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EXPLORING THE CPUE OF THE VIGO-MARIN TRAWL VII FLEET USING INFORMATION FROM OBSERVERS ON BOARD

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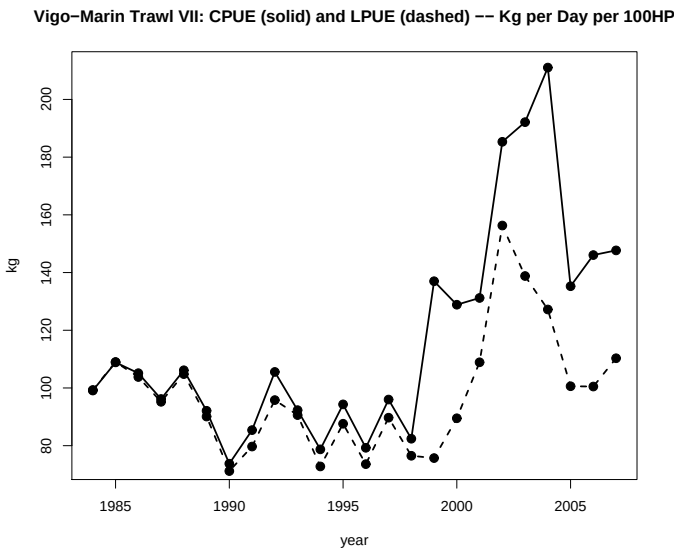
1. Background to the problem

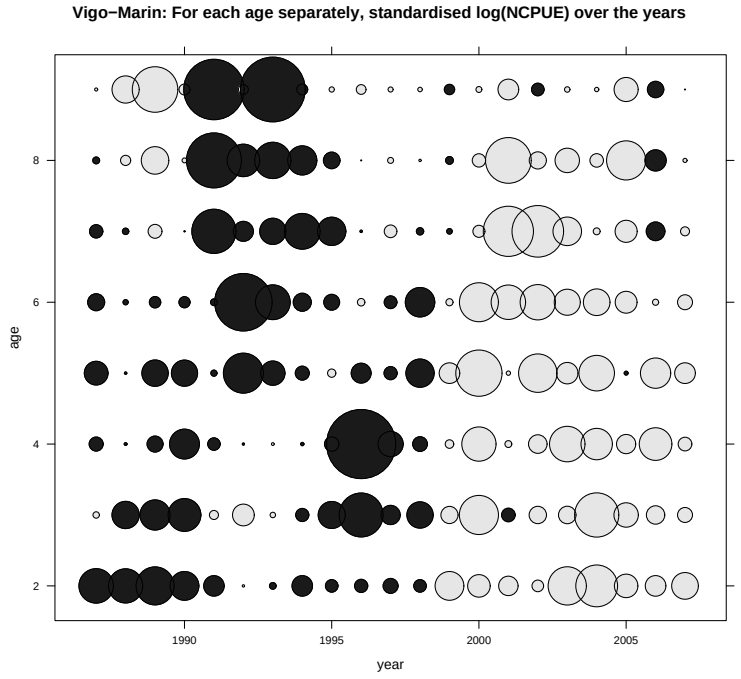
The CPUE of the Vigo-Marín trawl fleet operating in ICES Division VII is used for tuning the XSA-based assessment of the Megrim (*Lepidorhombus whiffiagonis*) stock in ICES Divisions VII b,c,e-k and VIII a, b, d.

A series of yearly CPUE (catch per unit effort) is available starting from 1984. Catch consists of the sum of the estimated landings and discards and effort is measured in fishing days per 100 HP. What is actually known in any given year is the number of trips (and corresponding HP) and it is assumed that each trip corresponds to 12.9 fishing days.

The following figure shows the historical series of CPUE and LPUE (landings per unit effort) for this fleet. The series that is used for tuning the assessment is the one corresponding to CPUE, which shows much higher values since 1999:



The following figure depicts numbers-at-age caught per unit effort for the Vigo-Marín fleet. It is in logarithmic scale and, for each age separately, values have been standardised over the years (subtracting the mean and dividing by the standard deviation). Clear and black bubbles represent positive and negative values, respectively. There is an abrupt change in 1999, with most values being negative before that year and positive after it. It is not possible to track cohorts in this figure, as would have been desirable.



These issues make the use of the Vigo-Marín CPUE series as a relative abundance index questionable. In the XSA assessments conducted in the last few years, there is a very clear pattern in the log-catchability residuals for this series, taking negative values until 1998 and positive values since 1999. This indicates that there is disagreement between this source of information and the other sources used in the XSA assessment (commercial catch matrix and tuning indices from the French FU04 commercial fleet and the UK-WCGFS-D and FR-EVHOES surveys). At the same time, the Vigo-Marín fleet gets substantial weight in the XSA assessment, which has very strong retrospective patterns that have led to ICES not having an analytical assessment for this megrim stock since 2006.

