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Spanish 2006-2008 Fisheries Footprint, scientific Observers and surveys coverage and update of the Standardized CPUE Indices for Greenland Halibut.

by

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ABSTRACT

The Spanish fleet has, at least, four different fisheries in NAFO Regulatory Area (NRA) Subarea 3. The Spanish fleet effort in depths more than 700 m. with 130 mm mesh size is mainly directed to Greenland halibut (mostly in Div. 3LM) , the effort with 280 mm mesh size in depth less than 200 meters is directed to skates (Div. 3NO), the effort with 40 mm mesh size in depth between 200-700 meters is directed to shrimp fishery (Div. 3LM) and the effort in depths between 200-700 meters with 130 mm mesh size is mainly directed to redfish (Div. 3O and 3M).

Surveys analyzed in this document cover quiet good all area where the Spanish fleet carries out their fisheries. The level and the spatial covertures of the samples taken by scientific observers are quite good for all fisheries in the studied period, except in 2008 where there are not samples in the shrimp fishery. The spatial and the level coverage of Scientific Observers information are reasonably good and we can considerer this information representative of the Spanish fisheries in NRA Subarea 3.

Based on Spanish commercial catch rates collected by the scientific observers, we update with the 2007 and 2008 data the linear regression model applied by Fernandez *et al*. in 2007 to standardize the Greenland halibut CPUE indices. Results show that the Greenland halibut CPUE has fluctuated through time, with no clear trend till 2004. Since then a clear increasing trend can be observed, reaching a level of double, compare with 1992 level, in the last two years (2007-2008).

INTRODUCTION

The aim of this document is to present the spatial distribution of the Spanish commercial fishing effort (footprint) for the 2006-2008 period and compare this with the survey and scientific observers coverage to see how representative of the different fisheries are the survey and observer data distribution.

We also present an update of the standardized CPUE Indices for Greenland halibut based on Spanish commercial catch rates collected by the scientific observers (Fernandez *et al.*, 2007) and its trend has been compared with the EU Flemish Cap and 3NO Spanish survey indices trends.

MATERIAL AND METHODS

The analysed period is 2006-2008 and we used different sources of data.

To explore the spatial distribution of the Spanish commercial fishing effort we use the NAFO Observers data. These data represent almost the 100% of the total Spanish effort in the studied period. In addition to NAFO observers

(NAFO Observers Program), IEO scientific observers were onboard Spanish vessels and the data collected by them were used to standardize the Greenland halibut CPUE Indices. Table 1 presents the total Spanish effort (fishing days) as well as the Scientific Observers examined fishing days and the percentage of the observed fishing days over the total.

Spain participates in different surveys in NRA Divisions 3LMNO but neither of them covers the entire area. We use the following three surveys information which cover all the fishing grounds in the study area: UE Flemish Cap survey (Vazquez and Gonzalez-Troncoso, 2008), Spanish 3NO survey (González-Troncoso *et al.* 2008) and Spanish 3L survey (Román *et al.*, 2008). Table 2 presents the main characteristics of these surveys.

To standardize the Greenland halibut CPUE indices we updated with the 2007 and 2008 data the linear regression model applied by Fernandez *et al.* in 2007. The potential explanatory variables were year, month, division, depth and vessel and all were treated as factors. Catch and effort data from the Spanish Greenland halibut fishery in NRA of Divisions 3LMNO were collected by Scientific Observers under the national sampling program. Data were recorded and analyzed on a haul by haul basis. For each haul, CPUE was computed as the catch in kilograms divided by trawling time measured in hours. It was assumed that all hauls at depths of at least 700 m targeted Greenland halibut.

RESULTS AND DISCUSSION

Figure 1 presents the spatial distribution of the Spanish Fishing effort in Divisions 3LMNO for the period 2006-2008 based on the NAFO Observers information. The maps show the start position of the hauls by mesh size. The mesh sizes were divided in three groups according with the NAFO Conservation and Enforcement measures: 40 mm is the minimum mesh size for shrimp, 130 is the minimum mesh size for Greenland halibut and other demersal species and 280 mm is the mesh size for the skates. In these maps we can observe that based on mesh size, depth and target species, the Spanish fleet has, at least, four different fisheries in NAFO Regulatory Area (NRA) Subarea 3. The Spanish fleet effort in depths more than 700 m. with 130 mm mesh size is mainly directed to Greenland halibut (mostly in Div. 3LM) , the effort with 280 mm mesh size in depth less than 200 meters is directed to skates (Div. 3NO), the effort with 40 mm mesh size in depth between 200-700 meters is directed to shrimp fishery (Div. 3LM) and the effort in depths between 200-700 meters with 130 mm mesh size is mainly directed to redfish (Div. 3O and 3M).

Figure 2 presents the haul down position of the EU Flemish Cap, Spanish 3NO and Spanish 3L surveys and their Greenland halibut catches for the 2006-2008 period. Surveys cover quiet good all area where the Spanish fleet carries out its fisheries.

Figure 3 shows the spatial distribution of the effort sampled by the Scientific Observers, the maps show the haul down position by mesh size and the Greenland halibut catches. It can be observed that the level and the spatial distribution of the samples are quite good for all fisheries in the studied period, except in 2008 where there are not samples in the shrimp fishery. The Greenland halibut survey spatial catches agree quite well with the Scientific Observers catches and it can be observed certain relationship between the size of the bubbles (catches) in the surveys and in the Scientific Observers hauls. The spatial and the level of coverage of Scientific Observers information are reasonably good and we can consider this information as representative of the Spanish fisheries in NRA Subarea 3.

Based on Spanish commercial catch rates collected by the Scientific Observers, we update with the 2007 and 2008 data the linear regression model applied by Fernandez *et al.* in 2007 to standardize the Spanish Greenland halibut CPUE indices.

A histogram of nominal CPUE values is displayed on the left panel of Figure 4. It is clear that the distribution is highly skewed and a logarithmic transformation seems natural. The amount of zero CPUE values in the dataset is very small. One tenth of the observed mean CPUE was adding to all the observations to avoid the problems with cero values. A histogram of the resulting values, transformed to logarithmic scale, is presented on the right panel of Figure 4. In this case the distribution is much more symmetric.

Figure 5 shows, for each of the four divisions, the number of observations available by month (left panel) and by depth stratum (right panel). Figure 6 displays the median value of CPUE with respect to the interactions division*month (left panel) and division*depth stratum (right panel).

Table 3 presents the analysis of variance and the obtained estimates are in Table 4. It is clear that all variables included in the model are highly significant. The percentage of the variance explained by the model is 53%, which we consider reasonable.

The left panel of Figure 7 displays the residuals plotted *versus* the fitted values, with no clear pattern of residuals. The right panel of the same figure is a Normal QQ plot of the residuals. The QQ plot indicates that the residuals are more dispersed (have wider tails) than would correspond to a Normal distribution, with this effect being a bit more pronounced on the left tail.

Figure 8 presents the standardized CPUE (transformed back to the original, non-logged scaled), scaled to CPUE in 1992. The graph shows point estimates and 95% confidence limits. According to these results, CPUE has fluctuated through time, with no clear increasing or decreasing trends till 2004. Since then a clear increasing trend can be observed, reaching a level of double in the last two years (2007-2008) compared with 1992 level.

Figure 9 shows the standardized commercial CPUE, the Flemish Cap up to 700 m. and 1400 m and the Spanish 3NO up to 1400 m. Greenland halibut biomass indices normalized to N(0,1). It can be observed that all the indices have similar trends, except in the 1997-2001 period in which the surveys indices were increasing till reach their maximum and after that decreasing while the CPUE index is more or less stable in this period.

