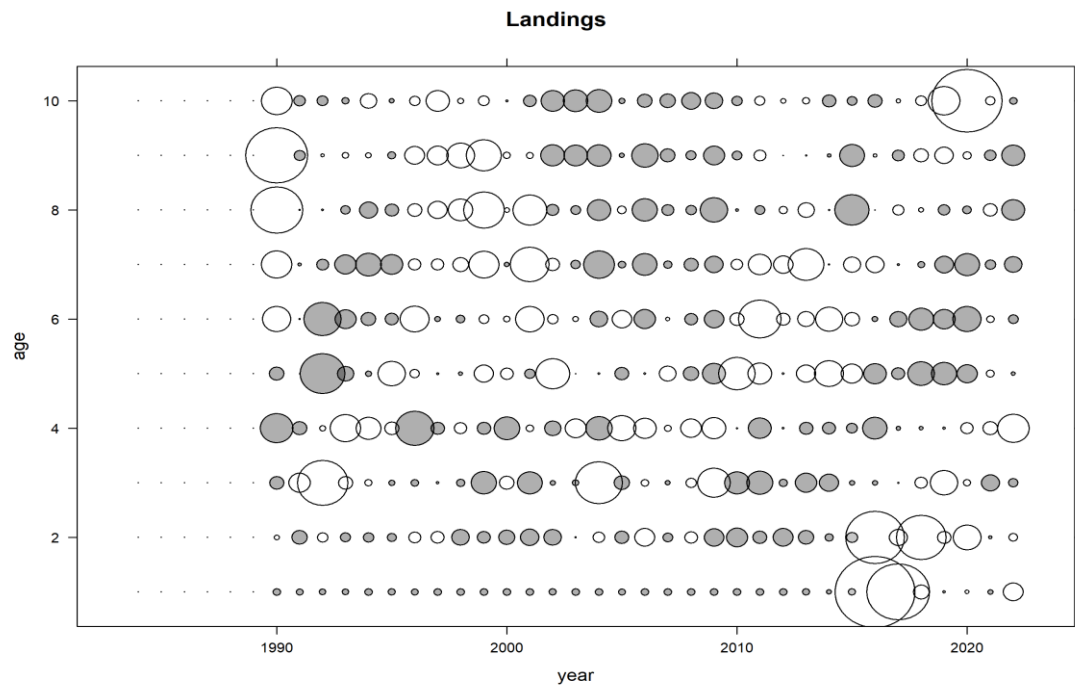


Figure 5.2.7. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Bubble plots for landing numbers-at-age (white – positive values, black – negative values).

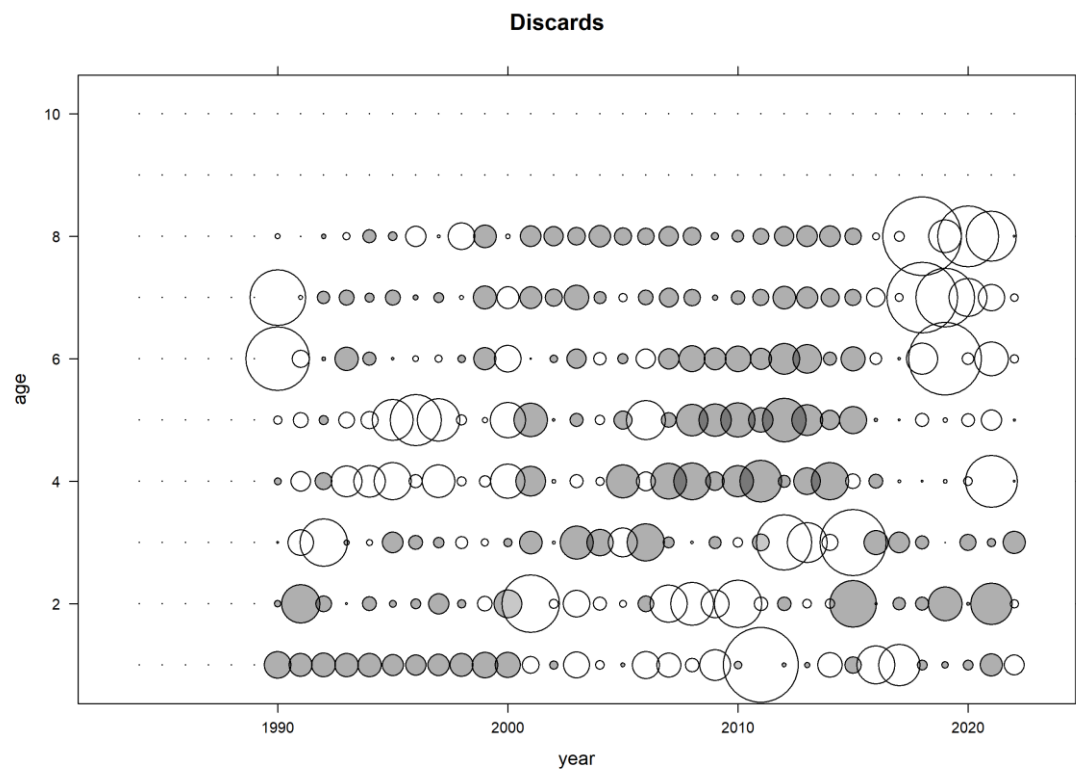


Figure 5.2.8. Megrim (*L. whiffiagonis*) in divisions 7.b-k and 8.a, 8.b, and 8.d. Bubble plots for discarded numbers-at-age (white – positive values, black – negative values).