Table 1: Years with sampling and number of trips sampled

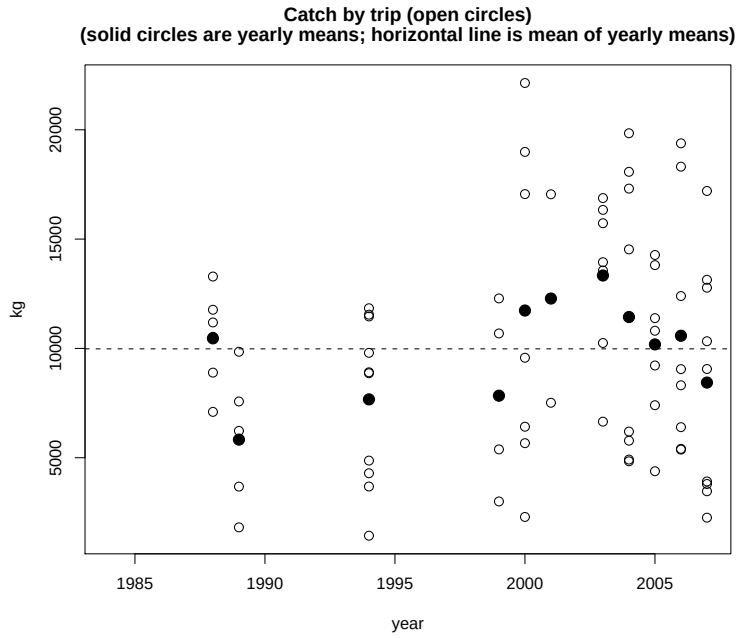
1988	1989	1994	1999	2000	2001	2003	2004	2005	2006	2007
6	5	10	4	7	2	7	8	7	8	9

2. Analysis of data from observers on board

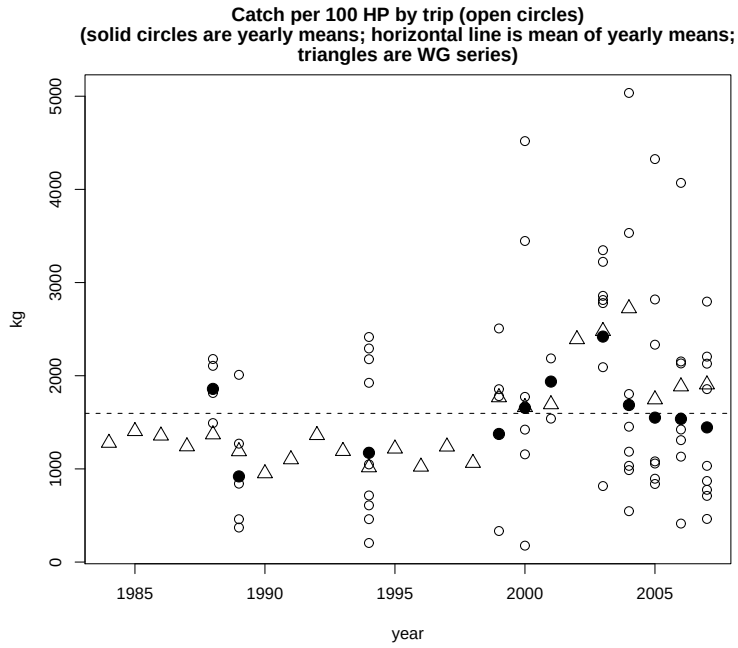
The main purpose of this working document is to explore an independent source of information, namely data collected by scientific observers on board, to shed some light on the issue of whether or not the observed increase in CPUE of the Vigo-Marín fleet might be reflective of an increase in stock abundance.

The observers data have been collected under the "Spanish ICES Discards Sampling Programme", which started in 1988, although it has been discontinued several times. Table 1 shows the years in which sampling has taken place and the number of sampled trips in each of those years.

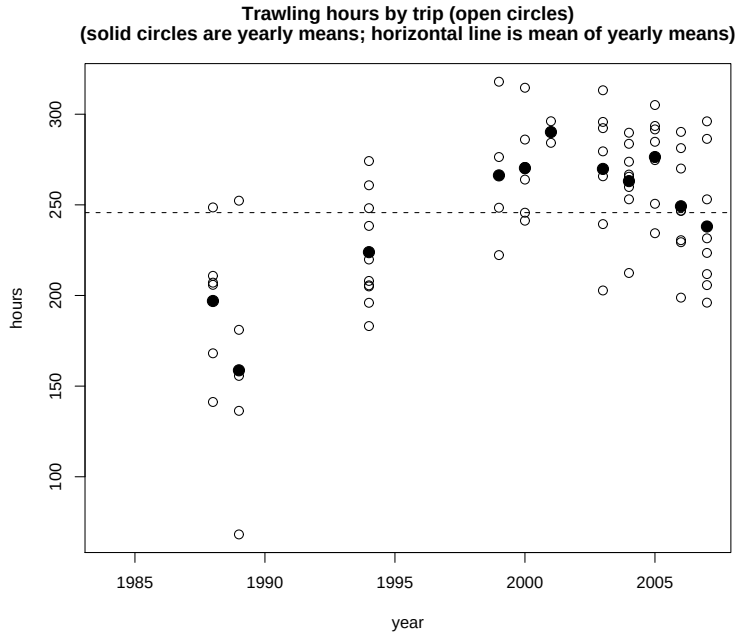
The following figure displays the total catch (retained plus discarded) for each of the sampled trips (open circles), ordered by year. Yearly averages are represented by solid circles and the horizontal line represents the overall mean level (average of yearly averages). Although yearly averages seem to have been a bit higher since 2000, this increase is not large and there is clearly a lot of inter-trip variability.