REFERENCES

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Table 1. Total Spanish effort (fishing days) in NRA Divisions 3LMNO as well as the scientific observed fishing days and the percentage of the observed fishing days over the total in the period 2006-2008.

	2006	2007	2008
Total Fishing days	2557	1677	1406
Observed Fishing days	355	281	290
% (Observed/Total)	14%	17%	21%

Table 2. Main characteristics of the EU and Spanish Surveys made in NRA Divisions 3LMNO.

	Divisions	Gear	Depth Range (m)	Hauls	Serie	Month
EU Flemish Cap	3M	Lofoten	1460	180	1988-2008	July
Spanish 3NO	3NO	Campelen	1480	120	2005-2008	June
Spanish 3L	3L	Campelen	1450	100	2003-2008	August

Table 3. Analysis of Variance Table

```
Response: lcpueplusmcpue
                 Df  Sum Sq Mean Sq F value    Pr(>F)
year             16 1086.27   67.89 391.272 < 2.2e-16 ***
division          3   74.86   24.95 143.811 < 2.2e-16 ***
month            11  298.56   27.14 156.421 < 2.2e-16 ***
depth             8   79.08    9.89  56.969 < 2.2e-16 ***
vessel           58  697.95   12.03  69.351 < 2.2e-16 ***
division:month   33   67.77    2.05  11.836 < 2.2e-16 ***
division:depth   22   48.73    2.22  12.766 < 2.2e-16 ***
Residuals     11988 2080.11    0.17
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

	Df	Deviance	Resid. Df	Resid. Dev	Diferencia	%
NULL			12139	4433.3		
year	16	1086.3	12123	3347.1	1086.2	0.25
division	3	74.9	12120	3272.2	1161.1	0.26
month	11	298.6	12109	2973.6	1459.7	0.33
depth	8	79.1	12101	2894.6	1538.7	0.35
vessel	58	697.9	12043	2196.6	2236.7	0.50
division:month	33	67.8	12010	2128.8	2304.5	0.52
division:depth	22	48.7	11988	2080.1	2353.2	0.53

Table 4. Parameter estimates from final log-linear model

```
Call:
lm(formula = lcpueplusmcpue ~ year + division + month + depth +
    vessel + division:month + division:depth)

Residuals:
      Min        1Q    Median        3Q       Max
-2.686704 -0.251569  0.008237  0.257554  2.241800

