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Report of the 2007 UWTV Survey on the Celtic Sea *Nephrops* Grounds

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Introduction

This is the second in a time series of UWTV surveys on the 'Smalls grounds'. The 2006 survey covered the distinct mud patches of the Smalls Grounds and also indicator stations on the Labadie Bank, Nymphe Bank and Seven Heads, whereas the survey 2007 covered the Smalls Grounds only due to poor weather. This report details the results of the surveys on the Smalls Grounds to date.

Material and methods

Indicator stations in the Labadie Bank, Nymphe Bank and Seven Heads were randomly picked based on VMS information. For the Smalls Ground prior information was available on the distribution of sediments was available and the boundaries of the fishing grounds were obtained from VMS. The survey design for the main area the Smalls Grounds 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 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 July each year. In 2006, 18 indicator stations and the Smalls Grounds stations were covered. In 2007, poor weather and technical problems did not allow the indicator stations to be surveyed.

At each station the UWTV sledge was deployed and once stable on the seabed a 10 minute tow was recorded onto DVD. Vessel, calculated layback of the sledge and where possible the USBL position (position of sledge) and 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 single 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 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 assuming that the sledge was flat on the seabed (i.e. no sinking). In 2007 the field of view estimates were confirmed with parallel lazers set at 74cm apart which were visible at the bottom of the screen for most tows.

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 for stations within the main fishing area the Smalls Grounds. 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 1416.666667 and maximum lag distance of between 24-25 km. A model variogram $\gamma(h)$, was produced with a linear 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: Linear Variogram Model

$$\gamma(h) = Co + S \cdot h$$

Where Co is the unknown nugget effect, and S is the unknown slope.

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 2006 to 2007 on the Smalls Grounds is presented in Figure 1.

The geo-statistical structural analysis is shown in the form of variograms in Figure 2. There is a weak evidence of a sill at around 25km in 2007. A comparison of the observed 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 well to the observed data. The results indicate that in 2006 high densities were apparent throughout the central part of the Smalls ground. Densities subsequently decreased in 2007. In general the densities are higher towards the central area of the ground.

The summary statistics from this geo-statistical analysis are given in Table 1. The mean density in 2007 has decreased by 28% on the 2006 value. The geo-statistical coefficient of variation estimate ranges is high between 80 – 96 %.

Finally Figure 5 shows the standardised length frequency distributions of *Nephrops* caught using a beam trawls on the Smalls ground during the 2006 and 2007 surveys. The results indicate large numbers of recruits in both sexes with modal length around 17mm CL in 2006 which did not occur in 2007.

Discussion

In 2008 ICES will produce new advice for *Nephrops* stocks in VII. Data for assessment of Nephrops in this area has been rather sparse in the past. The main source of significant new information on this stock comes from the fishery independent UWTV survey initiated by Ireland in 2006. This survey indicates that burrow density in 2007 decreased from that observed in 2006.

The methods employed during the Celtic 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. Give the problems with commercial data it is not yet possible to have a full calibrated assessment for this stock therefore the survey can only be used as an absolute abundance estimate in terms of number of burrows visible.

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 probably adds some random noise but this has been shown to

relatively minor using lazers to confirm the field of view at ~75 cm for most stations. If anything the field of view will be underestimated in very soft mud which are not that common in the Celtic Sea. 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 and the catch. In the Smalls 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).

The relative UWTV survey index of burrow abundance has decreased since 2006 and 2007. This may due to the large numbers of "recruits" (CL~17mm) which occurred in 2006 but not in 2007. It is premature to have catch advice based on the short time series available. Currently there is no serious concern about the stock status since burrow densities are high. A new survey point will be available after July which will provide a more up to date prognosis.

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. Draft.

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.