The following figure displays catch by trip per 100 HP (open circles) from the same observers dataset. Again yearly means are represented by solid circles and the overall mean level by a horizontal line. The CPUE series that has been used to tune the XSA assessment is overplotted with triangles. The before and after 1999 split seen in the tuning series is much less clear from the observers data.

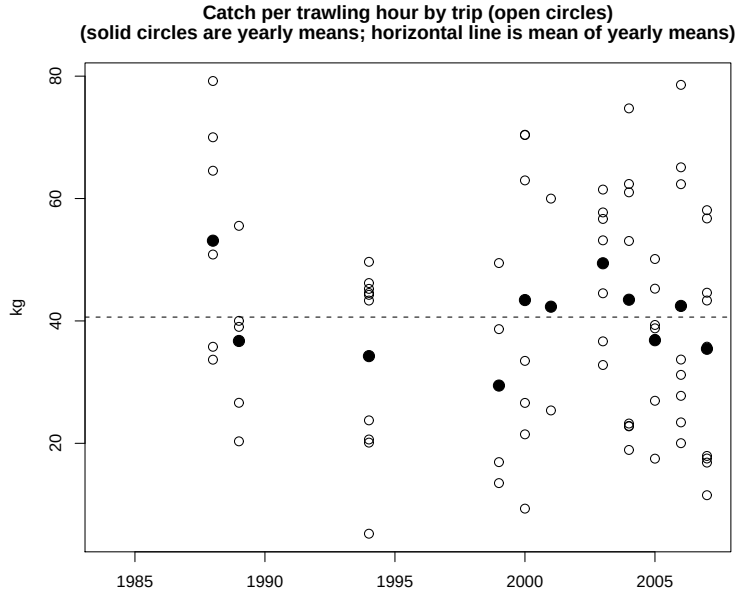


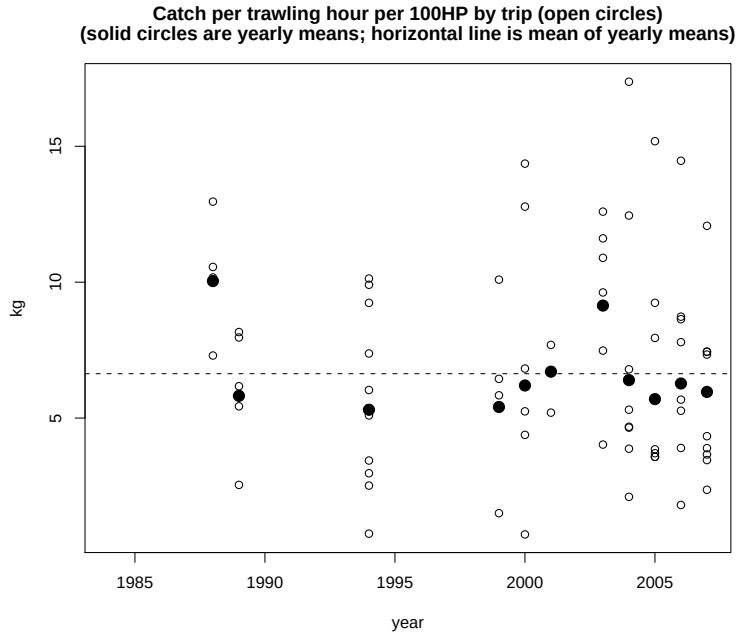
As already indicated, in the Vigo-Marín CPUE series used to tune the XSA assessment effort each trip is assumed to correspond to 12.9 fishing days. However, the observers data indicate that the number of fishing hours per trip has been higher in recent years, as the following figure shows:



This increase in number of fishing hours per trip does not seem to be due to a lengthening of the trips duration but to different working practices on board. The observers data indicate that in recent years trawling times per haul have been generally shorter with shorter inter-haul time intervals too. The net consequence of this appears to have been an increase in the total number of trawling hours per trip.

The increase in the number of trawling hours per trip suggests that a better measure of effort would be trawling hours or trawling hours per 100 HP. The next two figures show catch by trawling hour and catch by trawling hour per 100 HP from the observers data:





From the latter two figures, we see that once trawling hours have been taken into account, the observers data show no indication whatsoever of an increase in CPUE in recent years. So the conclusion from this investigation is that the data from observers on board do not support the notion of an increase in the abundance of the megrim stock.