Coefficients: (2 not defined because of singularities)
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)         6.205e+00  6.131e-02 101.206  < 2e-16 ***
year1993           -1.868e-01  2.487e-02  -7.511 6.30e-14 ***
year1994           -2.556e-01  2.487e-02 -10.277  < 2e-16 ***
year1995           -1.783e-01  5.251e-02  -3.395 0.000689 ***
year1996            1.336e-02  2.702e-02   0.494 0.621047
year1997           -6.648e-02  2.875e-02  -2.313 0.020751 *
year1998           -2.614e-01  2.941e-02  -8.889  < 2e-16 ***
year1999           -3.610e-01  3.594e-02 -10.046  < 2e-16 ***
year2000           -7.985e-02  2.581e-02  -3.094 0.001979 **
year2001           -1.693e-01  2.836e-02  -5.969 2.46e-09 ***
year2002            1.060e-03  3.044e-02   0.035 0.972225
year2003           -2.297e-01  2.913e-02  -7.884 3.44e-15 ***
year2004           -4.842e-01  2.679e-02 -18.072  < 2e-16 ***
year2005           -3.073e-01  2.858e-02 -10.754  < 2e-16 ***
year2006           -2.563e-02  2.854e-02  -0.898 0.369148
year2007            6.525e-01  3.058e-02  21.338  < 2e-16 ***
year2008            4.978e-01  4.396e-02  11.325  < 2e-16 ***
division3M         -4.488e-01  5.414e-02  -8.291  < 2e-16 ***
division3N         -4.213e-01  6.915e-02  -6.092 1.15e-09 ***
division3O         -1.620e+00  4.470e-01  -3.624 0.000291 ***
monthFeb           -7.964e-02  2.738e-02  -2.909 0.003633 **
monthMar           -2.770e-01  3.072e-02  -9.017  < 2e-16 ***
monthApr           -1.373e-01  3.102e-02  -4.427 9.63e-06 ***
monthMay           -2.032e-01  2.942e-02  -6.909 5.14e-12 ***
monthJun           -2.166e-01  2.971e-02  -7.292 3.26e-13 ***
monthJul           -3.034e-01  2.943e-02 -10.307  < 2e-16 ***
monthAug           -4.788e-01  2.856e-02 -16.765  < 2e-16 ***
monthSep           -5.767e-01  3.070e-02 -18.789  < 2e-16 ***
monthOct           -6.641e-01  2.970e-02 -22.363  < 2e-16 ***
monthNov           -3.687e-01  2.768e-02 -13.319  < 2e-16 ***
monthDec           -1.315e-01  2.769e-02  -4.748 2.08e-06 ***
depth2             -1.666e-02  1.892e-02  -0.881 0.378538
