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

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Introduction

This is the fifth in a time series of UWTV surveys on the western Irish Sea. The survey is carried out in co-operation with Marine Institute (Ireland) and AFBI (Northern Ireland). This report details the results of the surveys to date.

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 2007, 148 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.

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 lazers during the 2007 survey. Occasionally the lazers 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 2007 on the western Irish Sea is presented in Figure 1. 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 2. There are a few outliers apparent but they appear have little leverage on the variogram models observed. There is no nugget effect in the variograms. There is a weak evidence of a sill at around 31km in 2007. A comparison of the observer and expected density estimates for each year is given in Figure 3. 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 4. 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 2007. 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 mean densities and overall abundance is estimated to have decreased significantly between 2004 and 2005. The abundance estimates was close to 9 billion in 2003 and 2004 and since then the estimate have been similar for most years close to 6 billion. The geo-statistical coefficient of variation estimate ranges between 25-46%.

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. In 2006 the assessment and advice for FU 15 (Western Irish Sea) was based on several indicators from this stock (e.g. mean size, LPUE, trawl survey, UWTV). In 2008 ICES will up date the advice on the basis of these indicators and this report will feed into that process.

This UWTV survey is the main source of significant new information on this stock comes from the UWTV survey. It is expected that this data will be integrated into a formal assessment as part of the benchmark process in early 2009. For the moment the survey should still be only used as an indicator for this stock. In that context this survey indicates that there has been a step change in the burrow density and abundance from the first two years of the survey to last three years. In 2007 abundance decreased and is the lowest in the 5 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.

The methods employed during the Irish Sea UWTV surveys have recently been discussed and documented by WKNEPHTV (ICES, 2007). The workshop also considered the major uncertainties and assumptions in translating UWTV survey data to abundance or biomass. The conclusion was that there is a continuum in terms of how surveys are used. Using the survey as a relative index to tune some assessment model is the least demanding since assumptions and bias (provided they are stay reasonably constant over time) are handled as catchability term. Using the survey as absolute estimator of biomass is the most rigorous since the assumptions and biases need to be accounted for or minimised to obtain an accurate result.

For this particular survey field of view, occupancy and edge effects become critical when using the survey as an absolute abundance estimate. Whilst it is not possible to quantify these it is possible to estimate the relative scale of the problem. Variation in the field of view is apparently not significant given the recent application if lazers to monitor this routinely during the surveys. The edge effect has not been estimated or corrected for may lead to an over-estimation bias in abundance by between 25-34%. Occupancy also and important unknown and in this survey the assumption is that all those burrow counted are occupied by a single *Nephrops*.

Simulations have shown that applying a 20% harvest ratio to *Nehrops* stocks looks sustainable in the long-term (ICES, 2007). However, these simulations assume perfect implementation of the survey (unbiased) and the catch. In the Irish Sea Grounds this is not the case therefore it would be premature to continue with the harvest ratio approach discussed last year for this stock (ICES, 2006). Some progress towards an integrated assessment using the surveys and commercial data is expected for benchmark meetings in 2009.

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 2007 is the lowest since the series commenced. It is premature to have catch advice based directly on the survey. 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 2008 which will provide a more up to date prognosis for the stock.

References

ICES 2007. Report of the Working Group on the assessment of Hake, Monkfish and Megrim Stocks on the Southern Shelf (WGHMM). ICES CM 2004/ACFM: 29, pp 800.

ICES 2007. Report of the Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters.

Lordan C., Fitzpatrick, F and Nolan, G. 2005 Using UWTV surveys to construct a conceptual ecosystem model of *Nephrops* on the Aran grounds. ICES, CM XX:XX.