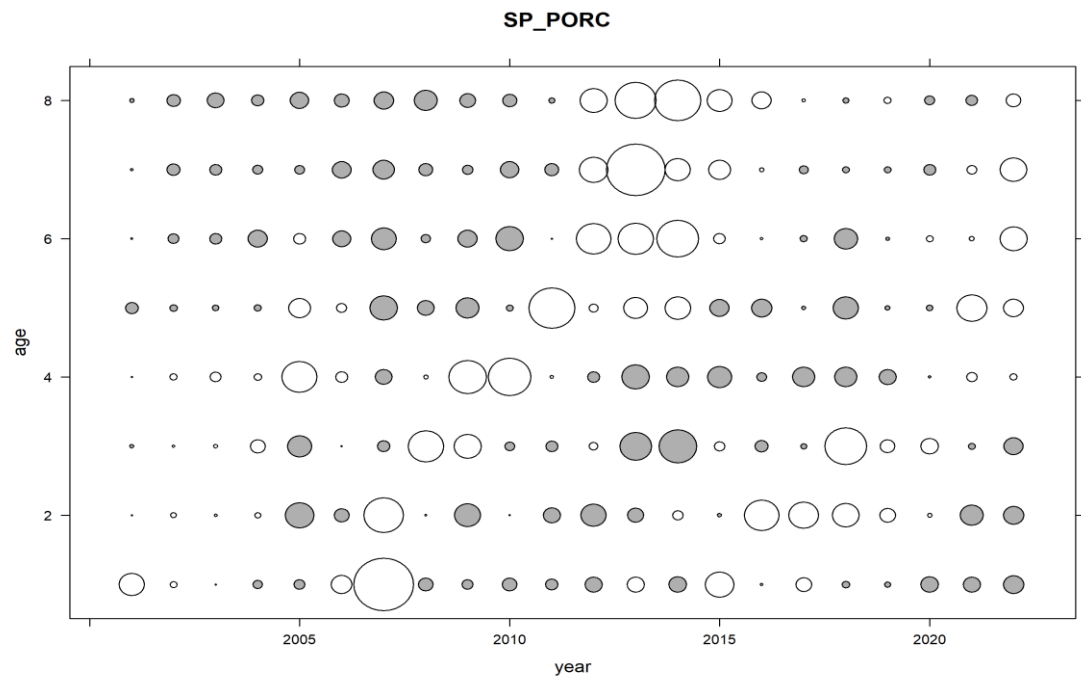


Figure 5.2.9. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Bubble plots for Porcupine SpPGFS-WIBTS-Q4 (G5768) survey numbers-at-age (white – positive values, black – negative values).

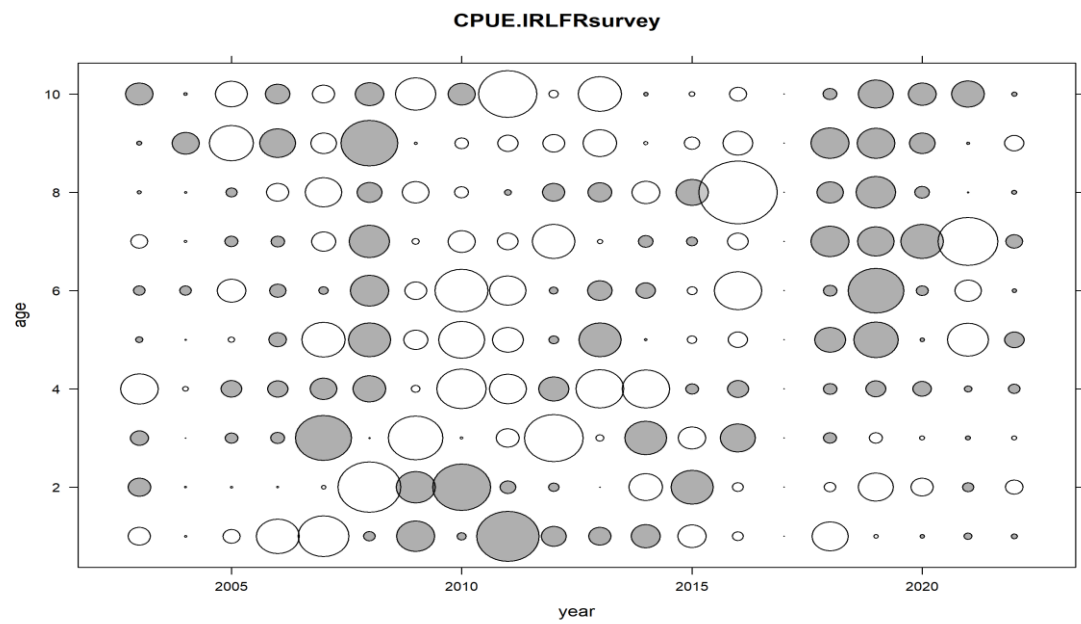


Figure 5.2.10. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Bubble plots for combined CPUE of the.FR\_IE\_IBTS survey numbers-at-age (white – positive values, black – negative values).