depth3             -4.284e-02  1.922e-02  -2.228 0.025890 *
depth4             -4.536e-02  1.997e-02  -2.272 0.023128 *
depth5             -1.956e-02  2.120e-02  -0.922 0.356362
depth6              9.541e-04  2.175e-02   0.044 0.965007
depth7              8.029e-02  3.300e-02   2.433 0.014980 *
depth8              1.472e-01  4.506e-02   3.266 0.001094 **
depth9              9.750e-02  9.749e-02   1.000 0.317247
vessel   2         -3.776e-02  9.926e-02  -0.380 0.703621
vessel   3         -3.284e-01  8.871e-02  -3.702 0.000215 ***
vessel   4          2.505e-01  5.786e-02   4.329 1.51e-05 ***
vessel   5         -3.715e-01  7.192e-02  -5.166 2.43e-07 ***
vessel   6          2.598e-01  5.699e-02   4.558 5.21e-06 ***
vessel   7         -2.294e-01  5.594e-02  -4.101 4.15e-05 ***
vessel   8         -1.255e-01  9.299e-02  -1.350 0.177202
vessel   9         -1.256e-01  5.920e-02  -2.122 0.033873 *
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vessel  10           1.859e-01  8.342e-02   2.229 0.025828 *
vessel  11          -5.144e-01  7.143e-02  -7.202 6.31e-13 ***
vessel  12          -4.806e-02  5.789e-02  -0.830 0.406446
vessel  13           3.709e-01  7.255e-02   5.112 3.24e-07 ***
vessel  14          -6.955e-01  5.521e-02 -12.597  < 2e-16 ***
vessel  15          -7.460e-01  5.817e-02 -12.825  < 2e-16 ***
vessel  16          -7.779e-01  6.054e-02 -12.849  < 2e-16 ***
vessel  17           2.697e-01  2.159e-01   1.249 0.211511
vessel  18          -1.711e-01  5.269e-02  -3.247 0.001168 **
vessel  19          -2.001e-01  5.609e-02  -3.567 0.000363 ***
vessel  20           1.601e-01  7.022e-02   2.280 0.022613 *
vessel  21          -5.546e-02  5.546e-02  -1.000 0.317318
vessel  22          -2.062e-01  7.089e-02  -2.908 0.003640 **
vessel  23           1.873e-02  5.467e-02   0.343 0.731870
vessel  24          -1.341e-01  1.115e-01  -1.203 0.229070
vessel  25          -8.200e-02  5.522e-02  -1.485 0.137598
vessel  26           6.893e-01  6.697e-02  10.293  < 2e-16 ***
vessel  27          -1.963e-01  6.183e-02  -3.175 0.001502 **