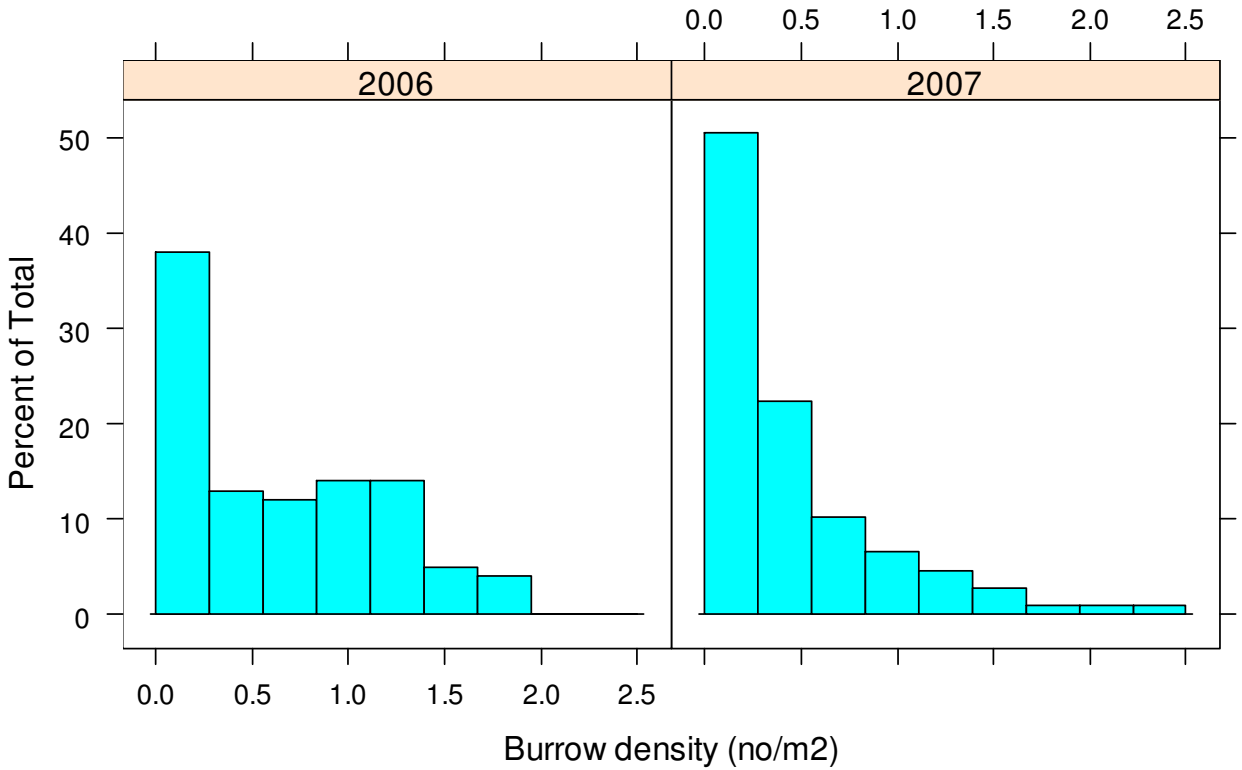


Figure 1: Burrow density distributions for the Smalls Grounds by year from 2006-2007.

Ground	Year	Number of stations	Number of boundary points	Mean Density (No./M2)	Standard Deviation	CVgeo (%)	Var	Domain Area (m2)	Raised abundance estimate (million burrows)
Smalls	2006	100	50	0.62	0.50	80%	0.25	2847	1914
Smalls	2007	107	63	0.46	0.44	96%	0.19	2915	1402

Table1: Summary geostatistics for the Nephrops UWTV surveys of the Smalls Ground from 2006-2007.