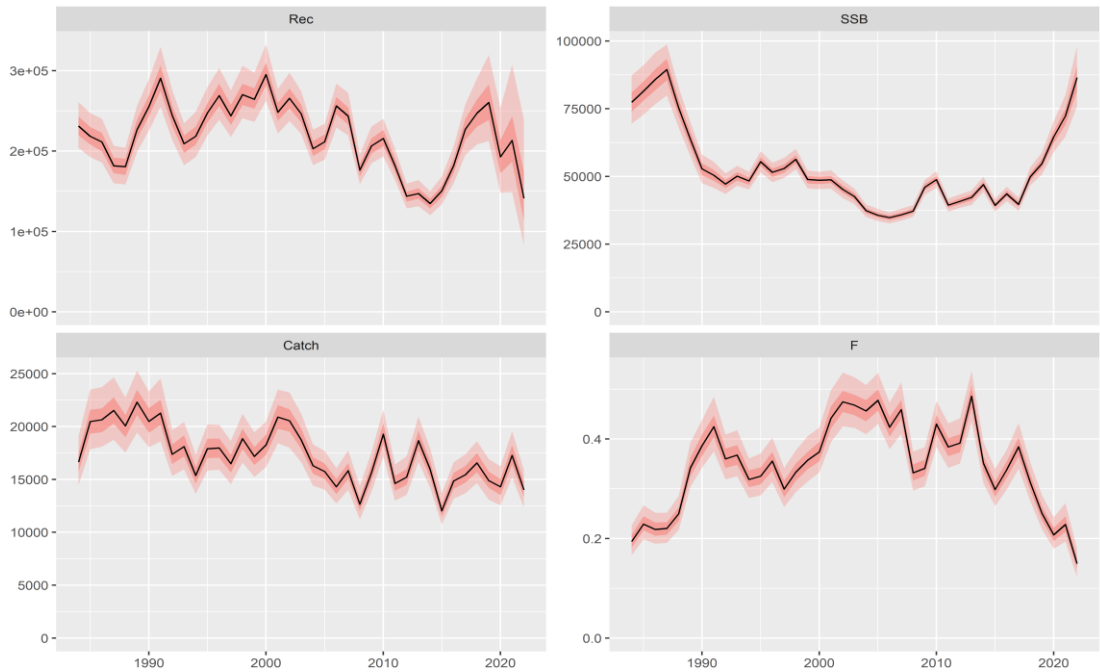
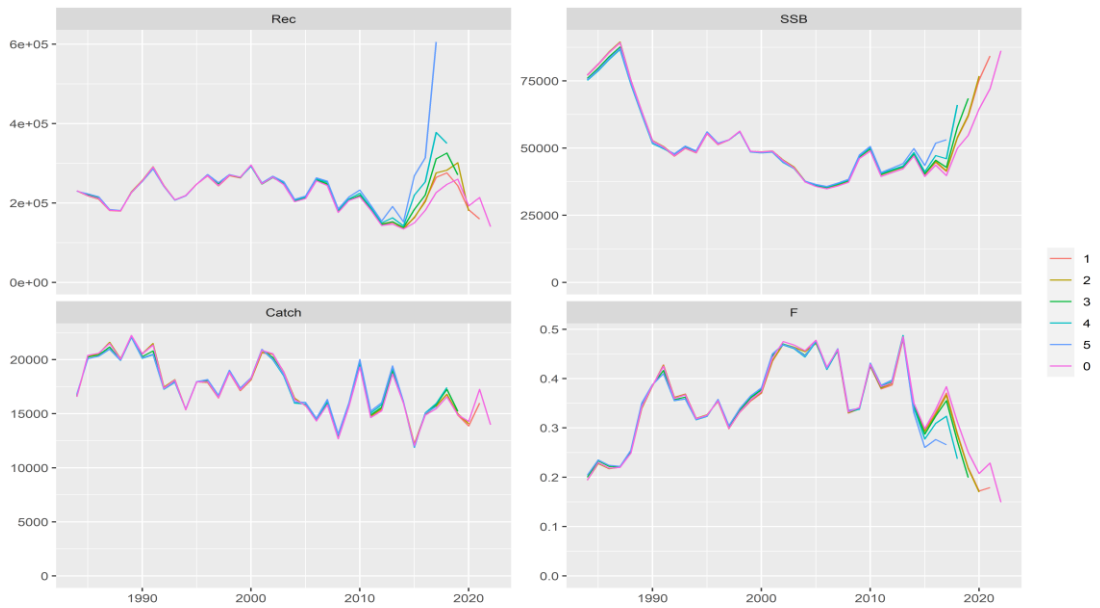
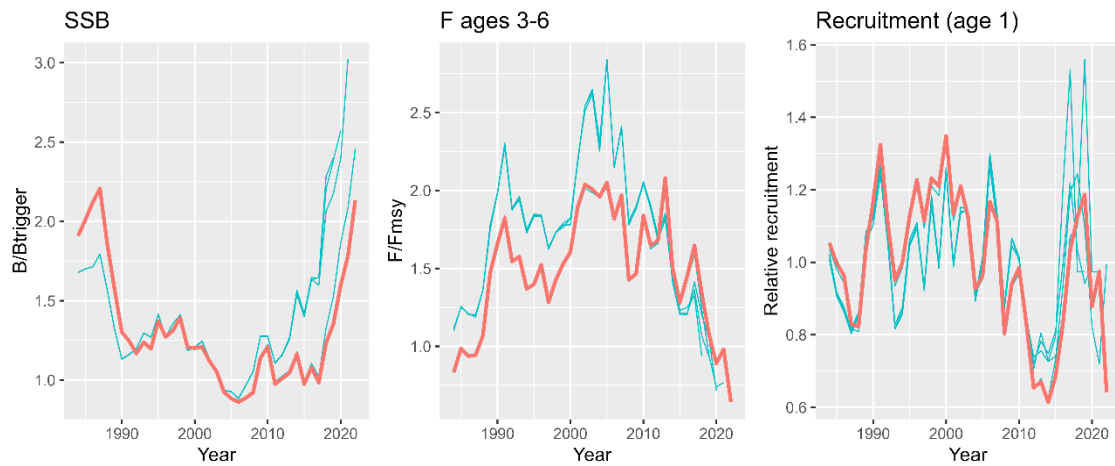


Figure 5.2.11. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Time-series results of spawning-stock biomass (SSB), recruits,  $F_{bar}$ , and catches from 1984 to 2022. The solid lines correspond to the median of the distribution and the dashed lines to the 5% and 95% quantiles.



Mohn’s rho F	Mohn’s rho SSB	Mohn’s rho R
-0.229	0.254	0.364

Figure 5.2.12. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Time-series of the median SSB, recruitment and  $F_{bar}$  in retrospective analysis.



**Figure 5.2.13. Megrim (*L. whiffiagonis*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Historical assessment results (final-year recruitment assumptions included for each line) relative to each year's reference points for comparison. In orange is the 2023 assessment results while in blue is for the previous years.**

### **5.3 Four-spot megrim (*L. boscii*) in divisions 7.b–k, 8.a, 8.b, and 8.d**

#### **5.3.1 Fishery description**

Four-spot megrim (*Lepidorhombus boscii*) in the Celtic Sea, west of Ireland, and in the Bay of Biscay are caught in a mixed fishery predominantly by French followed by Spanish, UK and Irish demersal vessels (see Stock Annex for details).

#### **5.3.2 Summary of ICES Advice for 2023 and Management applicable for 2022 and 2023**

##### **5.3.2.1 ICES advice for 2023**

In 2022, ICES was requested to provide advice on fishing opportunities for four-spot megrim in divisions 7.b–k, 8.a–b, and 8.d. ICES advised that when the precautionary approach is applied (ICES, 2023a), catches should be no more than 867 t for each of the years 2023, 2024 and 2025.

##### **5.3.2.2 Management applicable for 2022 and 2023**

The agreed TAC for the combined species was increased from 20 786 t in 2022 to 23 459 t in 2023.

Management of four-spot megrim and megrim under a combined species TAC prevents effective control of the single-species exploitation rates and could lead to overexploitation of either species. Four-spot megrim constituted 7% of average catches of both species from 2017–2019.

#### **5.3.3 Data**

##### **5.3.3.1 Commercial catches and discards**

Four-spot megrim was included in the ICES catch and discard data call for the first time in 2018 and data on commercial catch and discard information were made available to WGBIE from France, Ireland, Spain and UK. Historical data on commercial catch and discards, going back to 2003, were requested in the 2020 ICES data call and France, Ireland, Spain and UK responded to this request. Historical Spanish catches were requested again in the 2021 ICES data call but are still unavailable prior to 2017. Belgium provided catch and biological information to WGBIE for the first time in 2021 but no information was provided this year.