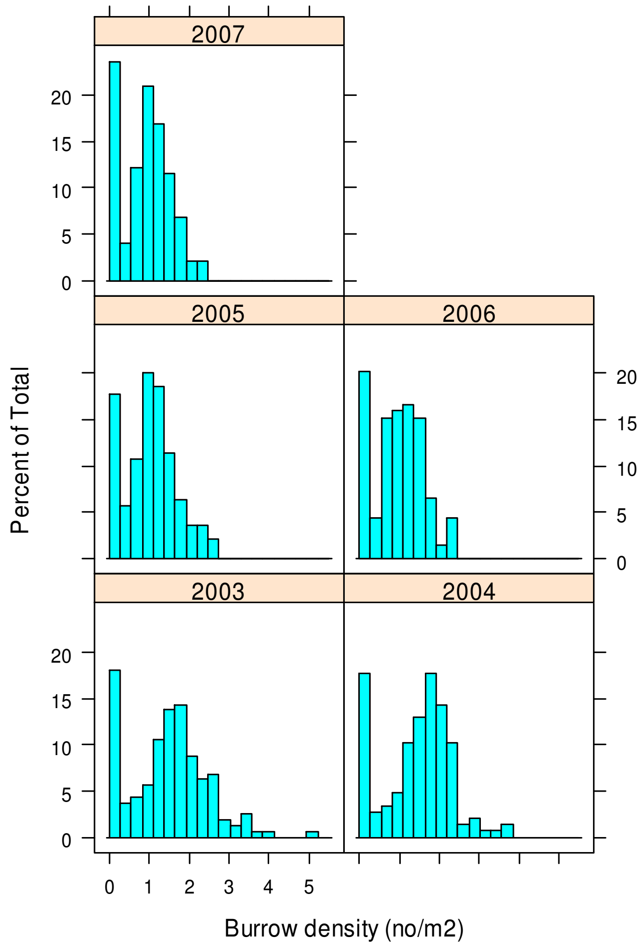

Figure 1: Burrow density distributions for the western Irish Sea by year from 2003-2007.

Year	Number of stations	Number of boundary points	Mean Density (No./M2)	Standard Deviation	CVgeo (%)	Var	Domain Area (m2)	Raised abundance estimate (million burrows)	Total Biomass estimate ('000 tonnes)
2003	160	54	1.58	0.77	48%	0.59	5441	8821	101
2004	147	45	1.58	0.63	40%	0.39	5463	8787	100
2005	140	64	1.08	0.50	46%	0.25	5288	6011	69
2006	138	50	1.07	0.45	42%	0.20	5429	5928	68
2007	148	53	1.00	0.45	46%	0.21	5452	5554	63

Table1: Summary geostatistics for the Nephrops UWTV surveys of the western Irish Sea from 2003-2007.