vessel  28          -5.431e-01  5.321e-02 -10.206  < 2e-16 ***
vessel  29           1.267e-01  7.628e-02   1.661 0.096738 .
vessel  30          -3.339e-01  7.615e-02  -4.384 1.17e-05 ***
vessel  31          -1.823e-01  1.286e-01  -1.418 0.156156
vessel  32          -5.984e-01  1.493e-01  -4.009 6.12e-05 ***
vessel  33           3.506e-01  1.397e-01   2.510 0.012079 *
vessel  34           1.778e-01  5.349e-02   3.325 0.000888 ***
vessel  35          -2.398e-01  6.215e-02  -3.859 0.000115 ***
vessel  36          -2.874e-01  9.683e-02  -2.968 0.003005 **
vessel  37          -9.146e-02  1.020e-01  -0.897 0.369756
vessel  38          -3.836e-01  6.324e-02  -6.066 1.35e-09 ***
vessel  39          -5.557e-01  6.067e-02  -9.160  < 2e-16 ***
vessel  40          -3.787e-01  7.331e-02  -5.166 2.42e-07 ***
vessel  41          -4.434e-01  8.412e-02  -5.271 1.38e-07 ***
vessel  42           1.454e-01  5.816e-02   2.501 0.012406 *
vessel  43          -3.238e-01  9.472e-02  -3.419 0.000631 ***
vessel  44           3.913e-01  8.626e-02   4.537 5.77e-06 ***
vessel  45          -6.342e-01  7.404e-02  -8.566  < 2e-16 ***
vessel  46          -3.764e-01  6.531e-02  -5.763 8.45e-09 ***
vessel  47          -1.386e-01  5.957e-02  -2.326 0.020027 *
vessel  48          -3.736e-02  5.634e-02  -0.663 0.507315
vessel  49          -3.110e-01  8.978e-02  -3.464 0.000534 ***
vessel  50           3.577e-02  7.573e-02   0.472 0.636675
vessel  51          -9.421e-02  5.681e-02  -1.658 0.097304 .
vessel  52          -9.964e-02  1.006e-01  -0.990 0.321961
vessel  53          -2.785e-01  6.008e-02  -4.635 3.60e-06 ***
vessel  54           3.930e-02  5.959e-02   0.660 0.509569
vessel  55           7.556e-02  6.228e-02   1.213 0.225045
vessel  56          -1.990e-01  5.629e-02  -3.535 0.000409 ***
vessel  57           1.988e-01  5.396e-02   3.684 0.000231 ***
vessel  58          -2.561e-01  6.576e-02  -3.894 9.89e-05 ***
vessel  59          -3.464e-01  5.485e-02  -6.315 2.79e-10 ***
division3M:monthFeb  1.432e-01  4.548e-02   3.150 0.001638 **