Sampling of commercial catches in 2020 and 2021 was negatively impacted by COVID-19 and complete catches of four-spot megrim could not be estimated for these years (ICES, 2022). Commercial landings were reported for 2022 by France, Ireland, Spain and UK. Commercial discards for 2022 were also available from France, Ireland and Spain. Length data for 2022 were only available for Ireland and Spain.

**Table 5.3.1. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Commercial catches (in tonnes) of four-spot megrim in 2022 by country and gear type.**

	BMS landing	Discards	Landings	Logbook Registered Discard	Total
France	-	-	-	-	-
MIS_MIS_0_0_0	-	-	0	-	0
OTB_CRU_>=70_0_0	-	-	0	-	0
OTB_CRU_100-119_0_0_all	-	-	0	-	0
OTB_CRU_70-99_0_0_all	-	-	0	-	0
OTB_DEF_>=70_0_0	-	0	0	-	0
OTB_DEF_100-119_0_0	-	-	0	-	0
OTB_DEF_70-99_0_0	-	0	0	-	0
OTT_CRU_>=70_0_0	-	0	0	-	0
OTT_CRU_100-119_0_0	-	-	0	-	0
OTT_CRU_70-99_0_0_all	-	-	0	-	0
OTT_DEF_>=70_0_0	-	0	0	-	0
OTT_DEF_100-119_0_0	-	-	0	-	0
OTT_DEF_70-99_0_0	-	-	0	-	0
Ireland	-	-	-	-	-
GNS_DEF_120-219_0_0_all	-	-	1	-	1
MIS_MIS_0_0_0_HC	-	-	0	-	0
OTB_CRU_100-119_0_0_all	-	35	1	-	36
OTB_CRU_70-99_0_0_all	-	219	1	-	220
OTB_DEF_100-119_0_0_all	-	0	16	-	16
OTB_DEF_70-99_0_0_all	-	0	3	-	3
SSC_DEF_100-119_0_0_all	-	1	4	-	5
TBB_DEF_70-99_0_0_all	-	0	8	-	8
Spain	-	-	-	-	-
GNS_DEF_>=100_0_0	-	-	11	0	11
GNS_DEF_120-219_0_0	-	-	4	0	4
GNS_DEF_60-79_0_0	-	-	0	-	0

	BMS landing	Discards	Landings	Logbook Registered Discard	Total
LLS_DEF_0_0_0	-	-	0	-	0
OTB_DEF_>=70_0_0	-	1	39	0	40
OTB_DEF_100-119_0_0	-	-	58	0	58
OTB_DEF_70-99_0_0	0	93	173	0	266
OTB_MCF_>=70_0_0	-	-	2	0	2
OTB_MPD_>=70_0_0	-	0	4	0	4
PTB_DEF_>=70_0_0	-	-	0	-	0
UK (England)	-	-	-	-	-
GNS_DEF_all_0_0_all	-	-	0	-	0
<b>Total</b>	<b>0</b>	<b>348</b>	<b>326</b>	<b>0</b>	<b>673</b>

Table 5.3.2. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Commercial catches (in tonnes) of four-spot megrim 2003–2022 by year and country. Note: BMS is “Landings below minimum conservation reference size” and LRD is “Logbook Registered Discards”.

	France		Ireland			Spain			UK		Belgium		Total
	Discards	Landings	Discards	Landings	BMS	Discards	Landings	LRD	(England) Landings	(Scotland) Landings	Discards	Landings	
2003	-	0	-	-	-	-	-	-	-	-	-	-	0
2004	-	0	-	-	-	-	-	-	-	-	-	-	0
2005	0	62	-	-	-	-	-	-	-	-	-	-	62
2006	4	1	-	-	-	-	-	-	-	-	-	-	5
2007	3	123	-	-	-	-	-	-	-	-	-	-	126
2008	-	0	-	-	-	-	-	-	-	-	-	-	0
2009	1	2	-	-	-	-	-	-	-	-	-	-	2
2010	8	65	-	-	-	-	-	-	-	-	-	-	73
2011	2	39	31	-	-	-	-	-	-	-	-	-	71
2012	1	2	73	-	-	-	-	-	-	-	-	-	75
2013	3	33	-	-	-	-	-	-	-	-	-	-	36
2014	2	31	-	-	-	-	-	-	-	-	-	-	33
2015	2	131	-	-	-	-	-	-	-	-	-	-	133
2016	8	268	-	-	-	-	-	-	-	-	-	-	275
2017	5	25	288	130	-	273	439	-	-	-	-	-	1160

	France		Ireland		BMS	Spain		LRD	UK		Belgium		Total
	Discards	Landings	Discards	Landings		Discards	Landings		(England) Landings	(Scotland) Landings	Discards	Landings	
2018	4	16	35	64	-	214	833	0	0	-	-	-	1166
2019	24	380	41	62	0	41	378	0	0	0	-	-	926
2020	0	0	6	51	0	117	437	0	0	0	0	0	611
2021	0	1	120	73	0	155	518	0	0	-	-	-	866
2022	0	0	254	34	0	94	291	0	0	-	-	-	673

### 5.3.3.2 Biological sampling

Biological sampling data for four-spot megrim were included in the ICES data call for the first time in 2018. Data on length were made available to WGBIE in 2019 from Ireland and Spain (ICES, 2019). Historical data on length, going back to 2003, were requested in the 2019 and 2020 data calls and Ireland, France, Spain and UK responded to this request (the UK has not sampled this species). Historical data were not requested in WGBIE 2022 data call.

Length frequency distributions (LFDs) for landings and discards were not available from all countries for 2020 due to the COVID-19 pandemic (ICES, 2021b) and although this situation improved for the 2021 and 2022 data, there are still sampling issues which affect catch estimation. Spain provided length distributions for 2022 landings and discards, whereas Ireland could only provide information on discard length distribution. France estimates the species composition of the combined megrim landings (*L. whiffiagonis* and *L. boscii*) from samples taken at sea. Sampling levels have declined substantially since 2020. The proportion of *L. boscii* in French landings was around 8.5% in 2019 (ICES, 2020). However, in 2022, no *L. boscii* were encountered in the French samples, resulting in estimated French landings of zero tonnes. WGBIE considers that this is an artefact of reduced sampling levels and considering the large proportion of the landings that are normally taken by France (ICES, 2022), WGBIE considers that the landings during 2020, 2021 and 2022 cannot be accurately estimated.