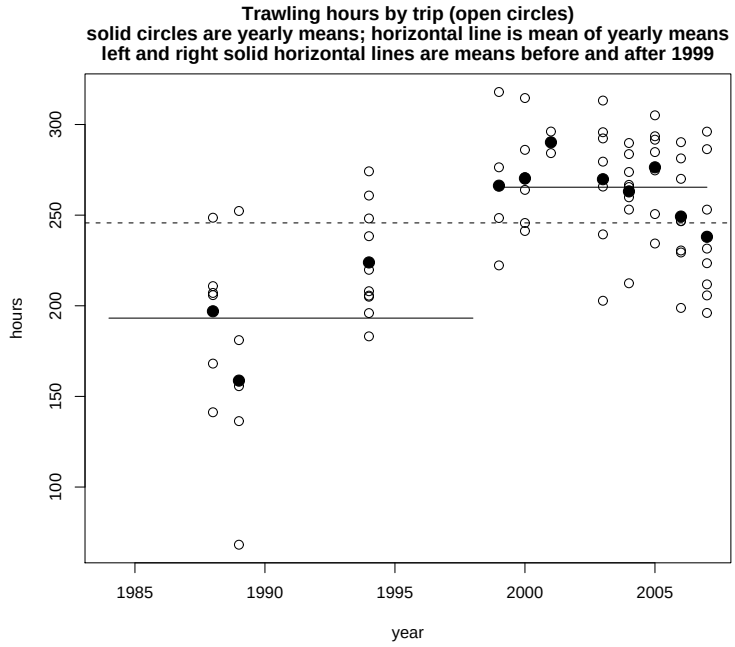
3. Possible actions to take regarding the CPUE series of the Vigo-Marín fleet

The fact that neither the other sources of information used in the XSA assessment nor the data from observers on board analysed in this working document agree with the higher levels of stock abundance indicated by the CPUE Vigo-Marín series suggests that this series is not reflecting stock abundance. Two obvious candidates to be generating problems in this CPUE series are:

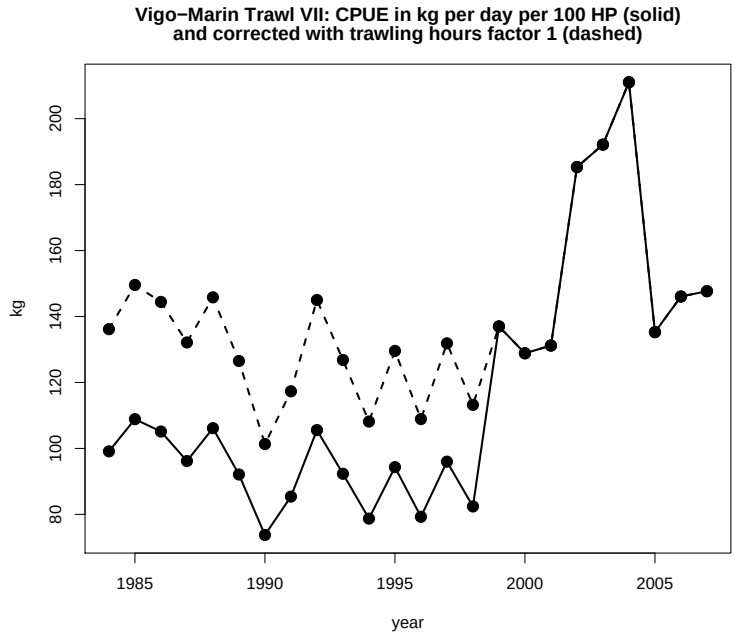
(1) The estimates of discards, which may be too noisy. Sampling to estimate discards has only taken place in the years indicated in Table 1, so there are many missing years, particularly in the earlier part of the series. Even in the years when there has been sampling, the resulting discards estimates are still very noisy. From the first figure of this working document, it is clear that the increase in the index values in recent years would less strong if only landings were considered. Hence, a possible course of action would be to remove discards from this series. We note, however, that while eliminating the discards would attenuate the problem somewhat, it would not remove it. At the same time, since the discards estimates are part of the international commercial catch matrix for this stock, it would seem inconsistent not to include discards in the Vigo-Marín tuning series.

(2) Effort is not appropriately standardirsed, as it is just computed as number of trips per 100 HP multiplied by 12.9 days per trip. A proper standardisation of effort of this fleet is not possible with the data that we have available. A partial solution would be to try and correct the effort in some simple way using yearly mean trawling hours per trip, as estimated from the observers on board data. Two effort correction factors as well as a split of the tuning series into two parts will be tried. Details follow:

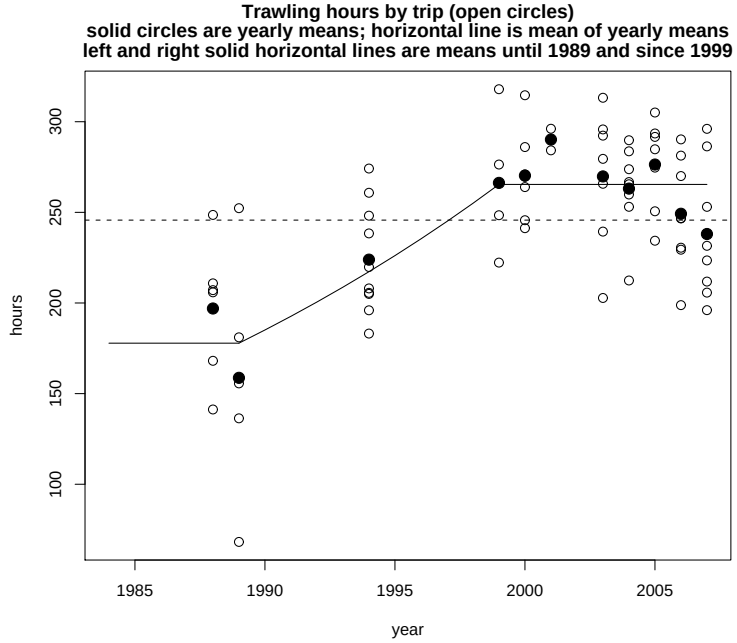
"Correction factor 1": We consider that yearly mean trawling hours per trip were at a constant level until 1998 and then increased to another level in 1999, as the two horizontal solid lines in the following figure suggest:



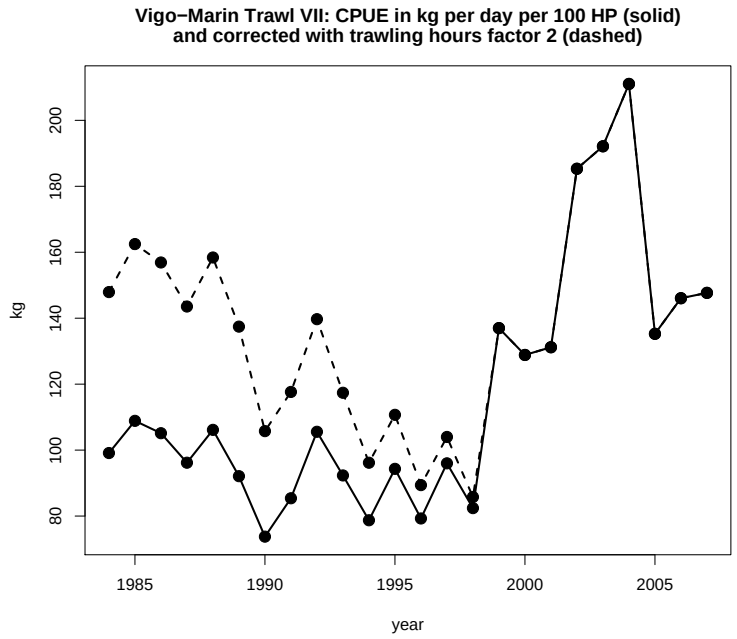
According to this idea, the effort of all years until 1998 should be multiplied by $193/265 = 0.73$ resulting in the following corrected CPUE series:



"Correction factor 2": Here we assume that yearly mean trawling hours per trip were at a constant level until 1989, then increased linearly from 1998 to 1999, and have remained at a constant level since then. This is represented by the solid line in the following figure:



When effort before 1999 is corrected according to this idea we obtain the following CPUE series:



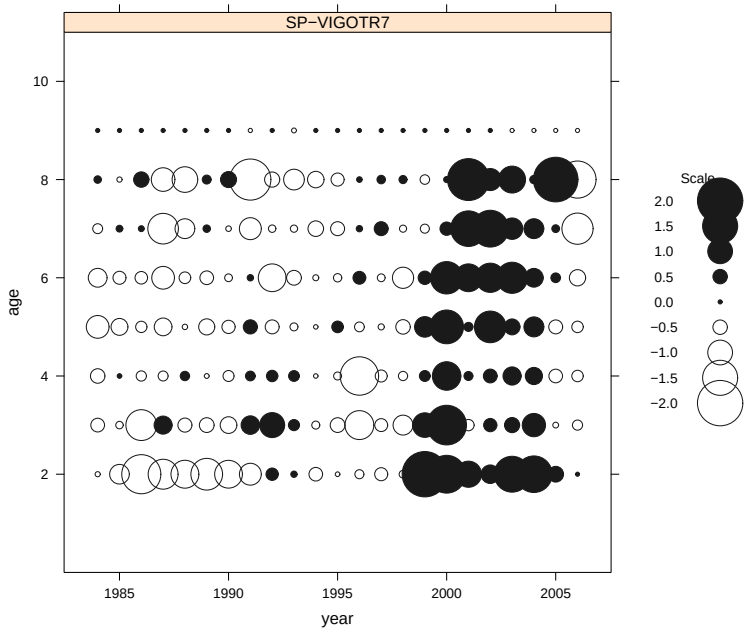
"Two parts split": A third possible course of action would be to split the tuning series into two, one going until 1998 and another one starting in 1999. This would implicitly say that effort has changed in the late 1990s in some way that we can not measure or model explicitly.