division3N:monthFeb  1.392e-01  7.475e-02   1.862 0.062559 .
division3O:monthFeb -3.686e-01  3.939e-01  -0.936 0.349422
division3M:monthMar  2.547e-01  4.515e-02   5.642 1.72e-08 ***
division3N:monthMar  2.826e-01  8.007e-02   3.529 0.000418 ***
division3O:monthMar  1.010e+00  4.284e-01   2.357 0.018415 *
division3M:monthApr  2.591e-01  4.709e-02   5.502 3.84e-08 ***
division3N:monthApr  4.257e-01  7.532e-02   5.652 1.62e-08 ***
division3O:monthApr  8.860e-01  3.549e-01   2.496 0.012556 *
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division3M:monthMay  1.528e-01  4.867e-02   3.140 0.001696 **
division3N:monthMay  4.471e-01  7.272e-02   6.149 8.05e-10 ***
division3O:monthMay  6.966e-01  3.336e-01   2.089 0.036770 *
division3M:monthJun  9.459e-02  5.247e-02   1.803 0.071445 .
division3N:monthJun  3.729e-01  7.012e-02   5.317 1.07e-07 ***
division3O:monthJun -1.397e-01  5.195e-01  -0.269 0.788015
division3M:monthJul  1.915e-01  5.521e-02   3.469 0.000525 ***
division3N:monthJul  4.210e-01  7.024e-02   5.994 2.11e-09 ***
division3O:monthJul  3.390e-01  3.333e-01   1.017 0.309128
division3M:monthAug  2.779e-01  5.094e-02   5.456 4.98e-08 ***
division3N:monthAug  7.401e-01  6.657e-02  11.118  < 2e-16 ***
division3O:monthAug  5.996e-01  3.426e-01   1.750 0.080166 .
division3M:monthSep  2.176e-01  6.620e-02   3.287 0.001014 **
division3N:monthSep  5.124e-01  6.744e-02   7.597 3.25e-14 ***
division3O:monthSep -5.410e-02  3.618e-01  -0.150 0.881138
division3M:monthOct  4.012e-01  5.497e-02   7.299 3.09e-13 ***
division3N:monthOct  6.098e-01  6.680e-02   9.129  < 2e-16 ***
division3O:monthOct  7.566e-01  4.830e-01   1.566 0.117277
division3M:monthNov  2.310e-01  5.147e-02   4.488 7.27e-06 ***
division3N:monthNov  2.851e-01  7.029e-02   4.056 5.03e-05 ***
division3O:monthNov  6.257e-01  3.299e-01   1.897 0.057876 .
division3M:monthDec  2.624e-01  5.943e-02   4.415 1.02e-05 ***
division3N:monthDec  2.586e-01  7.075e-02   3.655 0.000258 ***
division3O:monthDec  6.208e-01  3.368e-01   1.843 0.065370 .
