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Update on the UWTV Survey on the Irish Sea *Nephrops* Grounds

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Introduction

This survey is carried out in co-operation with Marine Institute (Ireland) and AFBI (Northern Ireland) and is in its sixth year. A revision of the count data for the early years 2003 and 2004 is also presented where the initial high burrow estimates were checked and a drift in burrow identification was detected as detailed in SGNEPS 2009.

Material and methods

For the western Irish Sea prior information was available on the distribution of sediments was available and the boundaries of the fishing grounds were obtained from VMS data from the Republic of Ireland. The survey design is a randomised fixed grid where a point is picked at random and stations are carried out at a fixed distance north-south and east-west. The distance between stations is currently 3.5 nautical miles. An adaptive approach is taken where by stations are continued past the known perimeter of the ground until the burrow densities are close to zero.

Survey timing was generally standardised to August each year. In 2008, 141 stations were surveyed. The protocols used were those reviewed by WKNEPHTV 2007 (ICES, 2007).

At each station the UWTV sledge was deployed and once stable on the seabed a 10 minute tow was recorded onto DVD. Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 second. For tows where sledge position this was unavailable the calculated layback of the sledge was used as an approximation. In addition depth was logged for the duration of the tow.

All recounts were conducted by two trained "burrow identifying" scientists independent of each other on board the research vessel during the survey. During this review process the visibility, ground type and speed of the sledge during one-minute intervals were subjectively classified using the classification. In addition the numbers of *Nephrops* burrows (multiple burrows in close proximity which appear to be part of a sing complex are only counted once), *Nephrops* in and *Nephrops* out of burrows counted by each scientist for each one-minute interval was recorded. Notes were also made on the occurrence of trawl marks, fish species and other species during the one-minute interval. Finally, if any there was any time during the one-minute where counting was not possible this was also estimated so that the time window could be removed from the distance over ground calculations. R Quality control tool developed inhouse also allowed for survey data to be analysed in terms of data quality in navigation signal, overall tow factors such as speed and visual clarity (Figure 1) documented by SGNEPS (ICES, 2009). .Figure 2 is an output that depicts counter trends for the survey. Figure 3 and Figure 4 shows the variability in density between minutes and operators for each station.

Due to the high estimates of mean density in the early survey years 2003 and 2004 - it was deemed necessary to verify these estimates.
Initially a 30% random sub-sample of the 2003 and 2004 survey stations were counted in the laboratory to check if there was any drift in burrow identification since the beginning of the survey series. The results showed that there was a drift in identification and it was concluded that the 2003 and 2004 surveys needed to be verified (SGNEPS 2009). Due to logistics, it was decided that all stations of mean density of 1.5 or more number of burrows/m2 were to be counted in the laboratory by one experienced counter. These revised counts are preliminary as only one counter was involved in this process and it is standard procedure to have all footage counted independently by two trained counters.

The resultant recount data were screened for one minute intervals with an unusually large deviation between recounts. Means of the burrow and *Nephrops* recounts were standardised by dividing by the survey area observed. Either the USBL or estimated sledge lay-back were used to calculate distance over ground of the sledge. The field of view of the camera at the bottom of the screen was estimated at 75cm assuming that the sledge was flat on the seabed (i.e. no sinking). This field of view was confirmed for the majority of tows using lasers during the 2008 survey. Occasionally the lasers were not visible at the bottom of the screen due to sinking in very soft mud (the impact of this is a minor under estimate of densities at stations where this occurred).

To account for the spatial co-variance and other spatial structuring a geo-statistical analysis of the mean and variance was carried out using SURFER Version 8.02. The spatial structure of the density data was studied through variograms. Initial the mid-points of each UWTV transect were converted to UTMs. In addition to the survey stations various boundary positions were included in the analysis. The assumption at these boundary positions was that the *Nephrops* abundance was zero. These stations were outside the known distribution of *Nephrops* or suitable sediment and were approximately equidistant to the spacing within the main grid each year. An unweighted and unsmoothed omnidirectional variogram was constructed with a lag width of approximately 1417m and maximum lag distance of between 53-55 km. A model variogram $\gamma(h)$, was produced with an exponential component (Equation 8). Model fitting was via the SURFER algorithm using the variogram estimation option.

Various other experimental variograms and model setting were examined before the final model choice was made.

Equation 8: Exponential Variogram Model

$$\gamma(h) = C\left[1 - e^{-h}\right]$$

Where C is the scale for the structural component of the variogram and h is the aniostrophically.

The resulting annual variograms were used to create krigged grid files and the resulting cross-validation data were plotted. If the results looked reasonable then surface plots of the grids were made using a standardised scale. The final part of the process was to limit the calculation to the known extent of the ground using a boundary blanking file. The resulting blanked grid was used to estimate the mean, variance, standard deviation, coefficient of variation, domain area and total burrow abundance estimate.

Results.

A histogram of the observed burrow densities for 2003 to 2008 on the western Irish Sea is presented in Figure 5. These indicate significant changes in the densities observed particularly in 2003 and 2004. However, since 2005 the density estimates observed are very similar with modal density of around 1/m2.