#### Age

Age data were made available for the first and only time to WGBIE 2021 from Belgium only (ICES, 2021). Fish from age 4 to age 11 were identified in landings with a modal age of 7 years.

#### Lengths

**Table 5.3.3. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Number of length samples and measurements of four-spot megrim by year and country.**

	Number of Length Samples	Number of Length Measurements
<i>France</i>		
2007	140	202
2014	8	124
2015	9	32
2016	14	103
2017	23	39
2019	45	393
2020	0	0
<i>Ireland</i>		
2011	168	2120
2012	184	8352

	Number of Length Samples	Number of Length Measurements
2017	402	34736
2018	171	1198
2019	100	11475
2020	12	1025
2021	52	6868
2022	76	4900
<i>Spain</i>		
2017	424	13396
2018	427	15502
2019	323	7410
2020	116	2023
2021	349	12113
2022	296	11005
<i>Belgium</i>		
2020	21	39

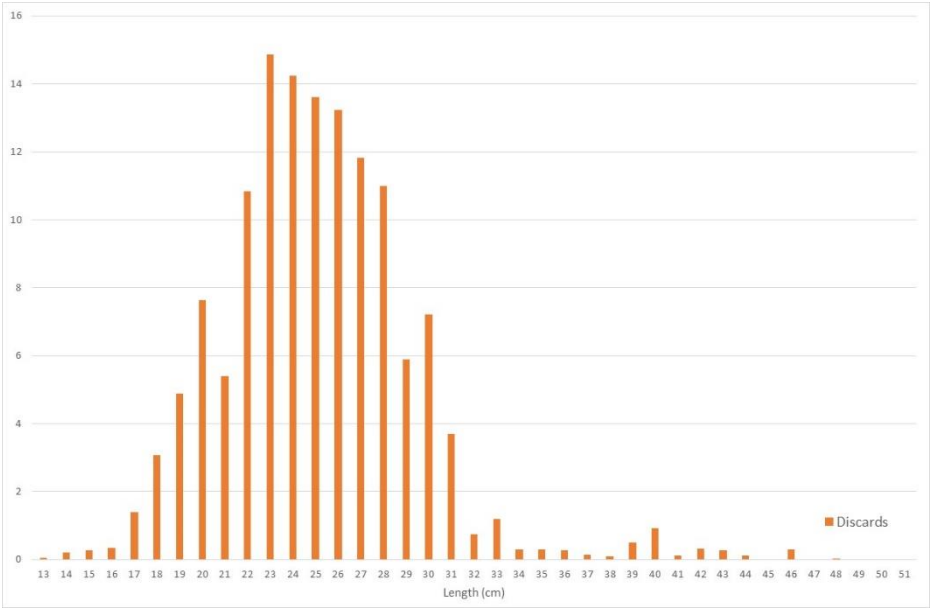


Figure 5.3.1. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Length–frequency distribution of discards from Irish fleets in 2022.

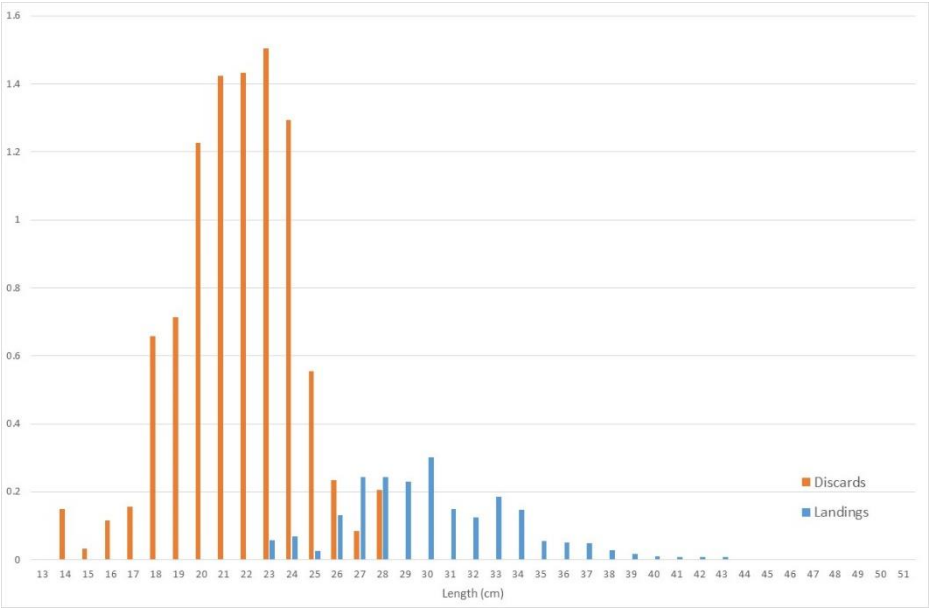


Figure 5.3.2. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Length–frequency distribution of landings and discards from Spanish fleets in 2022.

### Natural Mortality

Not included in the assessment.

#### 5.3.3.3 Survey data

Survey data were extracted from DATRAS for Spanish Porcupine Bottom Trawl Survey (SpPGFS-WIBTS-Q3, G5768), Irish Ground Fish Survey (IGFS-WIBTS-Q4, G7212) and French EVHOE Survey (EVHOE-WIBTS-Q4, G9527). French IBTS (EVHOE-WIBTS-Q4, G9527) survey data were not available for 2017 due to major technical vessel problems but recommenced in 2018 (ICES, 2019). The Spanish Porcupine index was initially down weighed by an arbitrary factor of ten because the Baka trawl used was highly more efficient at catching megrim than the GOV (*Grande Ouverture Verticale*) trawl used in the Irish and French surveys. Due to the large differences in catchability between the Baka and GOV gears, it was decided to remove the SpPGFS-WIBTS-Q3 (G5768) survey data from the final index which are based on data from IGFS-WIBTS-Q4 (G7212) and EVHOE-WIBTS-Q4 (G9527) surveys (ICES, 2020; 2021b). This combined French and Irish survey index is referred to by the ICES acronym FR\_IE\_IBTS. To include Spanish Porcupine Bottom Trawl Survey (G5768) data in the final index will require inter-calibration correction based on a comparison of four-spot megrim catches in the area where the Spanish and Irish surveys overlap. No difference in catchability was found between the Irish (IGFS-WIBTS-Q4, G7212) and the French (EVHOE-WIBTS-Q4, G9527) surveys in the area where they overlap.