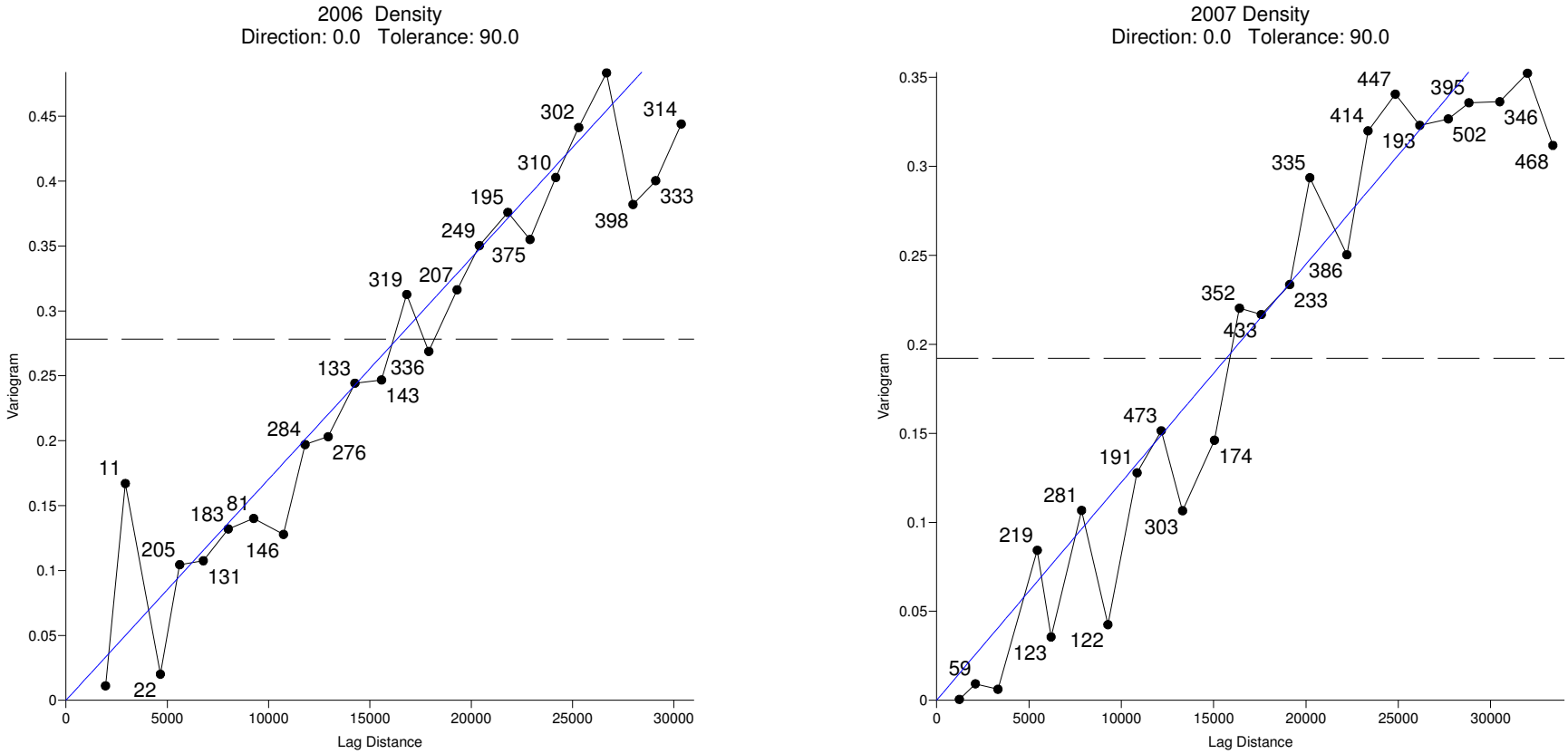
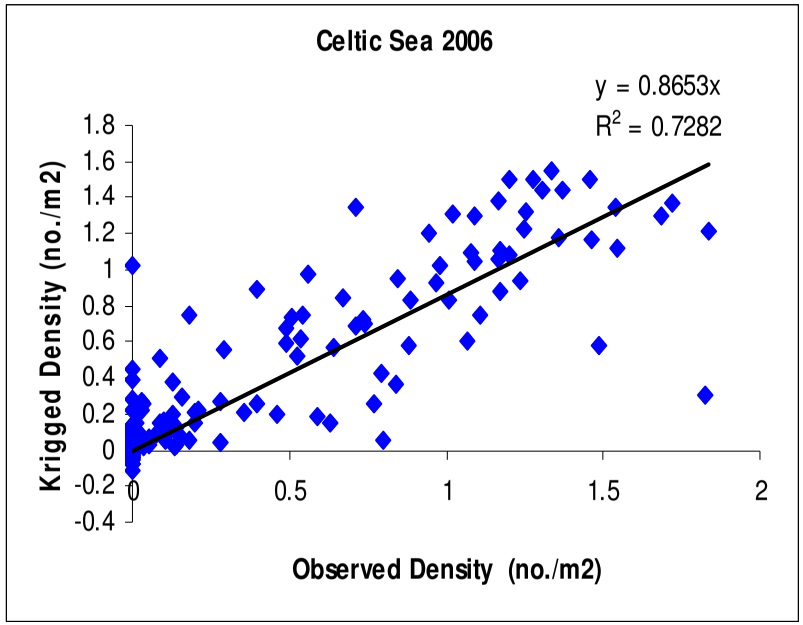


Figure 2: Omnidriectional mean variograms for the Smalls Grounds by year from 2006-2007.