The geo-statistical structural analysis is shown in the form of variograms in Figure 6. There are a few outliers apparent but they appear have little leverage on the variogram models observed. A comparison of the observer and expected density estimates for each year is given in Figure 7. There is good concordance between the observation and model estimates though there may be some underestimation

The blanked krigged contour plot and posted point density data are shown in Figure 8. The krigged contours correspond very well to the observed data. The results indicate the densities increased from 2003-2004 when very high densities were apparent throughout the ground. Densities subsequently decreased to the lowest levels observed in 2008. In general the densities are higher towards the western and northern side of the ground.

The summary statistics from this geo-statistical analysis are given in Table 1. The krigged mean density estimates for 2003 and 2004 using the preliminary revised count data depict the same overall trend but the scaling is somewhat lower Figure 9.
The mean densities and overall abundance is estimated to have decreased significantly between 2004 and 2005. The abundance estimates were between 7 to 8.4 billion in 2003 and 2004 and since then the estimate have been similar for most years close to 6 billion with a drop to just under 5 billion in 2008.

Discussion

The time series of available data with which to assess this stock is short. Previously an assessment has not been possible for this stock but several assessment options have been explored.

This UWTV survey is the main source of significant new information on this stock. The methods employed during the Irish Sea UWTV surveys have recently been discussed and documented by WKNEPHTV (ICES, 2007). It is expected that this data will be integrated into a formal assessment as part of the benchmark process in early 2009. The WKNEPH reported on an integrated assessment on using the surveys and commercial data for this stock.

However, for this document the survey is only used as an indicator for this stock. In that context this survey indicates that there has been a steep change in the burrow density and abundance from the first two years of the survey to last three years. In 2008 abundance decreased and is the lowest in the six year time series. The abundances observed in the western Irish Sea (FU 15) remain significantly higher than other areas where UWTV surveys are carried out.

In conclusion, the stock trends from the fishery for the Republic of Ireland fleet (landings and LPUE) appear to be stable and effort has decreased in recent years. The relative UWTV survey index of burrow abundance has decreased and 2008 is the lowest since the series commenced. The 2003 and 2004 preliminary revised counts will require a second counter for verification.

Currently there is no serious concern about the stock status since burrow densities are still high. A new survey point will be available after August 2009 which will provide a more up to date prognosis for the stock.

References

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ICES 2007. Report of the Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters (WKNEPHTV). ICES CM: 2007/ACFM: 14 Ref: LRC, PGCCDBS

ICES 2005. Using UWTV surveys to develop a conceptual ecosystem model of Aran Grounds *Nephrops* population distribution. ICES CM 2005/L:30 Annual Science Conference.

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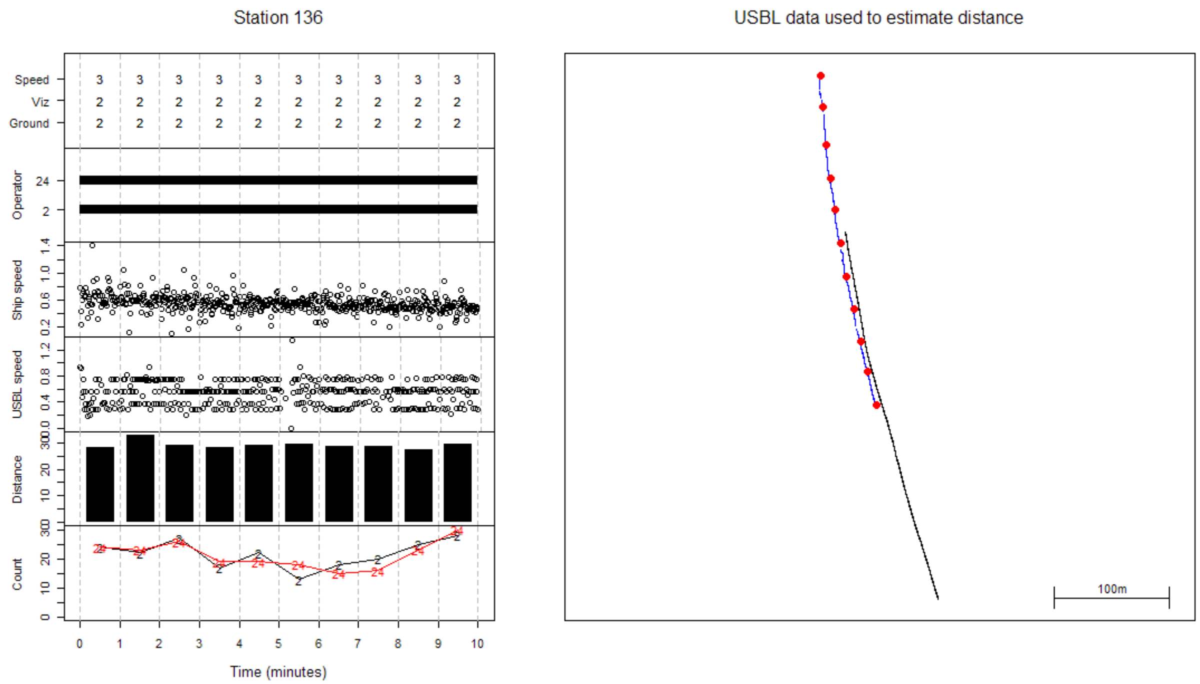

Figure 1.R tool quality control plot of station 136 UWTV Survey of the Irish Sea Grounds FU15 2008.