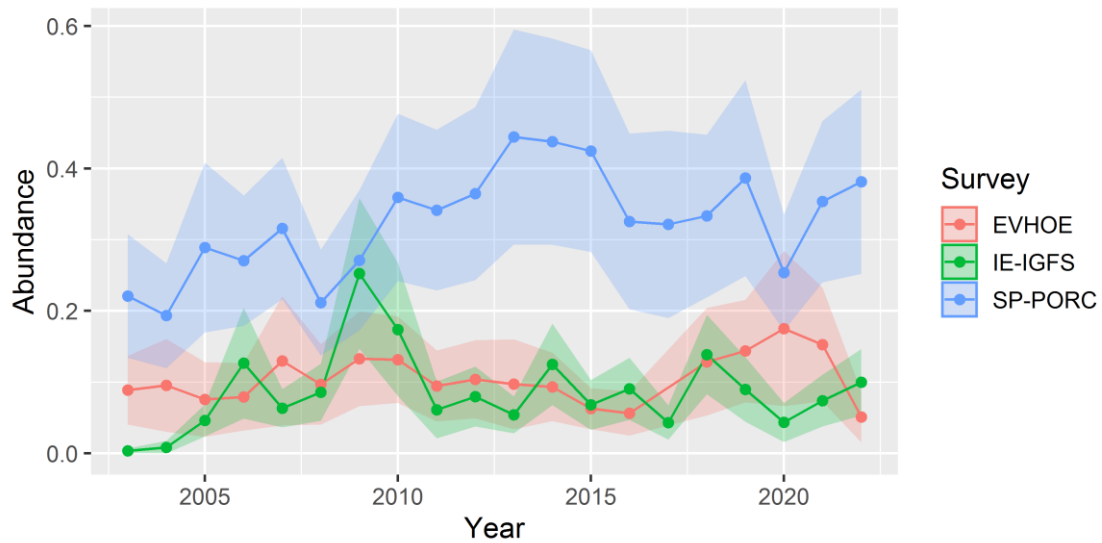


Figure 5.3.3. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Abundance indices of four-spot megrim from the French EVHOE (EVHOE-WIBTS-Q4, G9527), Irish Ground Fish (IGFS-WIBTS-Q4, G7212) and Spanish Porcupine Bottom Trawl (SpPGFS-WIBTS-Q3, G5768) surveys.

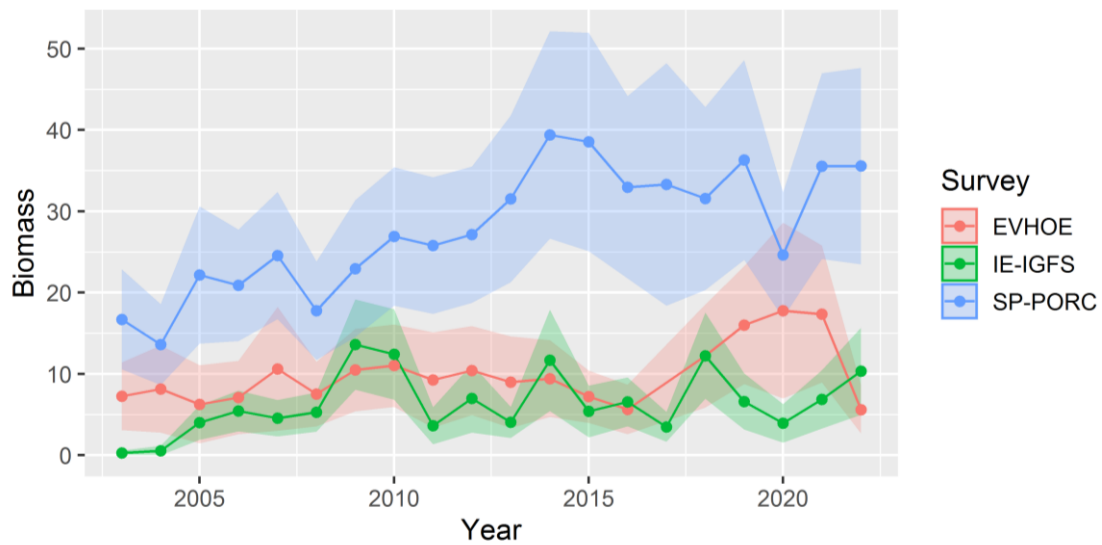


Figure 5.3.4. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Biomass indices of four-spot megrim from the French EVHOE (EVHOE-WIBTS-Q4, G9527), Irish Ground Fish (IGFS-WIBTS-Q4, G7212) and Spanish Porcupine Bottom Trawl (SpPGFS-WIBTS-Q3, G5768) Surveys.

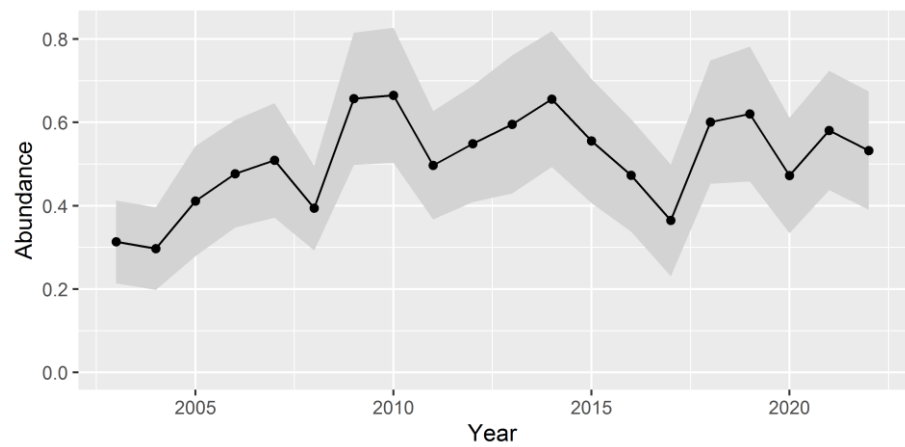


Figure 5.3.5. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Abundance index of four-spot megrim from combined FR\_IE\_IBTS survey.