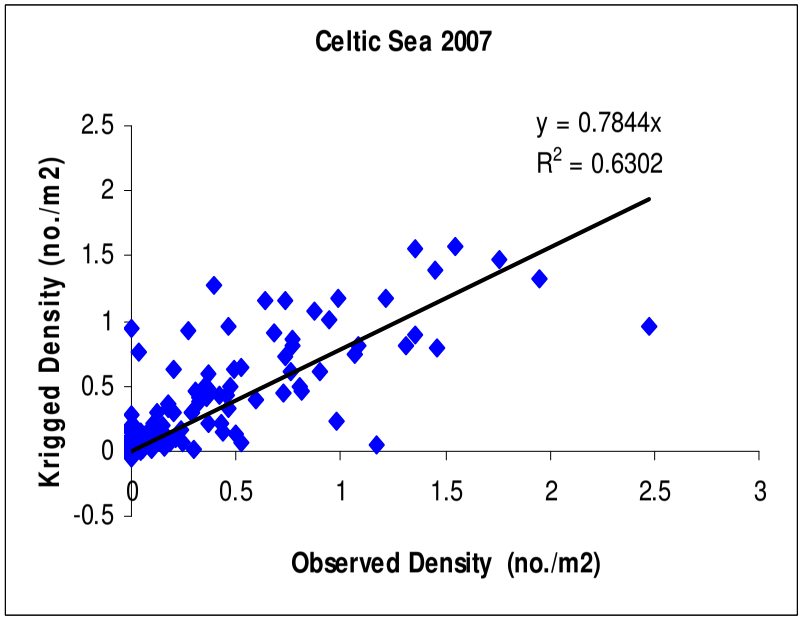


Figure 3: Cross validation plots for the Smalls Grounds by year from 2006-2007.