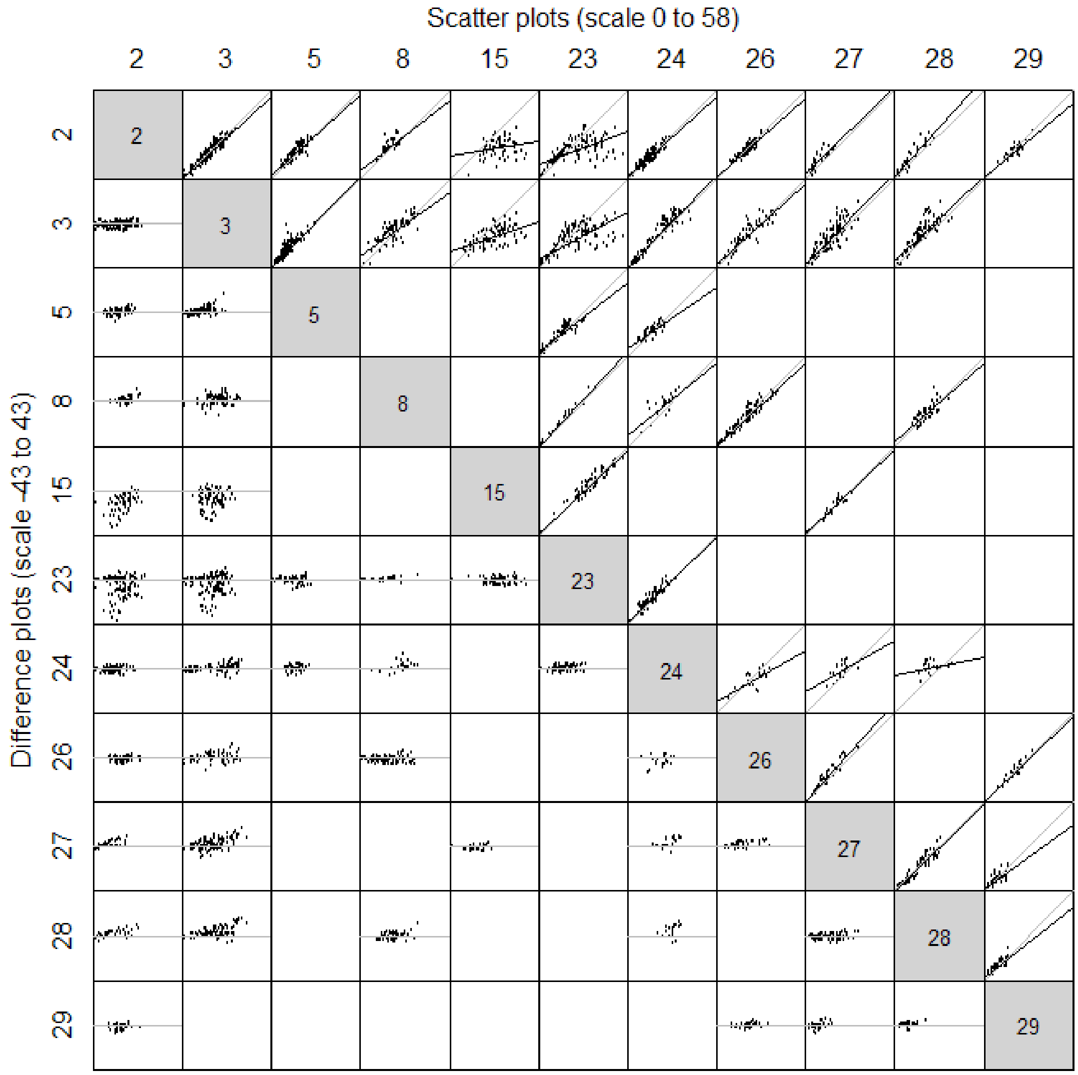

Figure 2.Scatterplot analysis of counter trends during UWTV Survey of the Irish Sea Grounds FU15 2008.