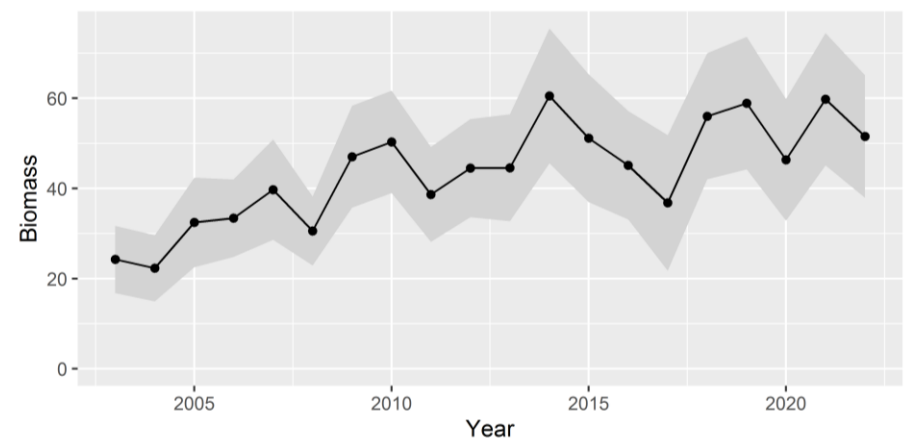


Figure 5.3.6. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Biomass index of four-spot megrim from combined FR\_IE\_IBTS survey.

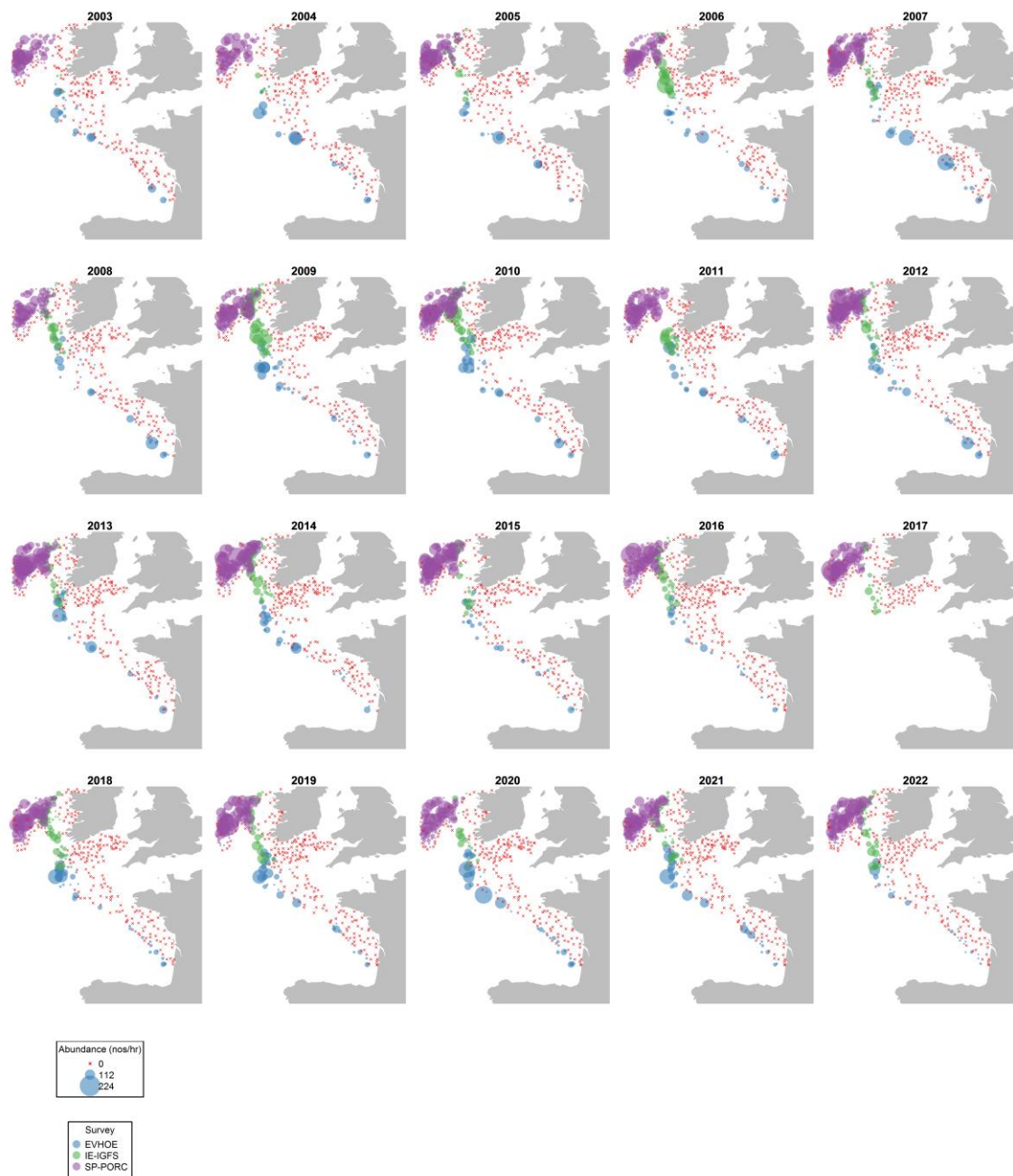
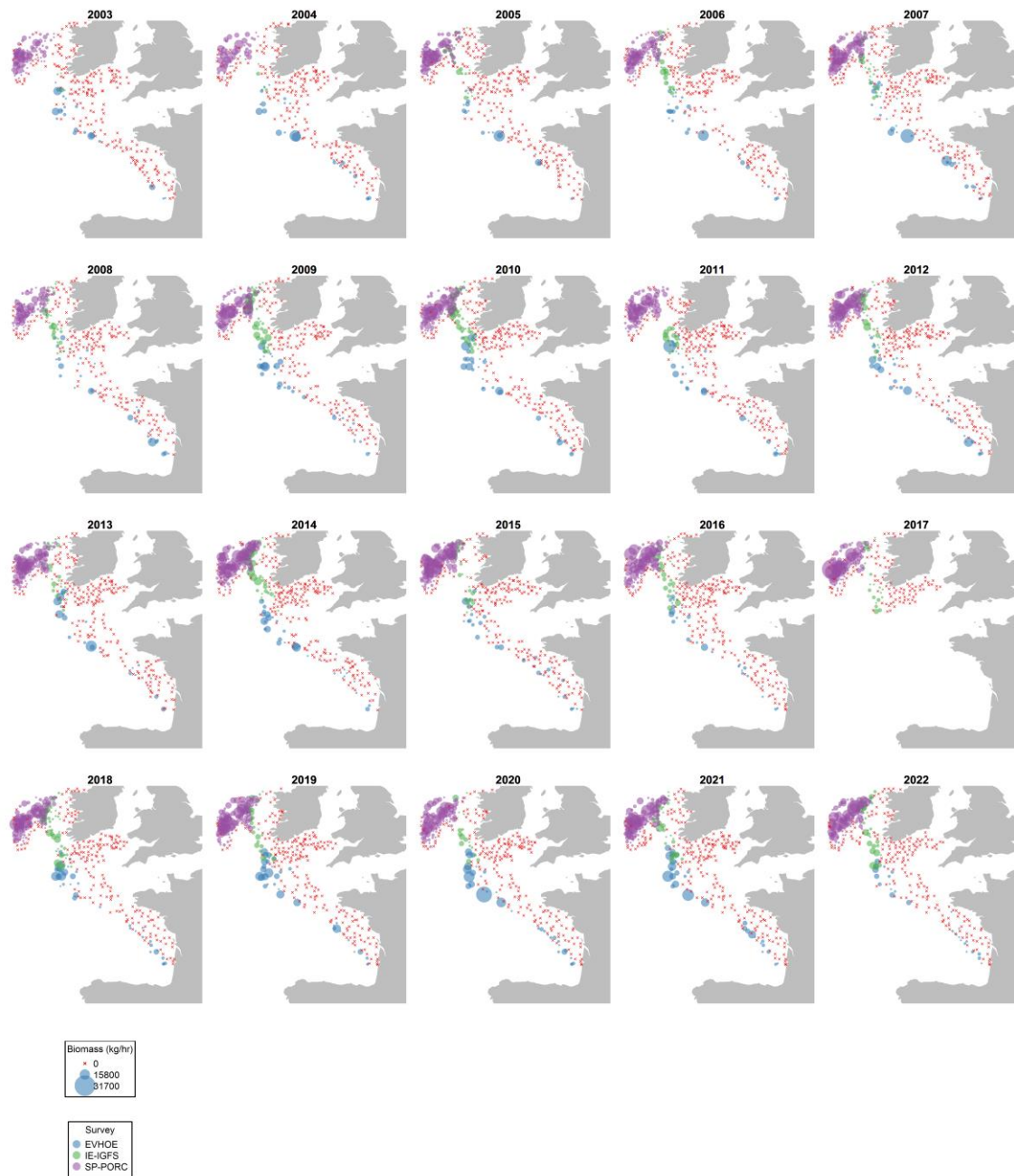