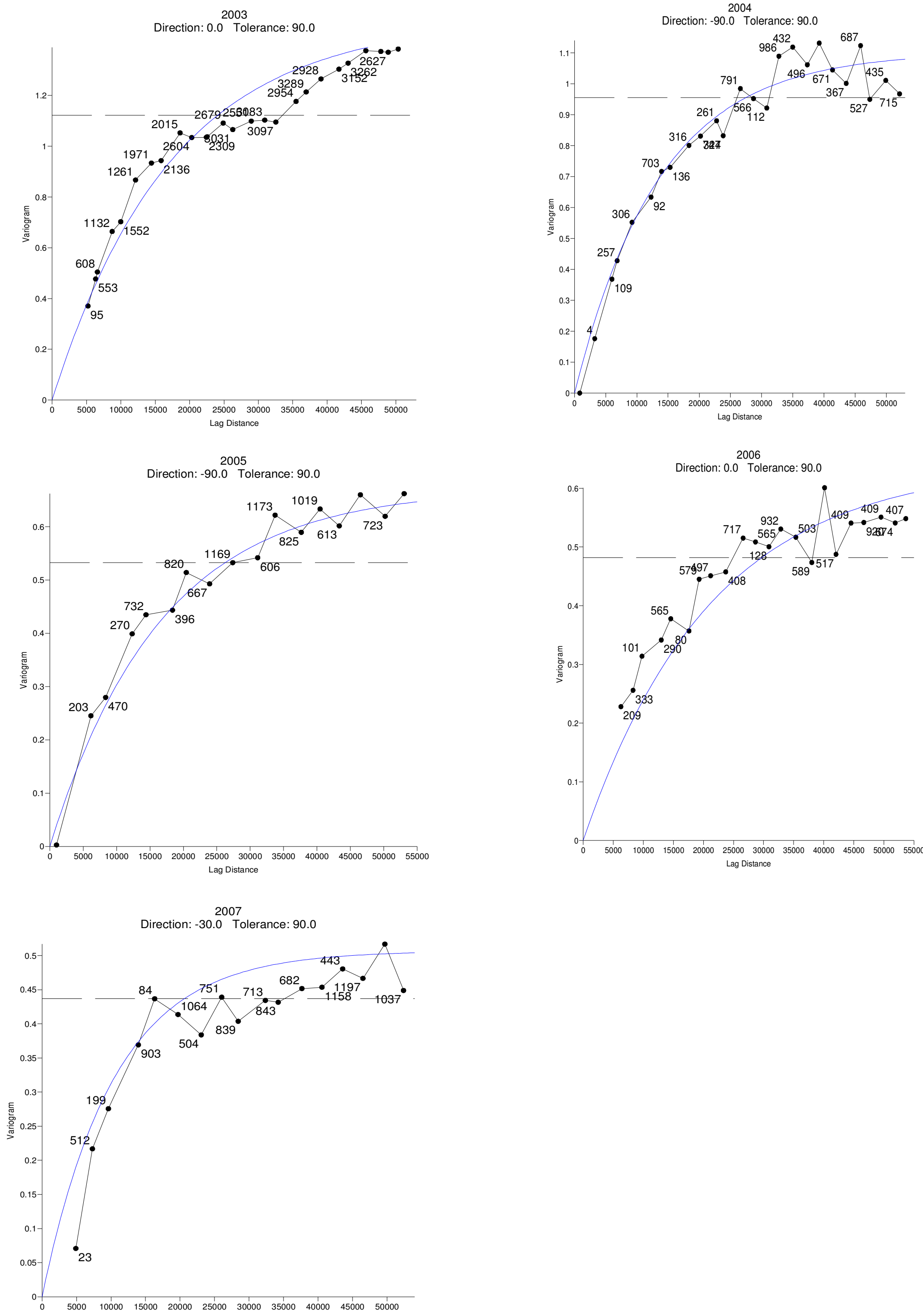

Figure 2: Omnidriectional mean variograms for the western Irish Sea by year from 2003-2007.

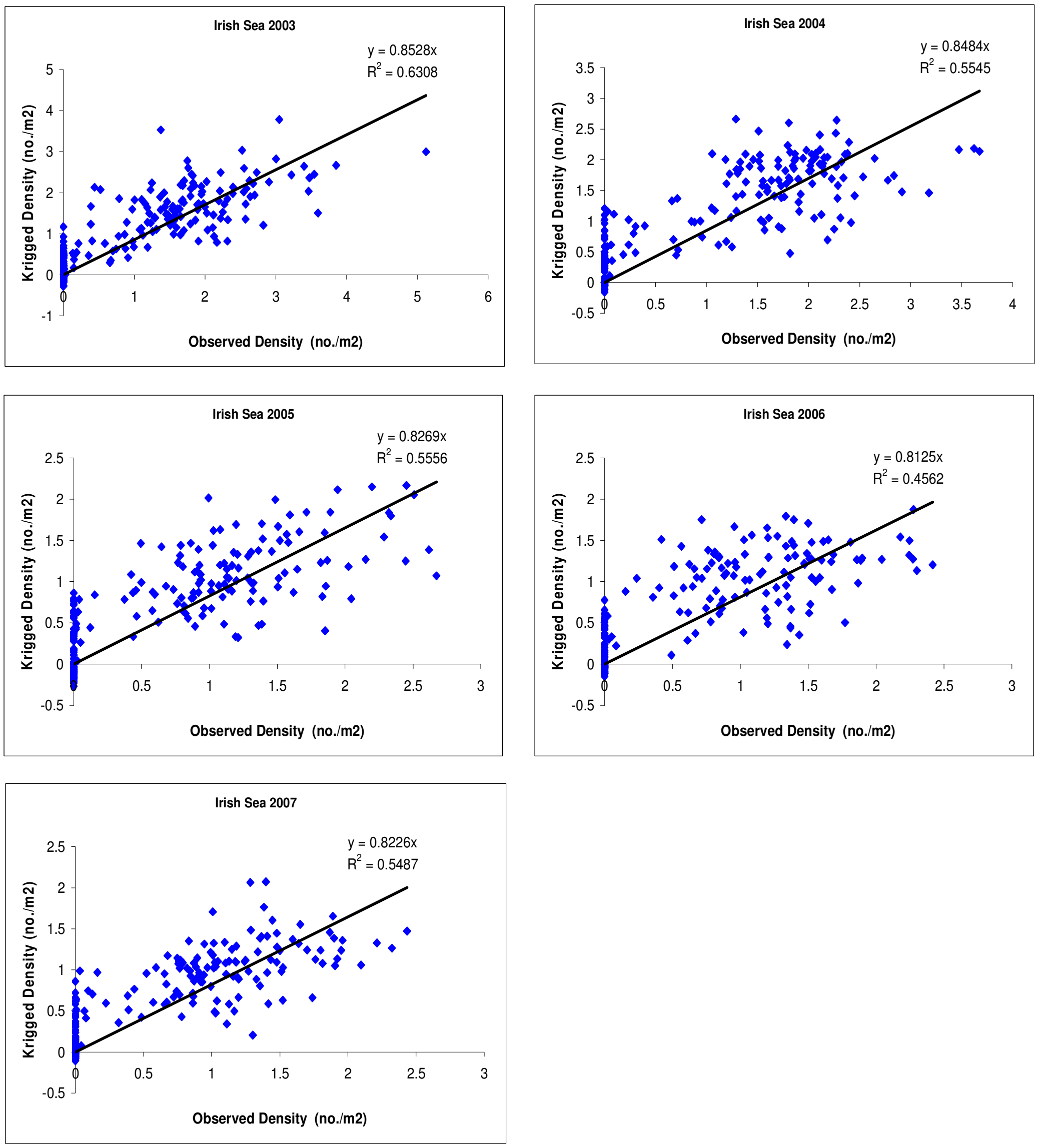

Figure 3: Cross validation plots for the western Irish Sea by year from 2003-2007.