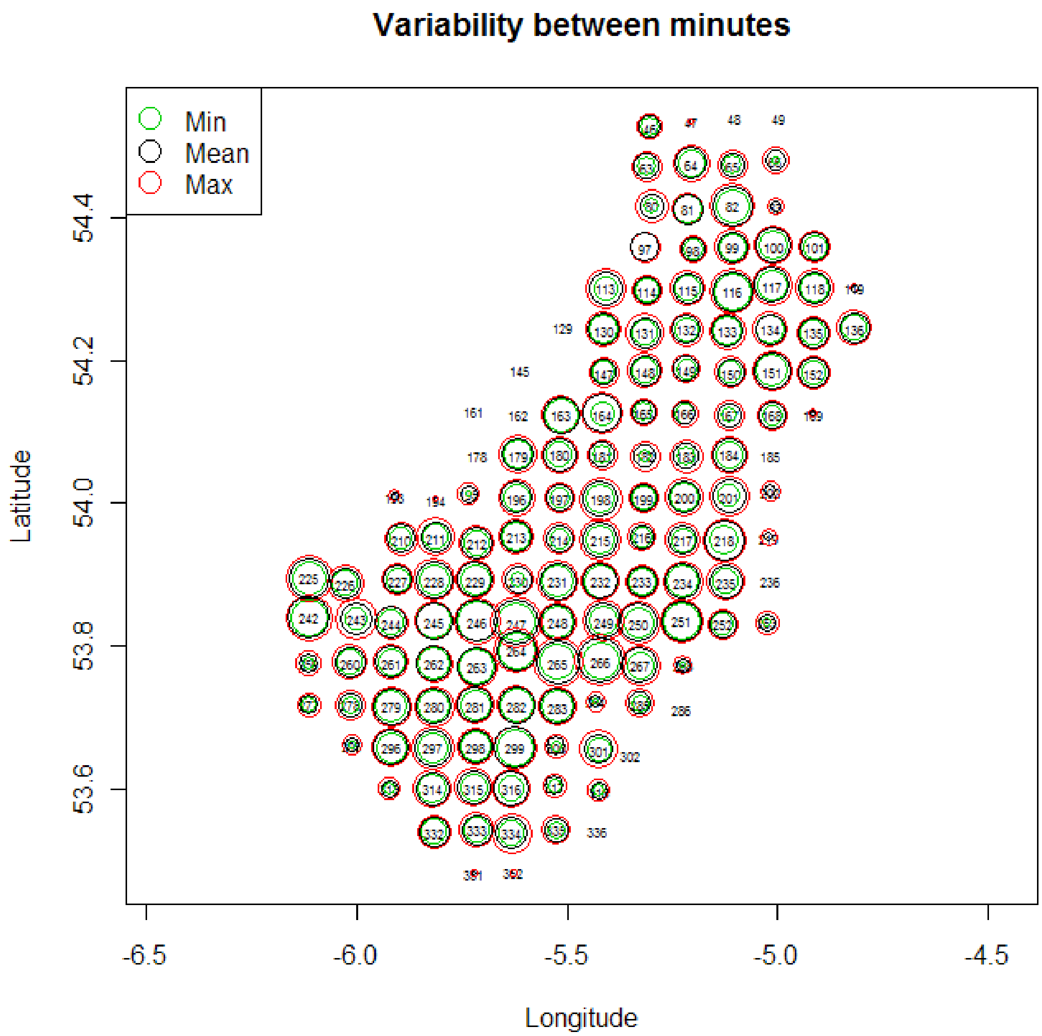

Figure 3. Plot of the variability in density between minutes for each station.