division3M:depth2    1.742e-01  4.640e-02   3.754 0.000175 ***
division3N:depth2   -5.969e-02  4.241e-02  -1.407 0.159343
division3O:depth2    7.470e-01  3.877e-01   1.927 0.054015 .
division3M:depth3    1.724e-01  4.412e-02   3.907 9.38e-05 ***
division3N:depth3   -4.822e-02  4.120e-02  -1.170 0.241861
division3O:depth3    9.099e-01  3.301e-01   2.756 0.005853 **
division3M:depth4    1.686e-01  4.361e-02   3.866 0.000111 ***
division3N:depth4   -1.641e-03  4.269e-02  -0.038 0.969332
division3O:depth4    1.002e+00  3.386e-01   2.959 0.003095 **
division3M:depth5    7.021e-02  4.421e-02   1.588 0.112278
division3N:depth5    8.907e-05  4.578e-02   0.002 0.998448
division3O:depth5    8.579e-01  3.492e-01   2.457 0.014021 *
division3M:depth6   -5.249e-03  4.787e-02  -0.110 0.912685
division3N:depth6    1.855e-02  5.078e-02   0.365 0.714964
division3O:depth6    5.502e-01  3.512e-01   1.567 0.117195
division3M:depth7   -1.575e-01  6.336e-02  -2.485 0.012960 *
division3N:depth7   -5.077e-02  6.855e-02  -0.741 0.458914
division3O:depth7    1.643e-01  4.628e-01   0.355 0.722601
division3M:depth8   -7.068e-01  7.931e-02  -8.911  < 2e-16 ***
division3N:depth8   -1.947e-01  1.509e-01  -1.290 0.196973
division3O:depth8           NA         NA      NA       NA
division3M:depth9   -7.347e-01  1.185e-01  -6.199 5.87e-10 ***
division3N:depth9    4.931e-02  1.808e-01   0.273 0.785054
division3O:depth9           NA         NA      NA       NA
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4166 on 11988 degrees of freedom
Multiple R-Squared: 0.5308,   Adjusted R-squared: 0.5249
F-statistic: 89.81 on 151 and 11988 DF,  p-value: < 2.2e-16
```
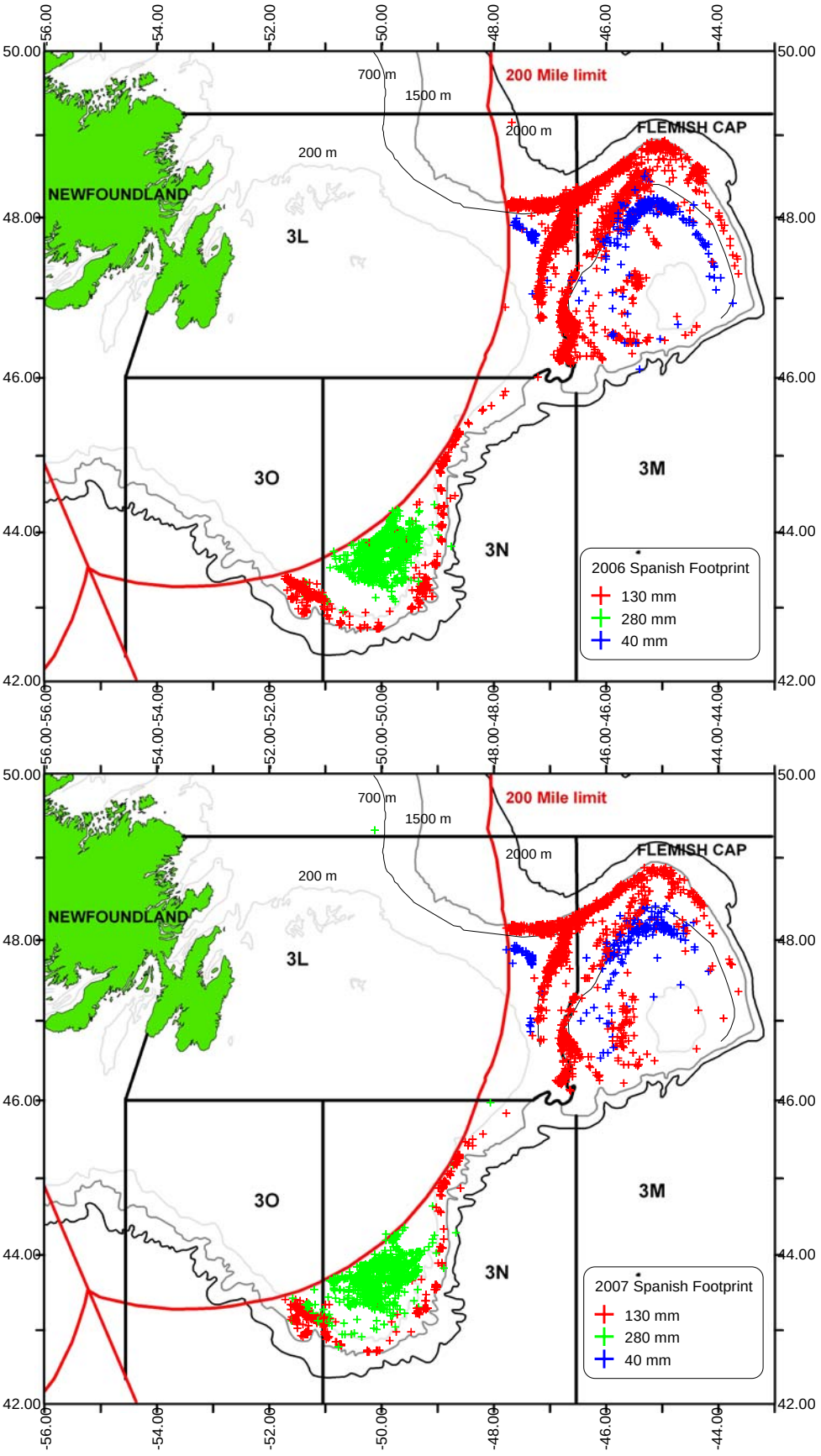


700 m
1500 m
200 Mile limit
2000 m
FLEMISH CAP
200 m
NEWFOUNDLAND
3L
3O
3M
3N
2006 Spanish Footprint
130 mm
280 mm
40 mm
2007 Spanish Footprint
130 mm
280 mm
40 mm
50.00
48.00
46.00
44.00
42.00
56.00
54.00
52.00
50.00
48.00
46.00
44.00

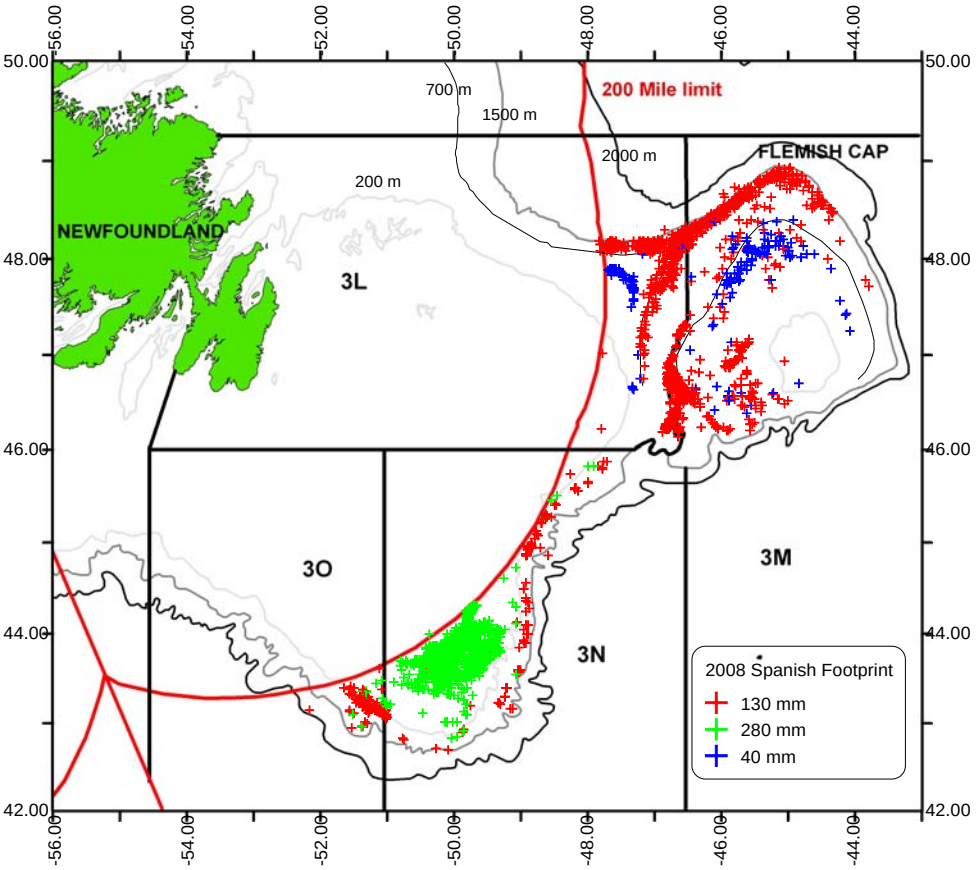
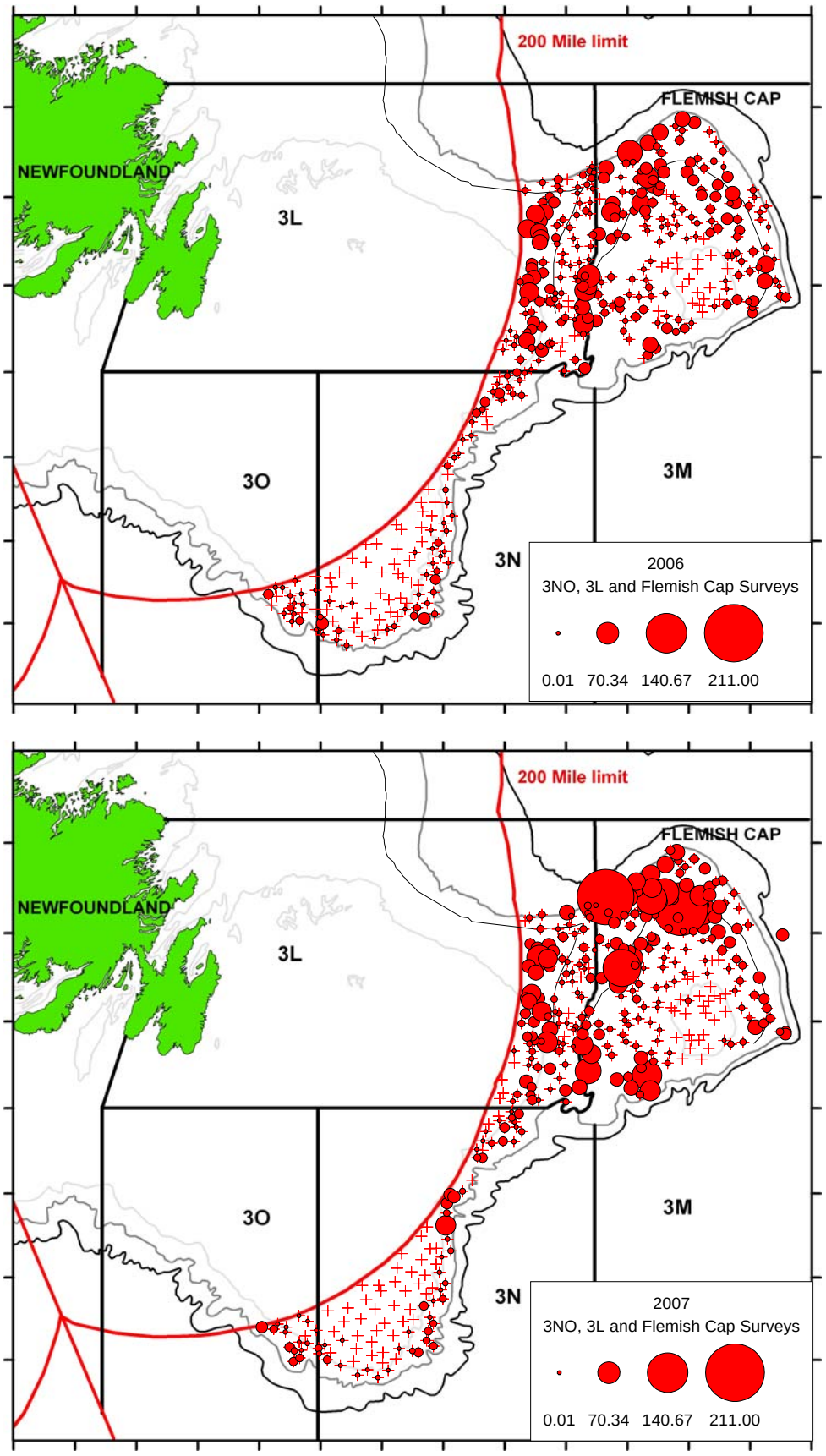