Figure 5.3.7. Four-spot megrim (*L. boscii*) in divisions 7.b-k and 8.a, 8.b, and 8.d. Abundance densities distribution of four-spot megrim from the French EVHOE (EVHOE-WIBTS-Q4, G9527), Irish Ground Fish Surveys (IGFS-WIBTS-Q4, G7212) and Spanish Porcupine Bottom Trawl (SpPGFS-WIBTS-Q3, G5768) surveys.



**Figure 5.3.8. Four-spot megrim (*L. boscii*) in divisions 7.b–k and 8.a, 8.b, and 8.d. Biomass densities distribution of four-spot megrim from the French EVHOE (EVHOE-WIBTS-Q4, G9527), Irish Ground Fish (IGFS-WIBTS-Q4, G7212) and Spanish Porcupine Bottom Trawl (SpPGFS-WIBTS-Q3, G5768) surveys.**

### **5.3.4 Assessment**

No quantitative stock assessment was carried out at WGBIE 2023 although the analysis was updated with the available catch data and biological information from 2022.

#### **5.3.4.1 Data exploratory analysis**

The following exploratory analyses were carried out for quality control reasons: sample weights were checked against expected weights (as estimated from length-weight parameters), excessive raising factors (from sample to catch weight) were checked and abundance indices (numbers per hour) were calculated for each survey series using all valid hauls and ignoring the spatial stratification.

#### **5.3.4.2 Model**

No model was used in the assessment.

#### **5.3.4.3 Results**

The stock status relative to candidate reference points is unknown. The precautionary buffer was last applied in 2021 (ICES, 2021). Discards were not estimated since 2020 due to insufficient sampling, but average discards from the last period of complete catches (2017 to 2019) were estimated to be 27% of the total catch.

#### **5.3.4.4 Retrospective pattern**

No retrospective analysis was performed.

#### **5.3.4.5 Short-term forecasts**

No short-term forecast was produced.

### **5.3.5 Biological reference points**

No biological reference points were produced at WGBIE 2023.

### **5.3.6 Conclusions**

This was the seventh year that an assessment was carried out for this stock and the sixth year that the stock was included in the ICES data call. This year, catch advice was not requested as advice was provided last year for the period 2023 to 2025.

The times series of this assessment was improved by the addition of another year of commercial landings, discards and length data. However, the incomplete historical (2003–2016) catch data from Spain means that the time-series of commercial catch is not sufficiently long to support the assessment.

There is still a requirement for substantial port samplings to provide an accurate species split for the landings as it is unsure how the survey catches relate to the commercial catches. The Covid-

19 pandemic reduced the availability of samples of landings and discards and meant that catches of four-spot megrim from France could not be estimated. In 2019, France contributed 44% of total landings (403 t) and the absence of these data undermined the confidence in 2020, 2021 and 2022 catch data.

Investigations into Length-Based Indicators were carried out at WGBIE 2021 (LBI; ICES, 2017) and Mean Length-Z (MLZ) as defined in WKLIFE V (ICES, 2015) were carried out using data from SpPGFS-WIBTS-Q3 (G5768). However, it was decided that this survey did not sufficiently cover the stock area to provide catch advice (ICES, 2021). Future work needs to be carried out on combining survey indices and using spatial models such as the Vector Autoregressive Spatio-Temporal (VAST; Thorson, 2019) package<sup>2</sup> in R (R Core Team, 2020).

### 5.3.7 References

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<sup>2</sup> [www.github.com/james-thorson/VAST](https://www.github.com/james-thorson/VAST)

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