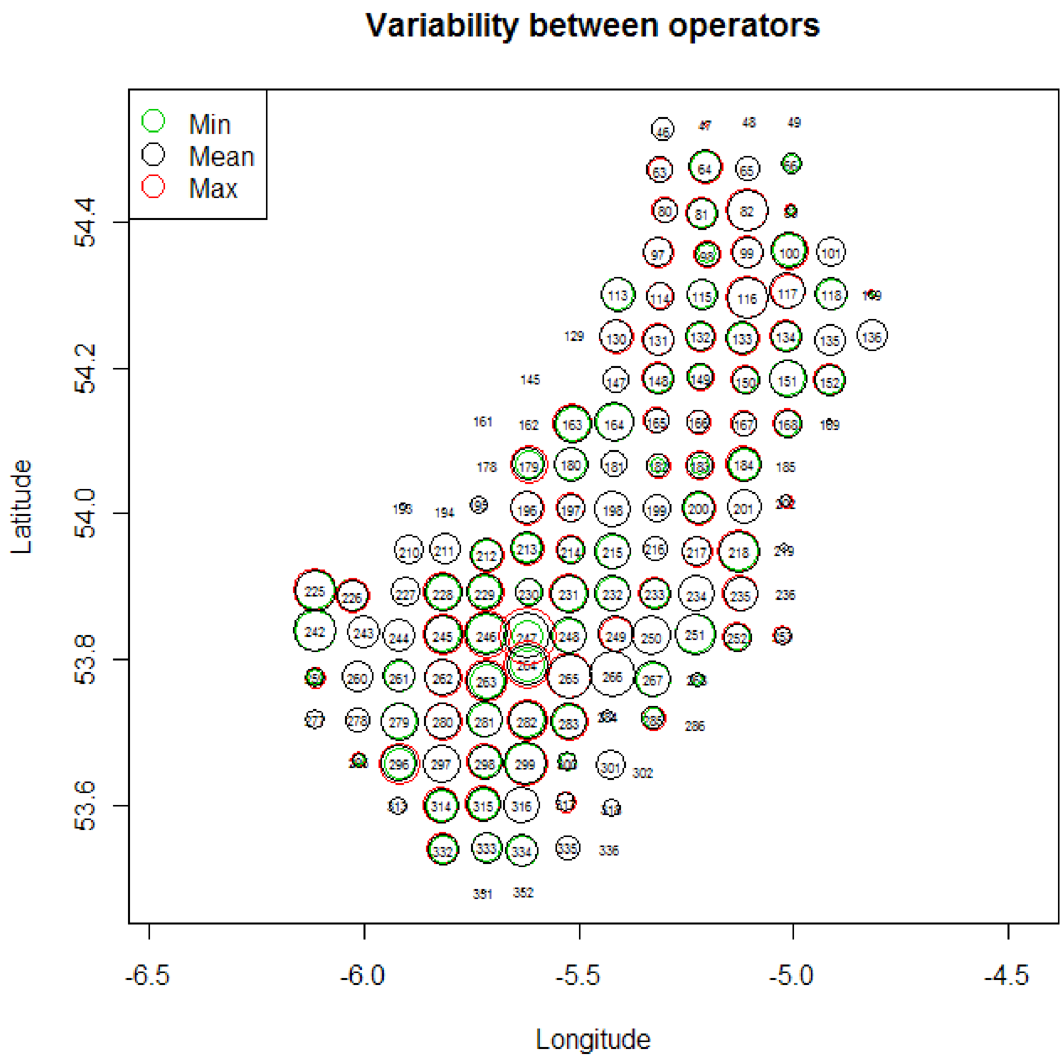

Figure 4. Plot of the variability in density between operators (counters) for each station.

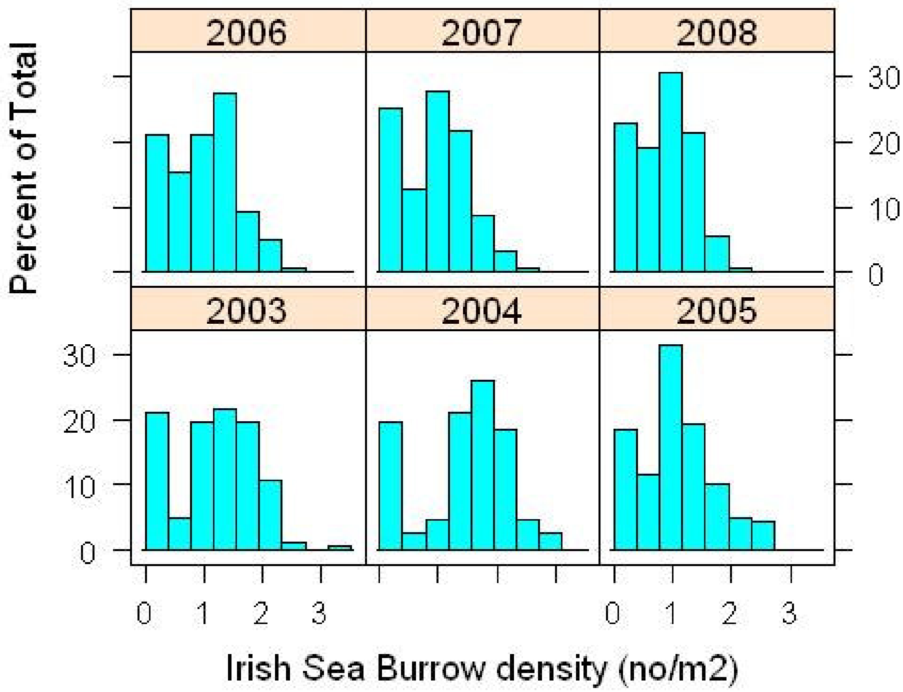

Figure 5: Burrow density distributions for the western Irish Sea by year from 2003-2008.

Year	Number of stations	Number of boundary points	Mean Density (No./m2)	Domain Area (km2)	Raised abundance estimate (billion burrows)
2003*	160	54	1.25	5291.867978	6.959853625
2004*	147	45	1.52	5302.444023	8.47707119
2005	140	64	1.08	5288.395287	6.01096494
2006	138	50	1.07	5428.69286	5.928355701
2007	148	53	1.00	5452.291054	5.554172406
2008	141	37	0.88	5287.456376	4.888586634

*Preliminary results from verified counts.

Table1: Summary geostatistics for the Nephrops UWTV surveys of the western Irish Sea from 2003-2008.