In order to explore which of these actions would be more in agreement with the signal coming from the international commercial catch matrix, we have performed XSA runs (using FLR), tuning only with the Vigo-Marín fleet. Each XSA run was performed using the commercial catch numbers-at-age matrix from 1984 to 2006, which goes from ages 1 to 10+, no shrinkage, catchability independent of stock size for all ages, q plateau at age 8 (the oldest age allowed by XSA) and no taper weighting. Eight options were considered for the tuning fleet:

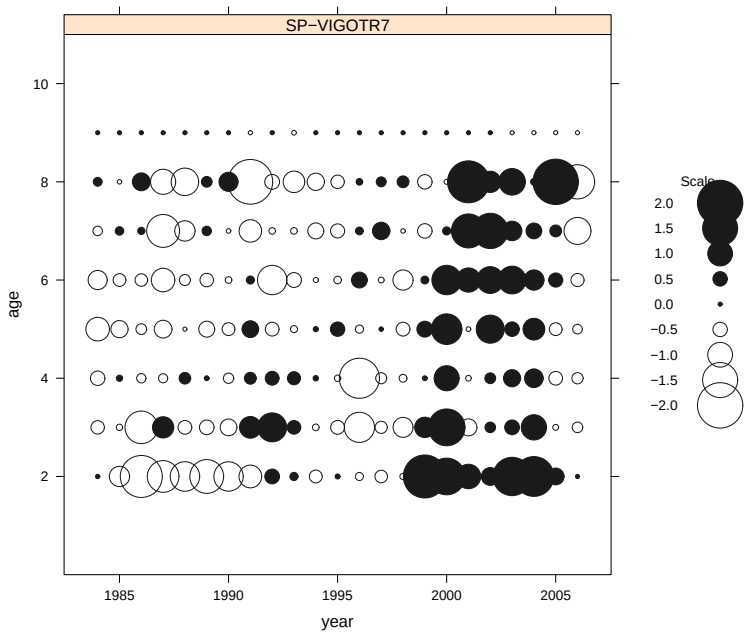
1) CPUE of Vigo-Marín
2) CPUE of Vigo-Marín with effort correction factor 1
3) CPUE of Vigo-Marín with effort correction factor 2
4) CPUE of Vigo-Marín split in two series (no effort correction)
5) LPUE of Vigo-Marín
6) LPUE of Vigo-Marín with effort correction factor 1
7) LPUE of Vigo-Marín with effort correction factor 2
8) LPUE of Vigo-Marín split in two series (no effort correction)

Plots of log-catchability residuals for each of these cases follow in the same order:

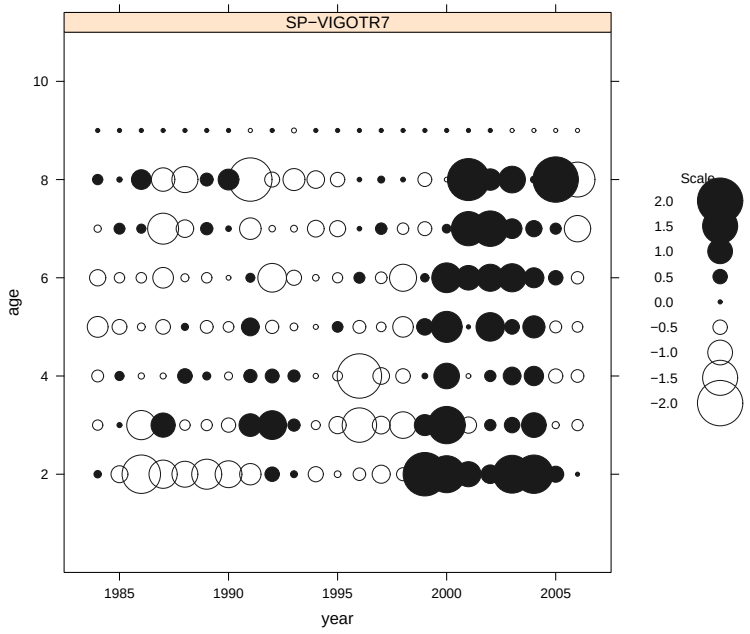
Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin only