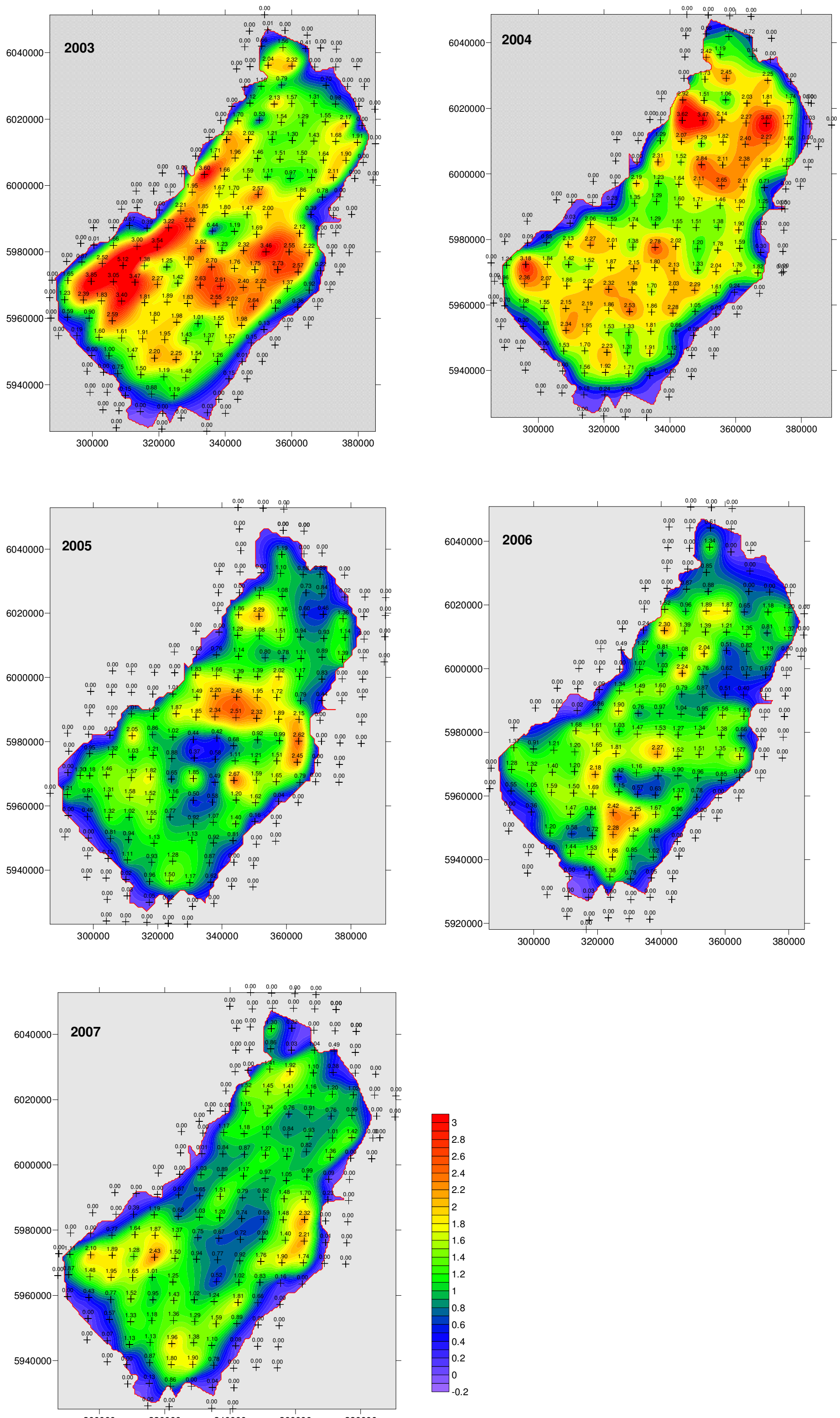

Figure 4: Contour plots of the krigged density estimates for the western Irish Sea from 2003-2007.