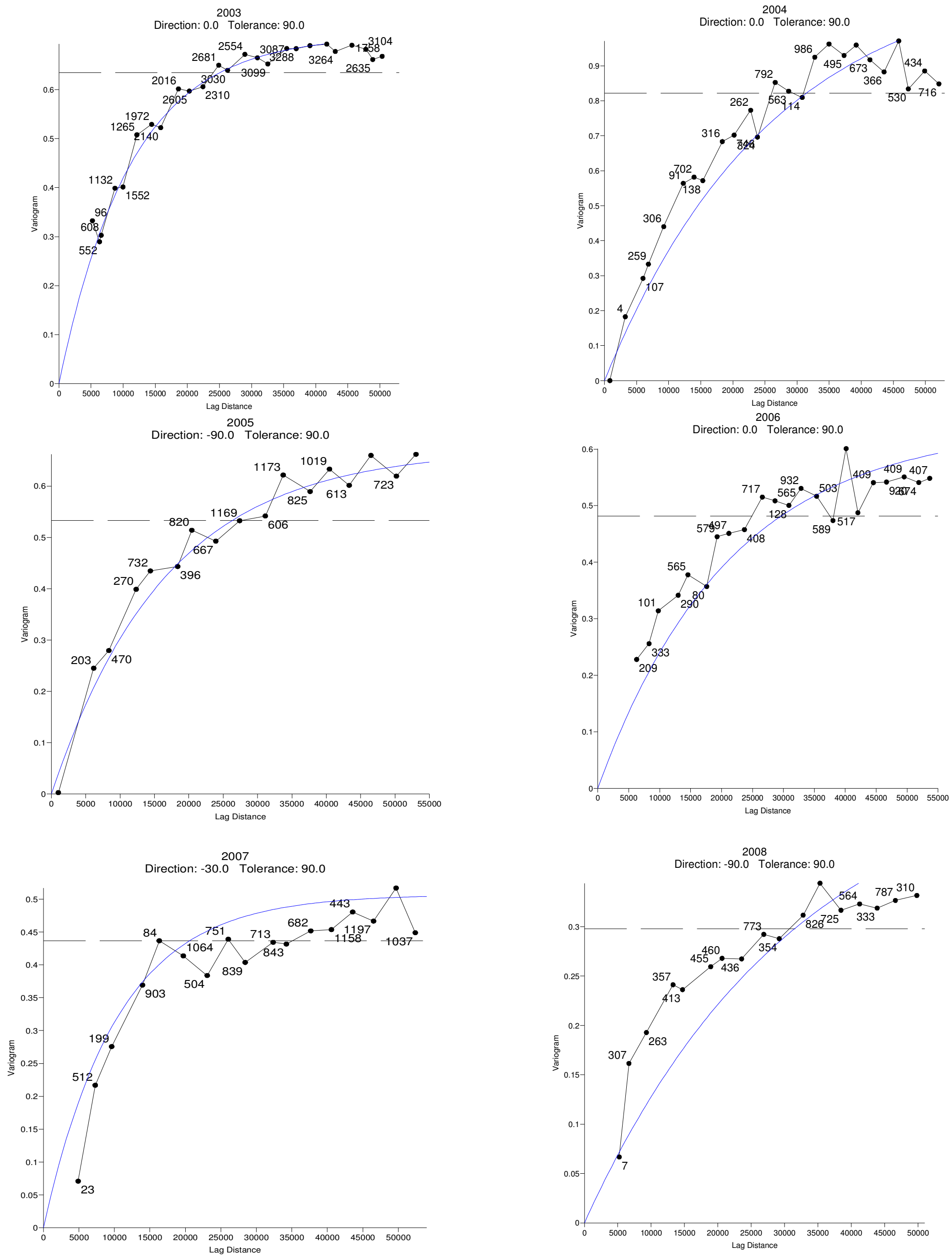

Figure 6: Omnidriectional mean variograms for the western Irish Sea by year from 2003-2008.