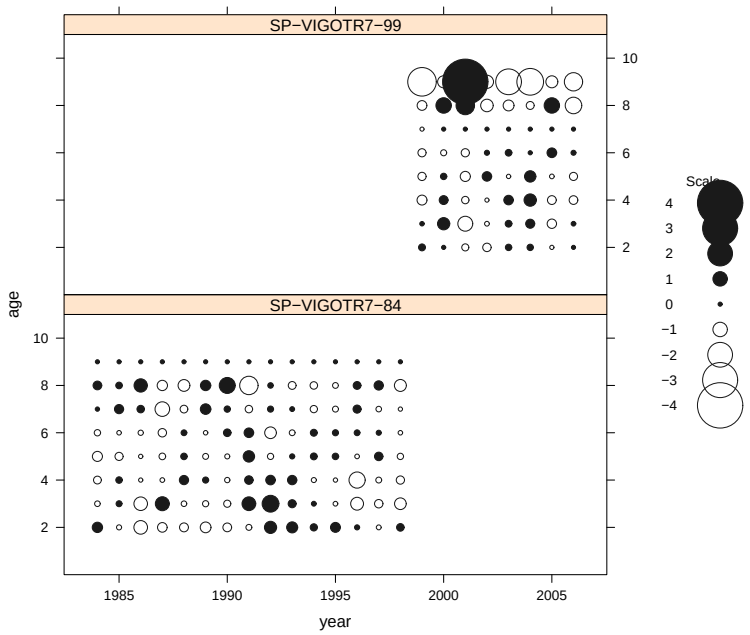
Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin only −− corrfact1



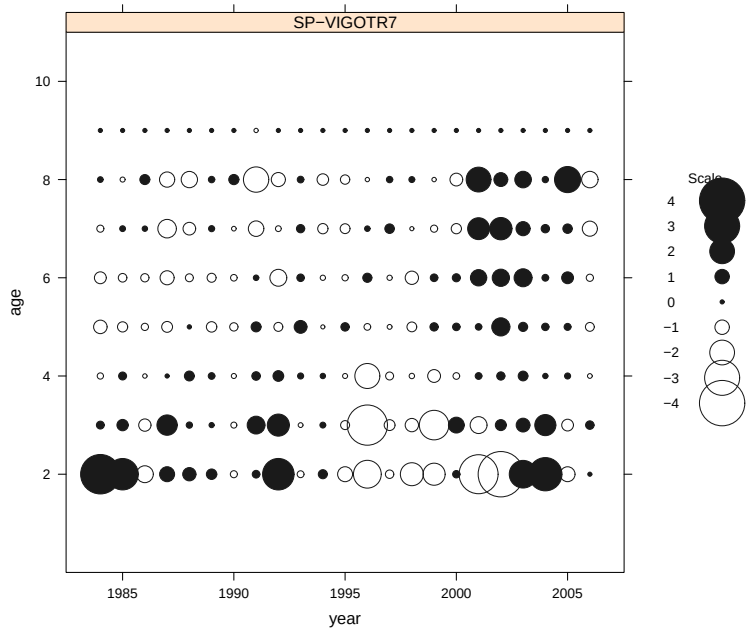
Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin only −− corrfact2



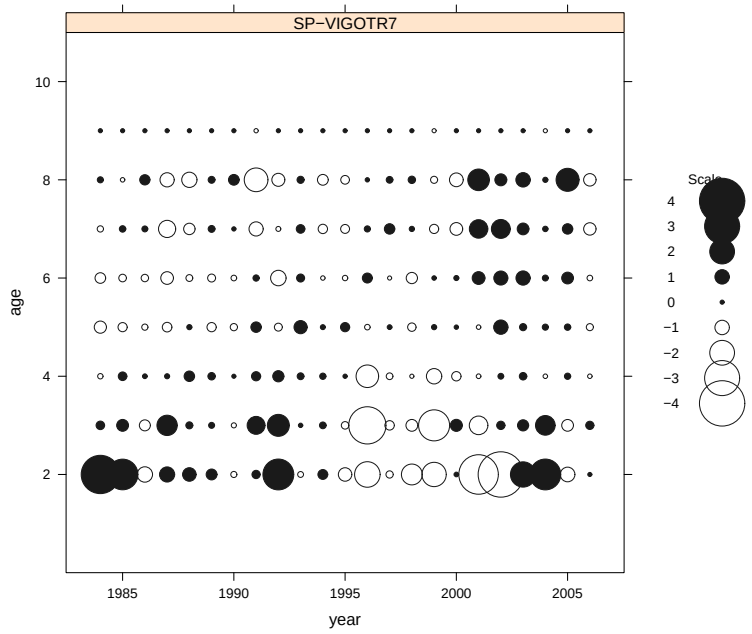
Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin only −− two parts



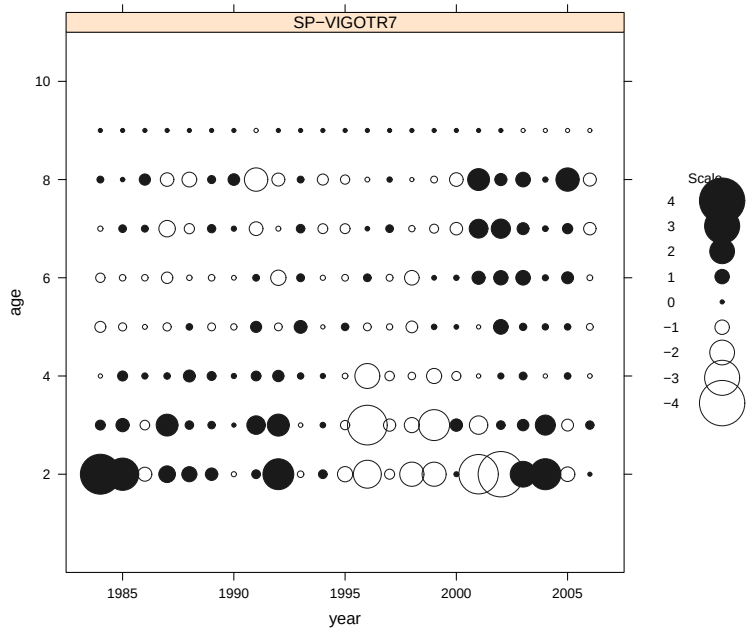
Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin Landings only