Figure 1. Start position of the hauls carried out by the Spanish fleet in the period 2006-2008 by mesh size and year, based on the NAFO Observers information.


200 Mile limit
FLEMISH CAP
NEWFOUNDLAND
3L
3O
3M
3N
2006
3NO, 3L and Flemish Cap Surveys
0.01 70.34 140.67 211.00
200 Mile limit
FLEMISH CAP
NEWFOUNDLAND
3L
3O
3M
3N
2007
3NO, 3L and Flemish Cap Surveys
0.01 70.34 140.67 211.00

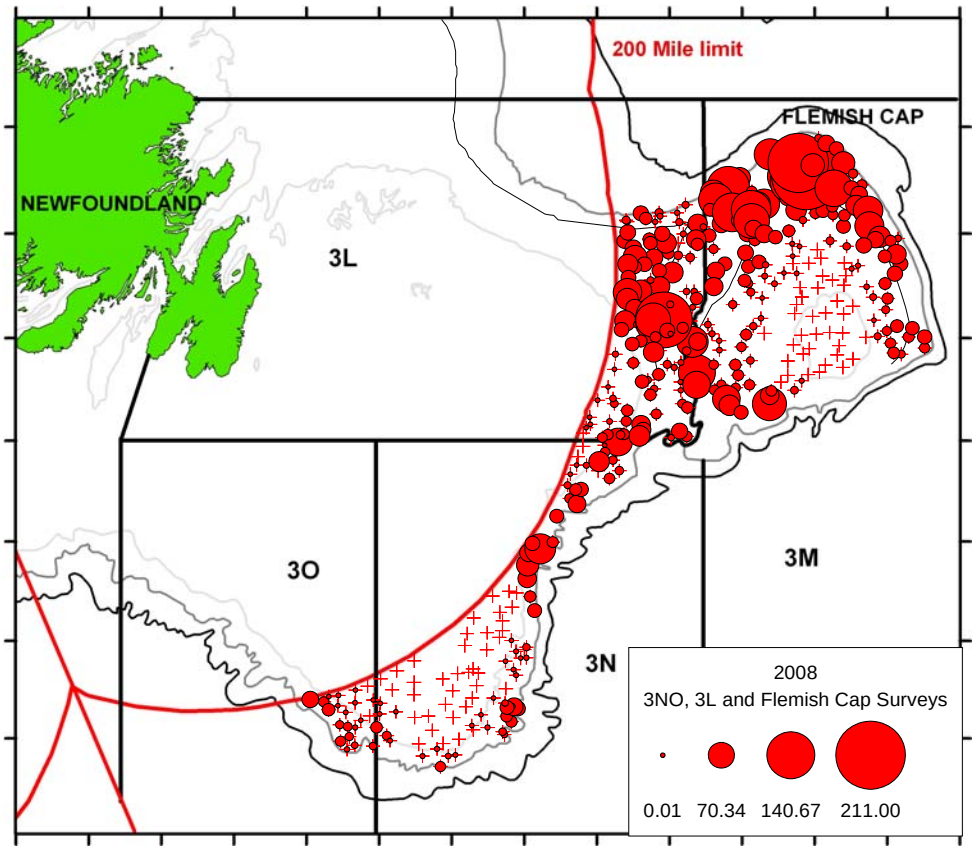
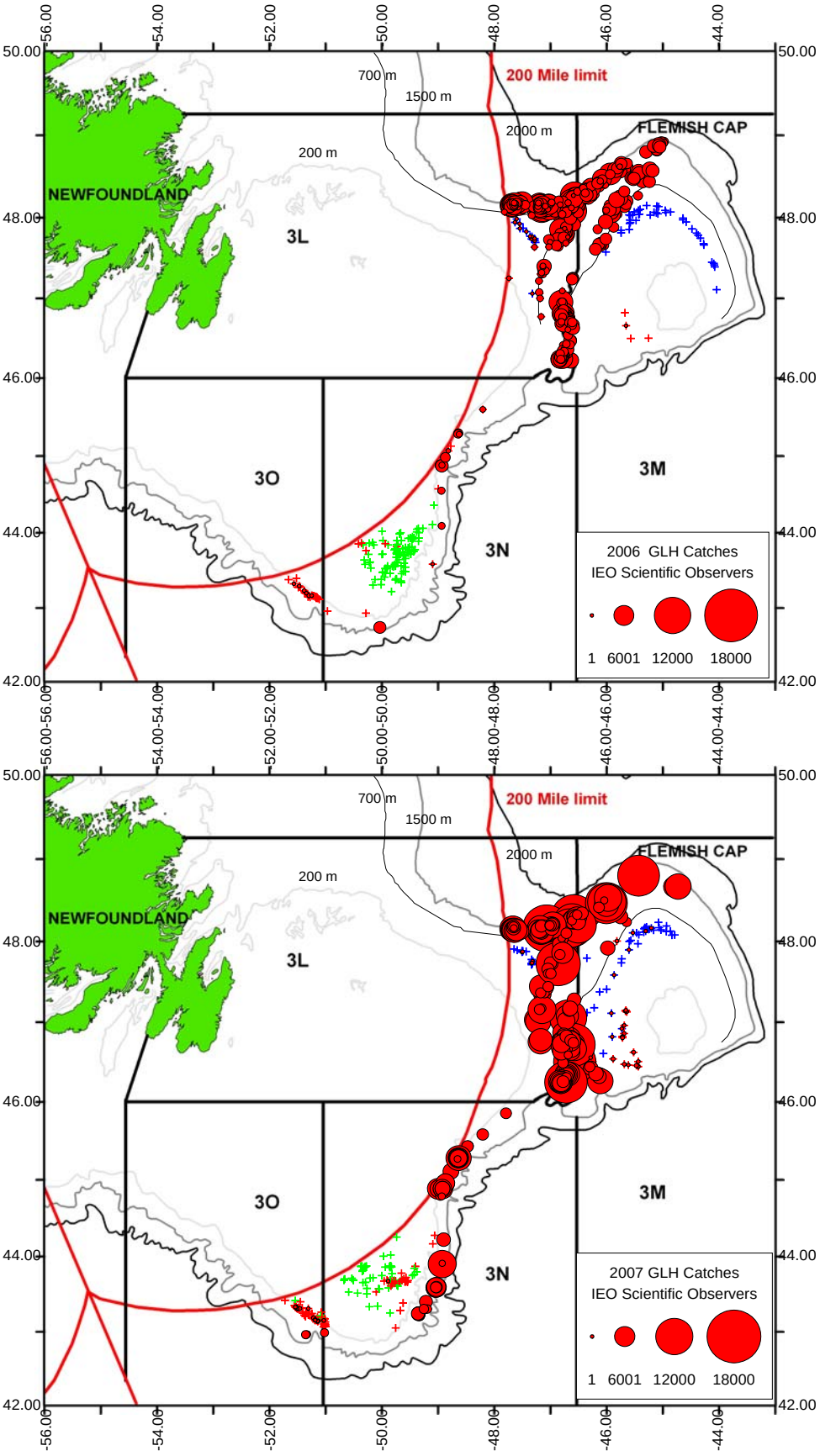


Figure 2. Start position of the hauls and Greenland halibut catches (kg) of the EU Flemish Cap, Spanish 3NO and Spanish 3L surveys in the period 2006-2008.


700 m
1500 m
200 Mile limit
2000 m
FLEMISH CAP
200 m
NEWFOUNDLAND
3L
3O
3M
3N
2006 GLH Catches
IEO Scientific Observers
1 6001 12000 18000
2007 GLH Catches
IEO Scientific Observers
1 6001 12000 18000

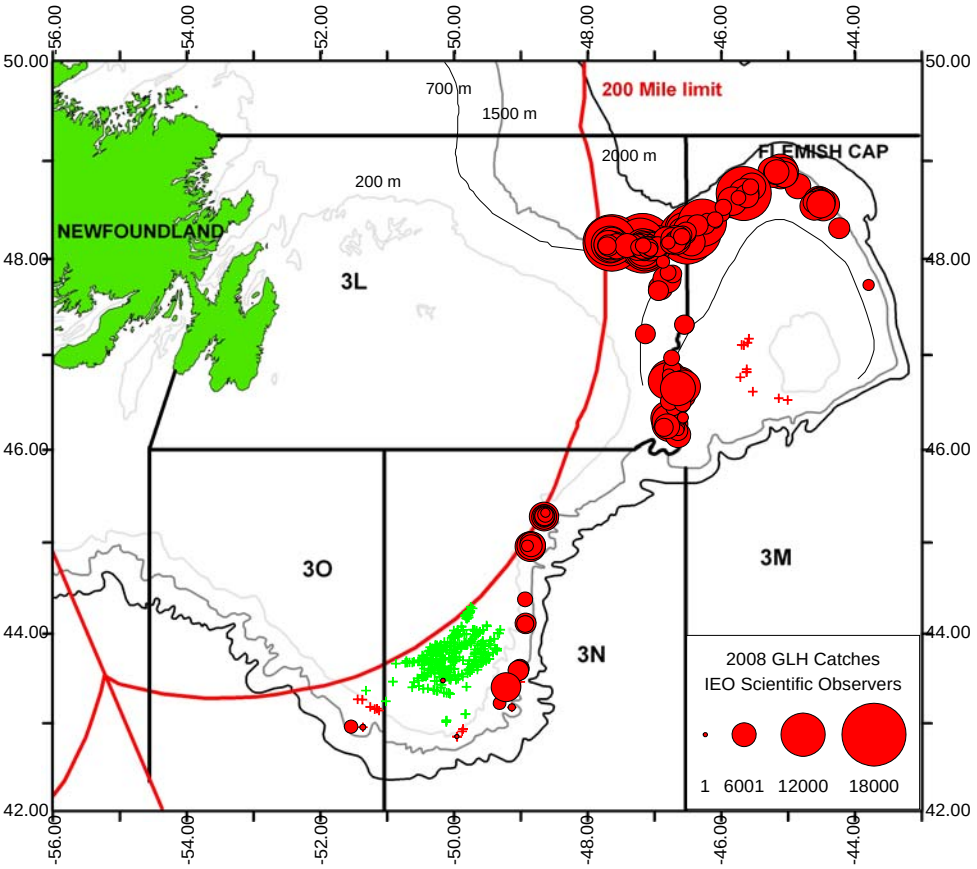


Figure 3. Start position and Greenland halibut catches of the Spanish Scientific Observers observed hauls by mesh size and year carried out in the 2006-2008 period. Red = 130 mm mesh size; Green = 208 mm mesh size and Blue = 40 mm mesh size.

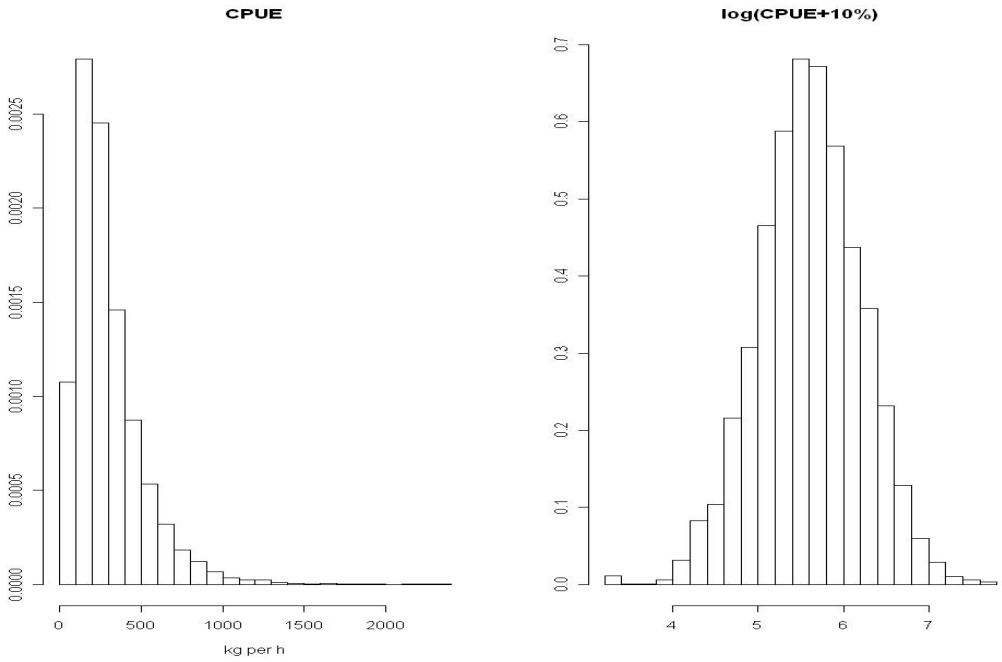


Figure 4. Histograms of CPUE (left panel) and log-transformed CPUE +10% of mean (right panel) data.

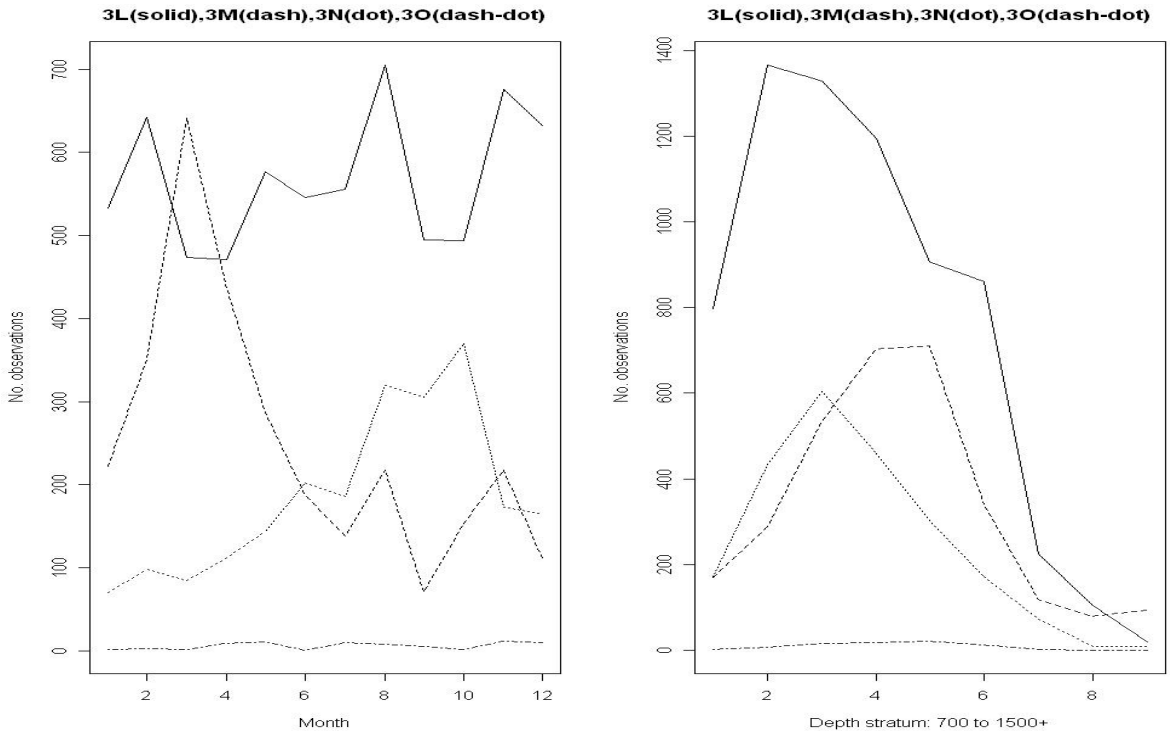


Figure 5. Number of observations per division, by month (left panel) and depth stratum (right panel)

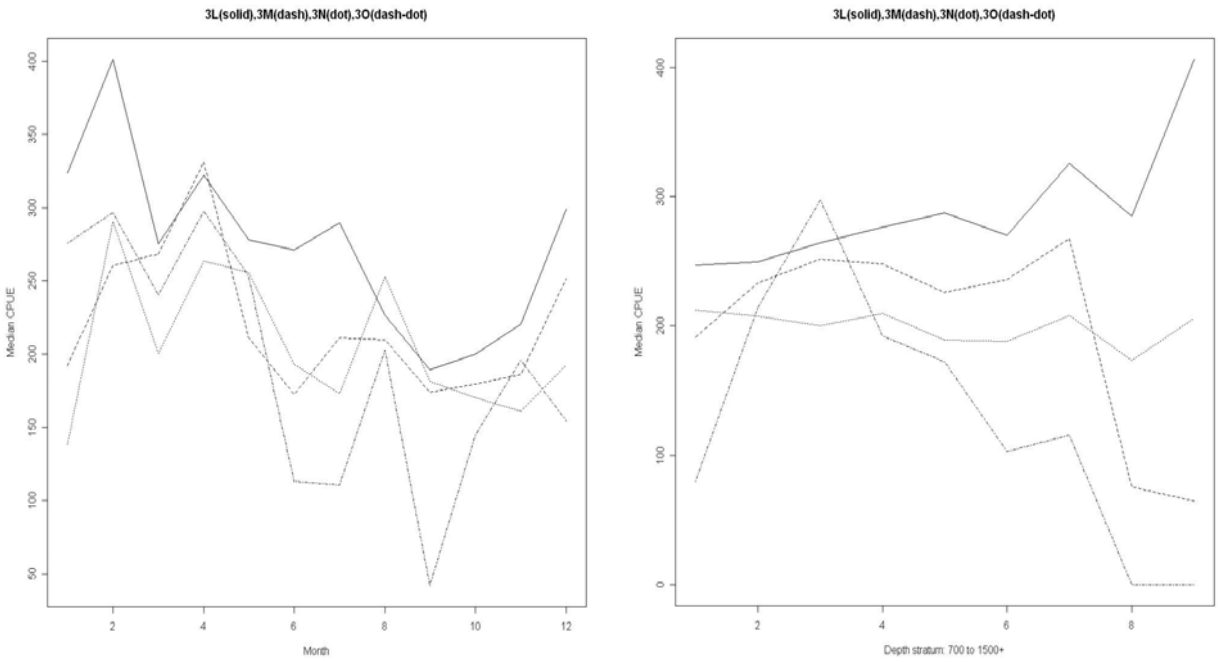


Figure 6. Interaction plots for division*month (left panel) and division*depth stratum (right panel)

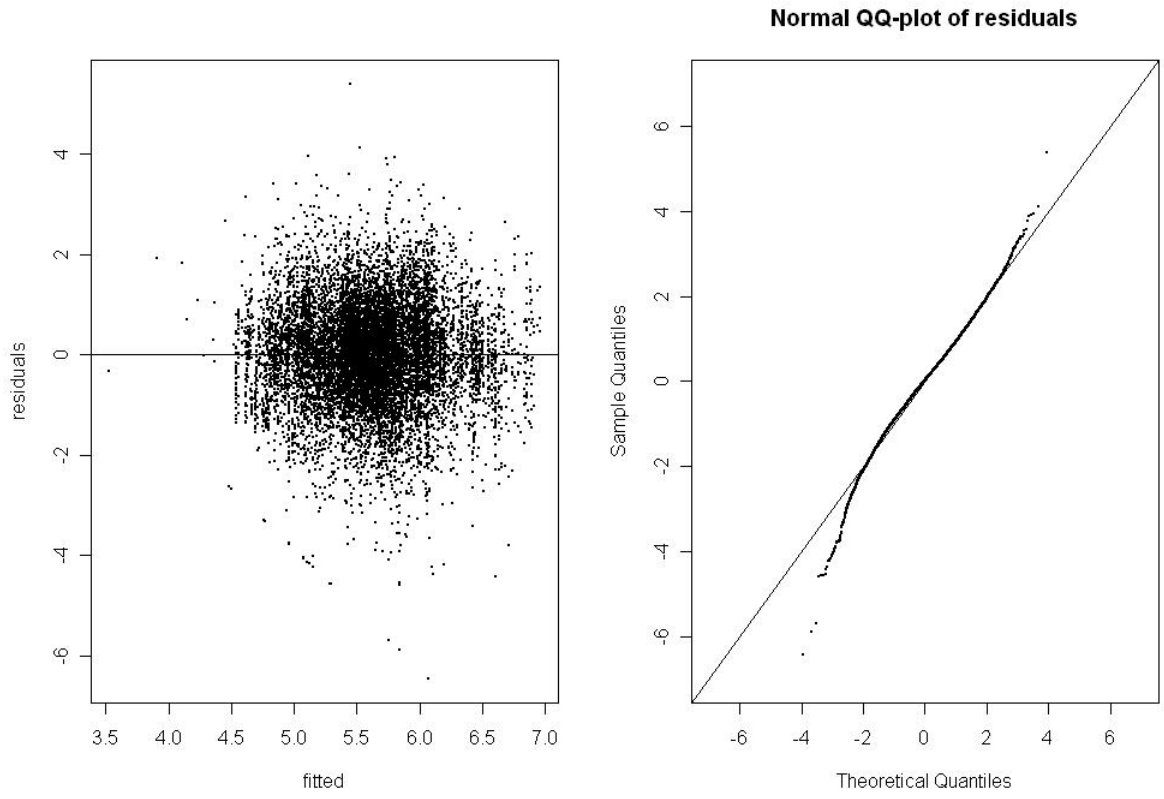


Figure 7. Residuals *versus* fitted values (left panel) and QQ plot of residuals (right panel).

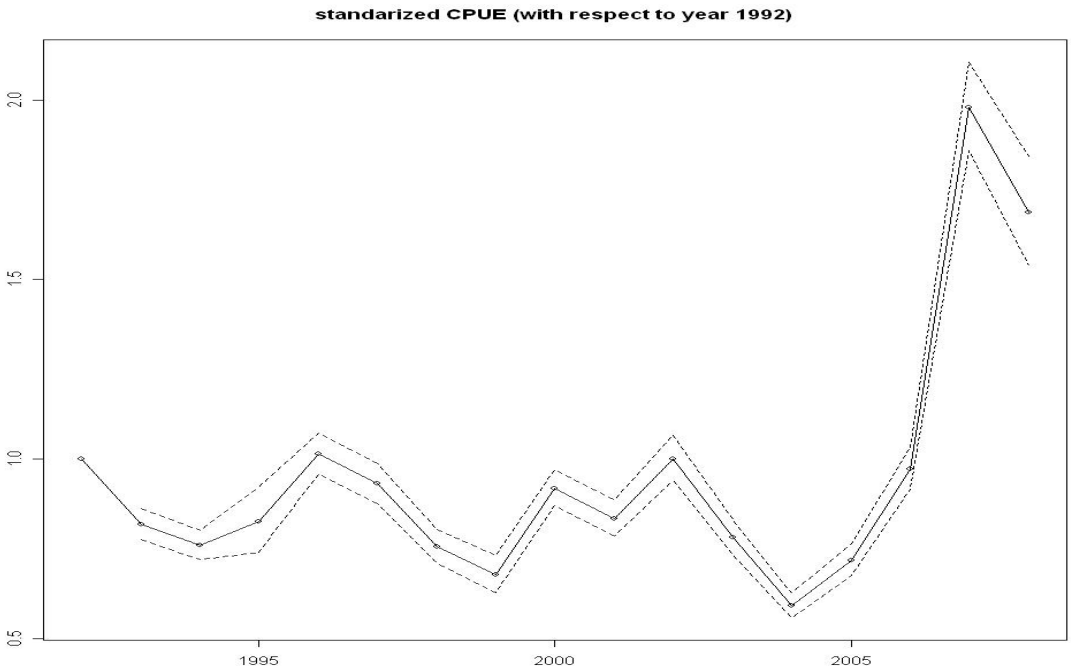


Figure 8. Standardized CPUE series for Greenland halibut in NRA of Divisions 3LMNO, scaled to CPUE in 1992. Estimates point and 95% confidence limits.

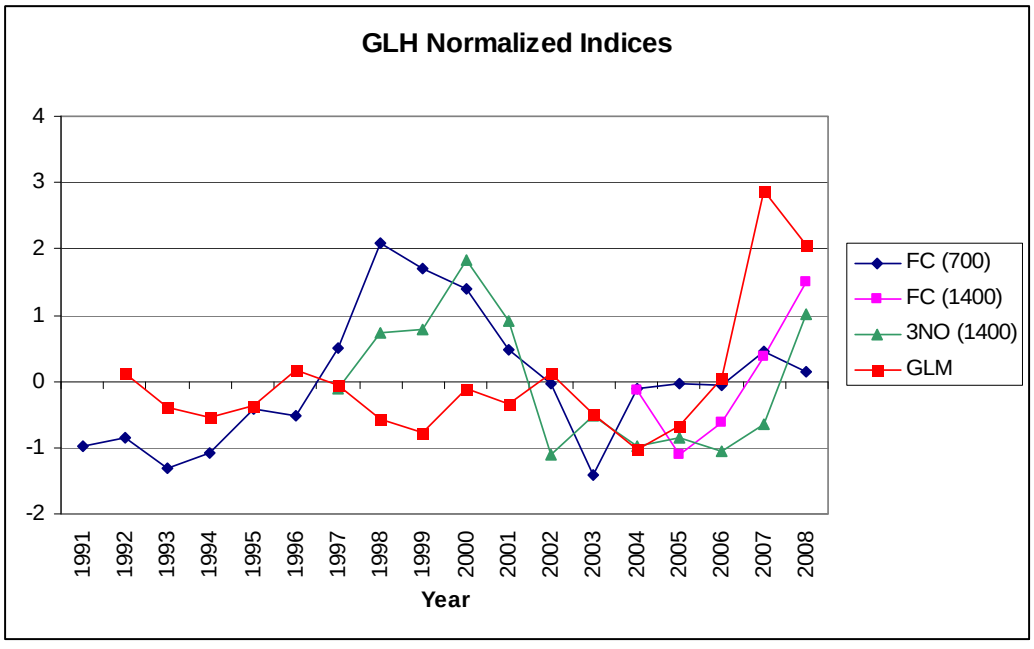


Figure 9. Normalized Survey Indices (Flemish Cap up to 700 m. and 1400 m. and Spanish 3NO up to 1400 m) and Normalized Spanish commercial CPUE series for Greenland halibut.