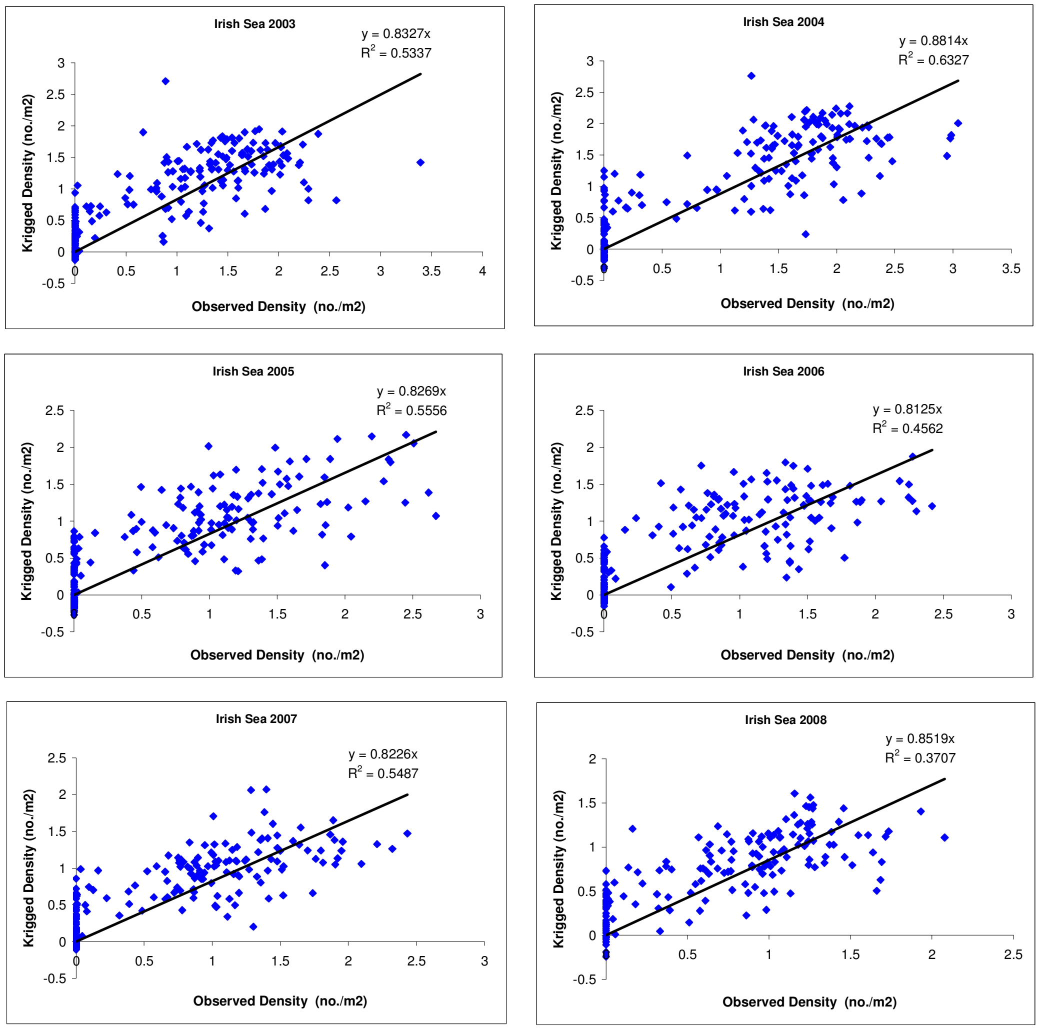

Figure 7: Cross validation plots for the western Irish Sea by year from 2003-2008.