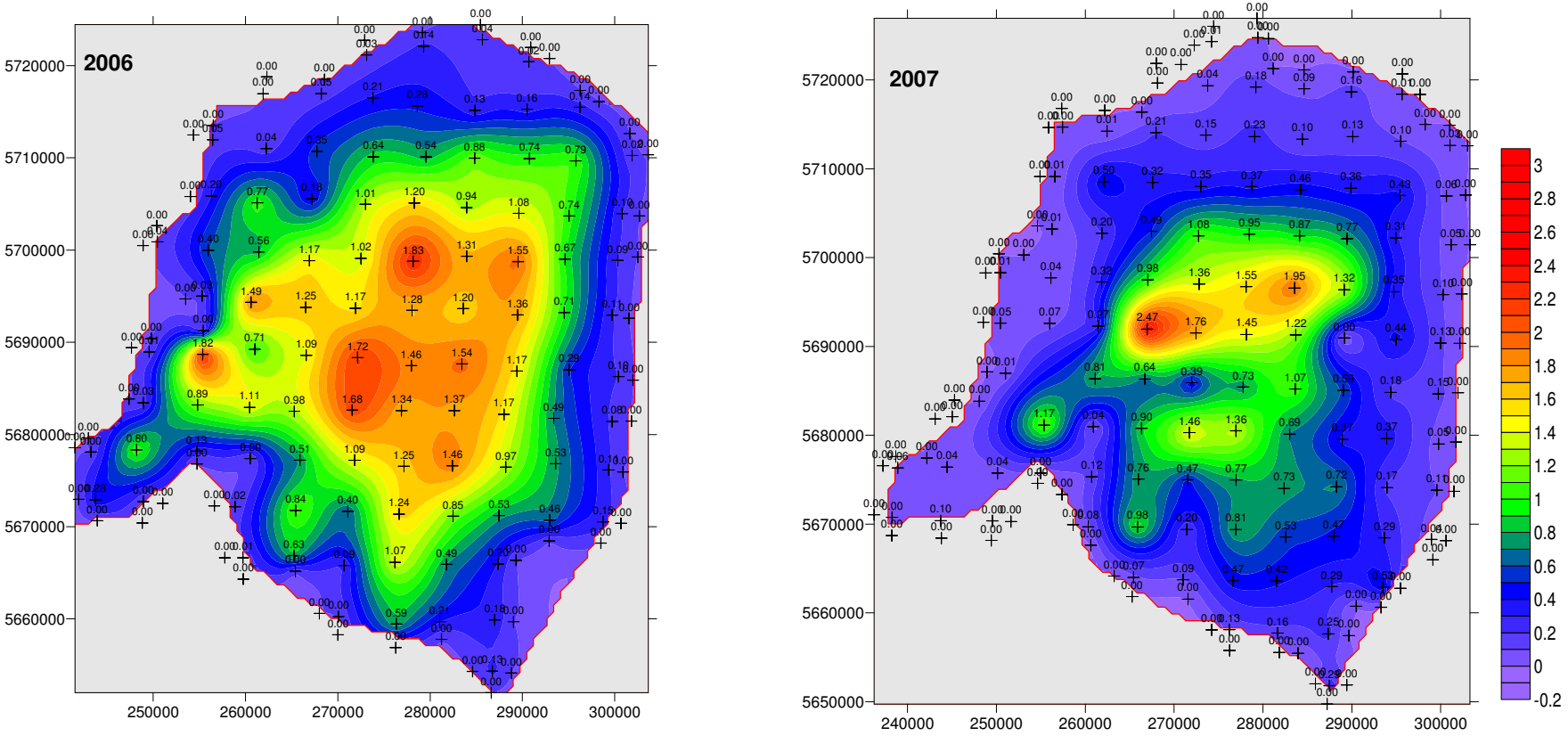


Figure 4: Contour plots of the krigged density estimates for the Smalls Grounds from 2006-2007.

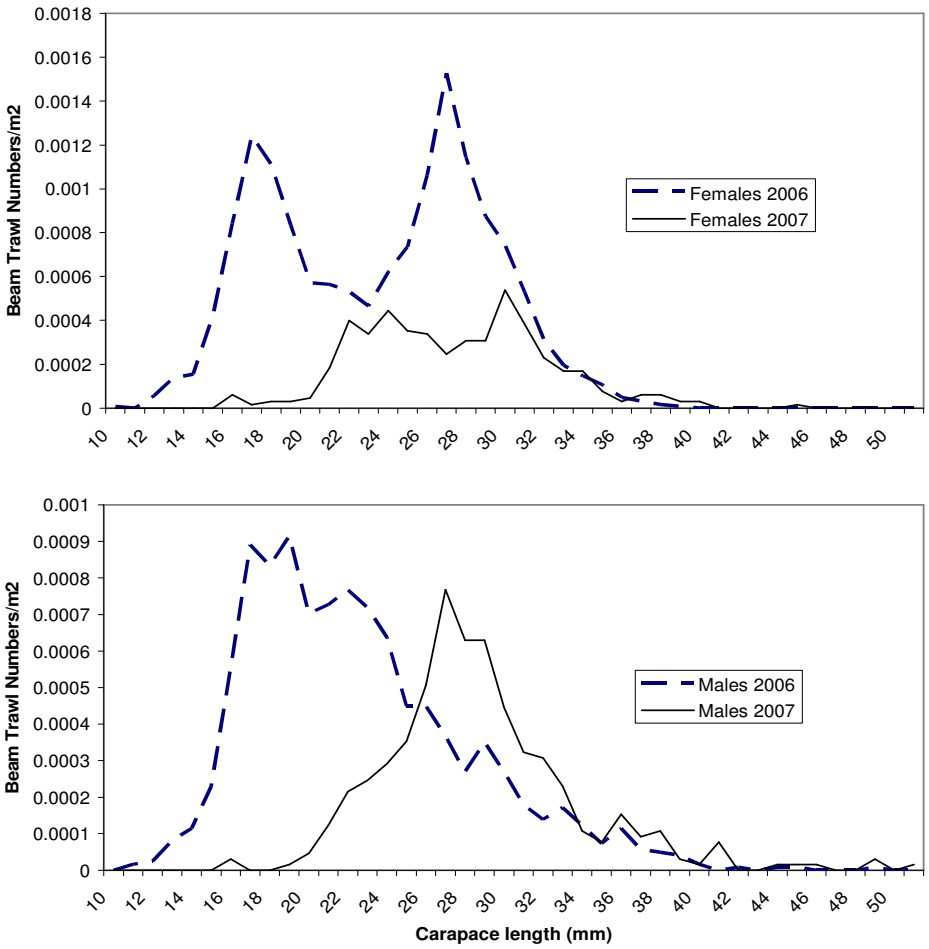


Figure 5: Standardised length frequency distributions for *Nerphrops* caught using beam trawls (nos/m^2) in July 2006 and 2007 on the "Smalls" Celtic Sea *Nephrops* ground