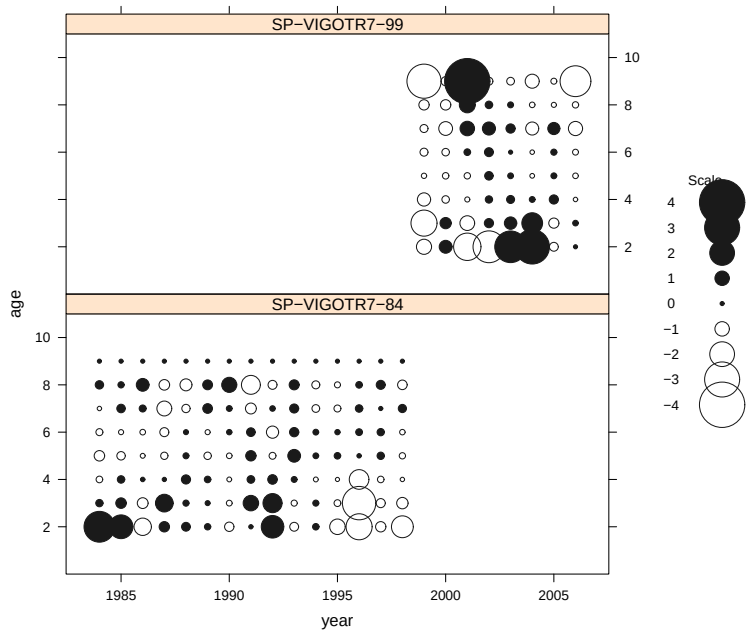
Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin Landings only −− corrfact1



Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin Landings only −− corrfact2



Northern Megrim in VII: Log catchability residuals tuning with Vigo−Marin Landings only −− twoparts



Note that the range of the residuals is not the same in all 8 plots. Whereas in the first 3 plots, residuals go from -2 to 2, in the last 5 plots they go from -4 to 4.

The residuals plots clearly show that there is a discrepancy between the commercial catch matrix and the Vigo-Marín CPUE tuning series, when effort of this series is not corrected (see first of the 8 residual plots). Applying either of the two proposed correction factors to the effort of this series has virtually no impact on the residual patterns obtained (second and third plots). The fourth plot shows a much improved residual pattern (except for age 9, when residuals become very large; note the change of range in the bubbles from (-2,2) in earlier plots to (-4,4) in this plot) when the CPUE tuning fleet is split in two parts. The last 4 plots correspond to the LPUE Vigo-Marín tuning series (note that bubbles in these plots are also in the range (-4,4)). Residual patterns look a bit better than for the first 4 plots, showing less of an abrupt change around 1999. Age 2 now has particularly large residuals. When the LPUE tuning series is split in two parts, age 9 residuals also become very large (eighth plot).

Based on these residual plots we may conclude that the option that is most in accordance with the signal coming from the international commercial catch matrix is option 4, namely to split the Vigo-Marín CPUE tuning series into two, with the first one covering from 1984 to 1998 and the second one starting in 1999. However, we note that the international commercial catch matrix for this stock contains French discards only until 1998, which means that there has been an artificial decrease in the catch numbers since 1999 in this matrix. Hence, conflicting signals between the international catch matrix and the Vigo-Marín tuning series, particularly as they relate to a changepoint around 1999, might be in part caused by that problem with the catch matrix.

4. Summary of conclusions and final recommendation

From analysis of the observers on board data (Section 2), we conclude that these do not support the notion of an increase in the abundance of the megrim stock in recent years.

From XSA runs with 8 possible variations of the Vigo-Marín tuning series (Section 3), we conclude that the option that is most in agreement with the signal coming from the international commercial catch matrix for this stock is the one corresponding to a split of the Vigo-Marín CPUE series in two parts (until 1998 and since 1999). We note, nonetheless, that the fact that the catch matrix contains French discards only until 1998 may be causing part of the discrepancies seen between this matrix and the Vigo-Marín CPUE series.

Basing ourselves mainly on the analysis from the observers on board data and to a lesser extent on the comparability with the international commercial catch matrix (notwithstanding the problems with it just mentioned), we suggest that the Vigo-Marín CPUE tuning series be split into two, with the first one covering from 1984 to 1998 and the second one starting from 1999.