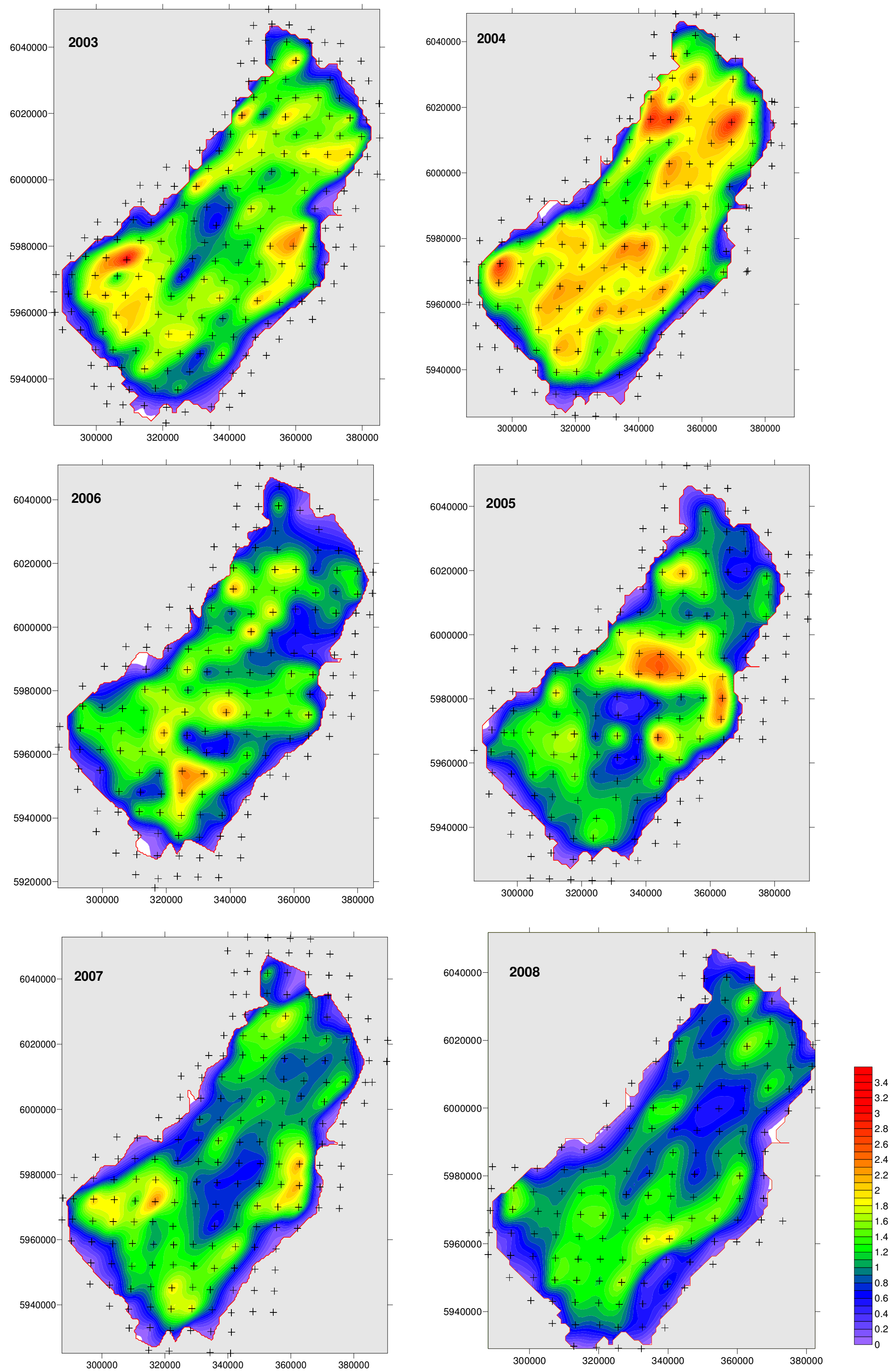

Figure 8: Contour plots of the krigged density estimates for the western Irish Sea from 2003-2008.

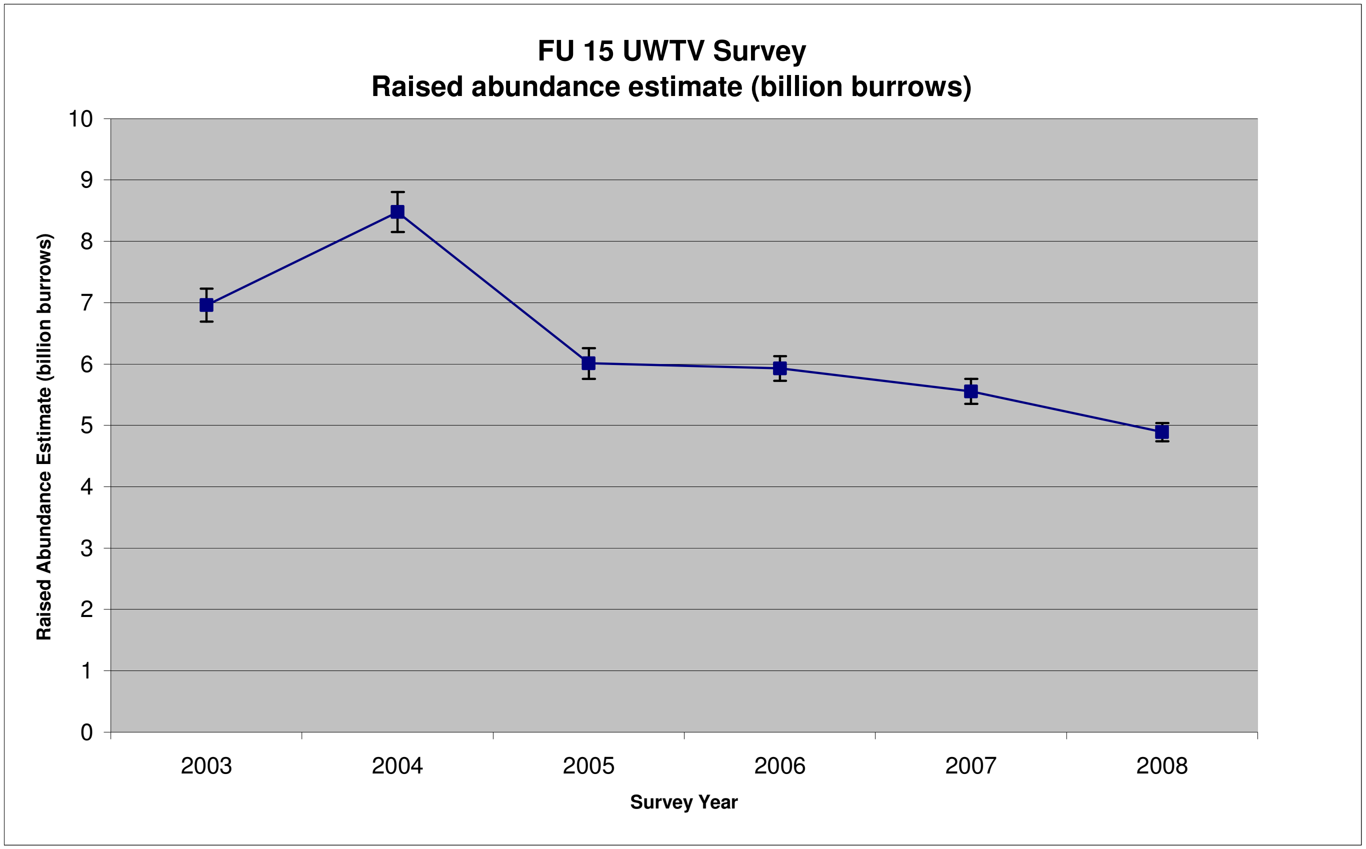

Figure 9. Raised abundance estimates estimates for the western Irish Sea from 2003-2008.